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"PVHardware was created by installers. Our intimate knowledge of what WORKS drove us to create our own product, utilizing the best possible manufacturing and installation methods, developed from experience. Ask our competition's management how many tracker arrays they have installed personally." -Sean Du Fosee (Co-Founder PVHardware)



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On our cover...

The San Miguel Power Association Community Solar Array is currently the nation's largest communityowned solar project. The 1.1 megawatt (MW) facility is located in Paradox Valley, Colorado-thanks to the Clean Energy Collective (CEC) and the rural electric cooperative San Miguel Power Association, Inc. (SMPA)-and serves more than 200 individual ratepayers throughout the utility territory.

Photo courtesy of: Clean Energy Collective (CEC) www.easycleanenergy.com

San Miguel Power Association, Inc. (SMPA) www.smpa.com

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I FIND IT INTERESTING how separate and distinguished many of the energy sources are when it comes to powering our electricity needs. There are traditional, fossil fuel sources versus alternative, renewable energy sources. A centralized grid versus distributed, off-grid power.

Clearly, history, location, and cost weigh heavy into the inclusion of one power source

versus another. And, anytime we can lower our carbon footprint and reduce unnecessary greenhouse gasses, it's a good thing—a battle worth fighting for. Yet, sometimes I wonder why a collective approach to power isn't more often considered and implemented.

Perhaps, the question shouldn't always be so cut and dry in terms of conventional versus alternative power means, but instead should be: what joint measures can reduce the environmental impact of this particular region?

The mining business, for instance, is a multi-billion dollar industry in North America. It contributed over \$50 billion to Canada's Gross Domestic Product (GDP) in 2012, and well over \$200 billion annually to the total direct and indirect economic impact of the United States. Yet, mining seems completely contrary to and discordant with renewables.

In South Africa, however, the two industries have found some common ground. Mining company CRONIMET was the first to connect solar power to the grid at its Thaba chromium mine in Limpopo province. Since 2012, the one-megawatt (MW) PV-solar hybrid system supplements the mine's diesel-based power system, and the company has cut its diesel bill by half-a-million dollars.

In an ideal world, mining might not be necessary at all, but until then maybe a hybrid alternative is better than not. Even when it comes to renewable energy, perhaps the question shouldn't be so narrowed down either, to just one type of power source or another.

Just this past summer, Jamaica unveiled the world's largest windsolar hybrid installation, which is expected to generate 106,000 kilowatt-hours (kWh) annually, with a return-on-investment (ROI) of less than four years. The project will save approximately \$2 million in energy costs over the course of its 25-year lifetime.

In Spain, Termosolar Borges serves as an example of the first-ever concentrated solar power (CSP) biomass hybrid power project. The plant runs 24/7 by using solar power during the day and biomass at night. Termosolar Borges is expected to generate 22.5 MW of electricity per year, which is sufficient to supply for some 27,000 households—removing about 24,500 tons of carbon dioxide from the atmosphere.

The US is also home to one of the world's first, with the Stillwater geothermal-solar power plant in Nevada, which is providing 59 MW of combined capacity to power more than 50,000 local homes. Plus, a 2 MW Stillwater CSP project is currently under construction and, upon completion, it will operate alongside Stillwater. Together, this project represents the first continuously generating hybrid plant, combining binary-cycle, medium-enthalpy geothermal power, alongside solar PV and solar thermodynamic.

Fortunately, more projects like these are being considered and implemented, and not only on a large scale. Hybrid energy systems can be especially beneficial in remote, off-grid regions that rely on expensive, often imported fuels (see the article on page 44). Collective energy systems can even be worthy from a homeowners standpoint, meeting air-conditioning and hot water needs, while reducing wasted heat and water (learn more on page 94).

I recently came across a quote that seemed to resonate. It's from The Sahara Forest Project's website, and if you haven't heard about this proposed project, which takes sustainability and renewables to yet another level, it's worth checking out (http://saharaforestproject.com).

As for the quote: "The greatest challenges of our time are closely interlinked...and the same must be true for their answers."

Enjoy the read! Michelle Froese





Enhancing biofuel yields A team of researchers at the University of California, Riverside's Bourns College of Engineering, have developed a versatile, relatively non-toxic, and efficient way to convert raw agricultural and forestry residues and other plant matter, known as lignocellulosic biomass, into biofuels and chemicals. The patentpending method, called Co-solvent Enhanced Lignocellulosic Fractionation (CELF), brings researchers closer to solving the long, elusive goal of producing fuels and chemicals from biomass at high enough yields and low enough costs to become a viable alternative or replacement for petroleum-based fuels and chemicals.

The key to the UC Riverside technology is using tetrahydrofuran (THF) as a co-solvent to aid in the breakdown of raw biomass feedstocks to produce valuable primary and secondary fuel precursors at high yields at moderate temperatures. Those fuel precursors can then be converted into ethanol, chemicals or drop-in fuels. Drop-in fuels have similar properties to conventional gasoline, jet, and diesel fuels, and can be used without significant changes to vehicles or current transportation infrastructure.

Read more at http://ucrtoday.ucr.edu/24072

University of California, Riverside www.ucr.edu



Solar cooking for a cleaner earth

Studies show about three billion people in the world still cook food and heat their homes with traditional stoves fueled by wood or coal fires, which account for a large percentage of the greenhouse gases that are polluting our planet. Solar cooking is a clean alternative that requires only sunshine as fuel.

Now, a simple, user-friendly solar cooking system exists that allows people to cook indoors and outdoors using solar energy. Ideal for areas where reliable electricity isn't available, the system includes two to four solar panels, one off-grid solar power inverter, and a hot plate.

Compared with traditional off-grid solar systems, this system: requires no batteries; offers panel-level MPPT to solve partial shading problems and maximize solar power production; doesn't have high-voltage or high-current DC (so the system is easy to install and intrinsically safe); and is affordable. The system can generate up to 1.15 kW peak AC power for hot plates, grills, electric cookware, and other electric heating elements in the range of 500 W to 3000 W.

Creator CyboEnergy will launch a "Solar Cooking for a Cleaner Earth" campaign to donate solar cooking systems to rural parts of the world, helping accelerate the adoption of solar cooking and emission reduction.

CyboEnergy | www.cyboenergy.com



Offshore trends

There are approximately seven gigawatts (GW) of offshore wind installed worldwide, based on the most recent "Offshore Wind Market and Economic Analysis" report compiled by Navigant Research for the Department of Energy. The objective of this, the third analysis to date, is to provide a comprehensive annual assessment of the US offshore wind market—which, accordingly, still faces challenges.

The report has outlined these barriers to include: the cost competitiveness of offshore wind energy; the lack of infrastructure, such as offshore transmission and purpose-built ports and vessels; and the current uncertain and lengthy regulatory processes.

Despite the challenges, however, two of the United States' most advanced projects have moved to their initial states of construction—namely, Cape Wind and the Deepwater's Block Island project. As the US market moves forward, "it will continue to respond to and reflect the general trends occurring in the global offshore wind market," according to Navigant's analysis.

It's worth noting that WindEnergy Hamburg, happening September 23rd to 26th, is showcasing a variety of offshore wind companies active in the international scene, as well as current and emerging national markets. American Wind Energy Association (AWEA) will also present information on current wind market opportunities in Hamburg.

For more information, visit www.windenergyhamburg.com.

To download the "Offshore Wind Market and Economic Analysis" report, go to http://energy.gov/eere/downloads/2014-offshore-wind-market-and-economic-analysis

Navigant | www.navigant.com



Did you know?

Earlier this summer, construction began on the first, commercial-scale, postcombustion carbon capture retrofit project in the United States—and, the largest such project in the world. The Petra Nova Project will use this cuttingedge technology to help decrease a Texas power plant's greenhouse gas emissions. Once completed, the energy technology project will capture about 1.4 million metric tons of carbon dioxide (CO_2) annually from the coal-fired power plant. The captured CO_2 will then be used to extract additional, hard-to-access oil from a previously depleted field 80 miles away, safely storing the carbon underground in the process.

The project is supported by the Department of Energy (DOE), in partnership with NRG Energy Inc. and JX Nippon.

Learn more at www.netl.doe.gov/research

Department of Energy | http://energy.gov



Geothermal consulting

The Canadian Geothermal Energy Association (CanGEA) is now providing advisory services to decision makers at the community level, as well as in the corporate, public, First Nations, and non-profit sectors to uncover new sources of value in the rapidly changing economy with regards to geothermal power and heat. It is CanGEA's mission to empower Canadian companies and communities to take advantage of available geothermal resources by delivering customized information to interested players, and aiding with long-term business planning and success.

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The new green investment

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Carbon Xprint (CXP) Bonds, which are certified by the FDIC, allow companies and individuals to invest in a profitable method that certifies their commitment to sustainability. Additionally, investors actually make interest on their investment. The recipients of loans, financed by CXP Bonds, are able to borrow the capital to make necessary changes to reduce their carbon footprint. Some businesses may choose to invest initially, and then use their profits to finance their improvements. Regardless, it is a win-win all around—including for the environment.

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How to Mitigate Ownership Risks Smart O&M solar strategies By Alexander Boyatt

OWNING A SOLAR POWER PLANT comes with a set of risks—some known and some unknown—that could potentially impact an owner's return on investment (ROI). By taking the time to create a well thought-out operations and maintenance (O&M) strategy prior to a project going online, owners have a chance to prepare for possible hazards and mitigate some these concerns altogether.

The following highlights three of the more common problems plaguing the solar power industry, along with recommendations for owners in confronting and conquering such issues before they develop into problems.

1. Conflicts of interest

Employing an engineering, procurement, and construction (EPC) contractor or a vertically integrated manufacturer (herein referred to as the "warranty provider") is a common practice for utility-scale solar projects. Warranty providers can provide an important overall perspective on a solar project, guaranteeing performance of a plant during the warranty period, as well as sometimes performing O&M services.

However, a conflict of interest can arise between a solar project's owner(s) and the warranty provider. Most often, the primary goal of the former is to ensure positive, long-term project results and a good overall ROI, whereas, the goal of the latter is for more immediate, short-term results. Generally speaking, a warranty provider makes sure that a project hits its performance guarantee target over the term of the service contract—and that doesn't necessarily include the full lifetime of the plant. Such providers are most interested in finding and remedying any immediate performance issues with a solar plant, as it's currently operating.

As a result, potential problems that might impact performance later in the life of a project might not get noted or brought to the attention of an owner, resulting in some conflict of interest. Of course, this doesn't mean the warranty provider isn't doing his or her job it's merely an issue of each party's objectives. A smooth and efficiently run solar power plant is just as important today as it will be tomorrow and next year.

For the most part, warranty providers are invested in building plants and/or in supplying the equipment required for proper construction and getting projects off the ground. Although some also provide O&M services, it's usually not their main focus. To avoid any potential conflict, therefore, plant owners should set clear objectives and know what they're getting. For instance, 24/7 monitoring, procurement, and long-term quality control might be included or be something they have to invest in separately. It's worth doing the research beforehand.

Furthermore, hiring a third-party to commission the plant and to provide a full report of any issues at the end of a construction period can save possible miscommunications and misread expectations. Often times, the problems found in this type of inspection and reporting processes are ones that would lead to lingering performance issues over the lifetime of a project, so it's best to address them early.

2. Transition expectations

A solar power plant's transition from construction to operations has challenges that must be carefully managed. Depending on the contract, a warranty provider is likely to want to demobilize its related resources and move onto the next job as soon as a project's construction is completed. However, most solar projects have a punch list of obligations that providers should complete to ensure the successful, long-term operations of the plant.

Creating a successful plan for properly managing this post-construction transition period is important. As long as a project is still even partially being treated like a construc-

tion site, and that punch list of obligations isn't fully met, third-party post-construction operators can't take control of the plant or run it properly. This can result in a period where the solar power plant is stuck halfway between the control of the warranty provider and the third-party operator.

Obviously, this can cause unnecessary disruptions in effective plant uptime and operations, which could be moderated with a prior plan of action. Therefore, it's just as significant that solar power plant owners arrange ahead of time for the transition between construction and operations, as it is to plan for the project itself. Ensuring an unbiased procedure (done by a third-party) is in place for a post-construction inspection and reporting system is one way to help identify any punch list items that need to be resolved. This procedure should also include recommendations for addressing that list.

A good plan of action should help eliminate any shifting of blame or undue responsibility between the parties on site with respect to the plant's operations. Overall, to carefully manage the transition of a solar plant from construction to operations, all transitions must clearly define care, custody, and control throughout each transitional stage, including who will be in charge at each transition point.

3. Buyer beware

As with any industry, the solar energy industry has a wide variety of companies providing different services and operations. Some of these providers have more experience than others. Unlike certain products, such as panels or modules that can be third-party tested and verified, certifications aren't available in the same way in the service industry.

If a construction crew or a warranty provider suddenly ceases to offer their services midoperation, a project owner can be exposed to multiple risks—not the least of which is loss of production or warranty claims. For the most part, such concerns can be avoided with a little research and a solid O&M strategy. Check references and know whom you're hiring. And, ensure a proper O&M plan is in place prior to any problems arising—even prior to a project beginning.

Ultimately, owners should ascertain contractual arrangements providing the surety required to safeguard against serious disruptions in construction, O&M services, or warranties. Proper planning, using third parties to provide checks on the absolute controls of a project, along with a back-up plan and contract, can go a long way in ensuring a smooth solar project today and into the future.

Having a strategy to manage the end of construction, the transition into permanent operations, and to ensure the continued operation and management of solar assets is critical to reach expected performance and financial targets for investments in solar power plants. There are many potential hiccups in the process of building, owning, and operating a solar power project, but most can be foreseen and managed with proper planning and partnerships.

Alexander Boyatt is the Solar Business Development manager for North America at EDF Renewable Services, Inc. (EDF RS).

EDF Renewable Services ensures ongoing project profitability for renewable energy project owners and investors by providing a full range of operation and maintenance (O&M) services and expertise.

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Far Left: AET Rayport G-Eco installation *Left:* AET Rayport-B on a rooftop in Hawaii

Evolving Solar Standards A look at UL 2703 in terms of quality manufacturing By John Klinkman & John Harberts

MOUNTING AND RACKING TECHNOLOGIES continue to evolve with the goal of reducing costs, as well as improving reliability and ease of installation. Providing long-lasting, cost-effective solutions to common issues is a challenge shared by leading companies in the industry today. Corrosion and wind and snow loads are chief among these challenges, and standards still need to improve to ensure greater reliability.

The evolution of UL 2703

Underwriters Laboratories (UL) has been positively impacting the solar industry for many years and, in 2008, it began developing UL 2703 standards and guidelines—the codes that provide a framework for racking manufacturers to work within, ensuring the safety, reliability, and performance of their products.

Today, UL standards are more relevant than ever, as safety requirements are increasingly enforced across the photovoltaic (PV) sector. End-use customers, installation site owners, and financial institutions are becoming more educated about the laws in place to protect their investments.

To remain competitive, racking manufacturers must be compliant with codes. At the same time, manufacturers are under increasing pressure to reduce costs, while maintaining the high-quality structural and mechanical design and performance of the products they offer. As with any growing industry, the PV sector has many different suppliers of varying quality. Although meeting the UL 2703 specification is a mandatory requirement for some customers and jurisdictions, there are several aspects to the specification—such as bonding, corrosion, structural, and fire-rating—that are not all equally enforced.

Essentially, this leaves customers little choice but to rely on product warranties as a guide to the quality of the systems on the market. However, warranties are only as good as the company behind them. And, as large-scale developers making sizeable investments are increasingly focused on product quality and company bankability as part of their vetting process, warranty lengths aren't necessarily their focus.

Corrosion and UL 2703

Racking companies make material selections early in the design process, and in most cases steel is a natural choice due to its durability, strength, availability, and low cost. Although it has many attractive properties, steel is vulnerable to corrosion when in contact with water, oxygen, or any corrosive agents found in the soil or air (all of which differ in various environments).

Galvanizing allows steel products to stand up to corrosion, extending the lifespan of steel structures. The challenge for racking companies is in ensuring that the materials and the galvanizing process employed in construction will stand up to local environmental conditions for the life of the project—while, at the same time, bearing costs in mind.

UL 2703 addresses corrosion protection with its requirements for galvanizing thickness on steel support posts for solar racking. According to the standard, a minimum coating weight of G90 should be used on all steel components above-grade, and a minimum coating weight of G210 should be used on all components below-grade.

Even with these requirements, there are a number of important factors that the UL standard doesn't yet take into account in its testing phases. For example: how the integrity of the steel's galvanized protective cover is compromised once it's shaped, or once open drill points are added for screws. Another important factor relates to the natural environment surrounding the racking system itself. Galvanized corrosion protection is only effective if it's allowed to dry after encountering moisture, such as fog, rain, or snow. The standard's existing salt spray tests (which don't allow for drying) are not truly representative of a real-world scenario.

Design is as also an important factor in preserving the integrity of a racking structure,

and the best products are engineered to reduce the potential for the galvanized surface to be compromised. Some designers reduce racking drill points or ensure their racking systems feature an open design, for instance, which allows airflow to reach parts that are exposed to moisture, thereby reducing any opportunity for a buildup of dampness to occur.

Today's tests for measuring the integrity of materials used in solar racking are certainly an excellent starting point, but still lack some of the elements needed to undertake a true test of safety and performance. It will be interesting to see future iterations of the UL standards as they are introduced to the industry.

Addressing wind & snow loads

North America's key solar installation locations have very different climates and environmental challenges, and solar systems must be able to withstand everything from high snow loads to strong, sustained winds. Since environmental conditions are one of the most common reasons for system failure, it's critical that they not only be able to stand up to, but to exceed standard testing conditions.

Racking companies engineering for locations that face high wind and snow loads must be able to evaluate the mechanical load capabilities. The existing UL standards provide a testing framework, however, the industry's still waiting for a true standard to guide testing and design of solar structures in relation to wind and snow loads.

Currently, racking companies rely on design guidelines, including ASCE7 (Minimum Design Loads for Building and Other Structures), which doesn't contain specific values for ballasted roof or ground-mount solar systems. ASCE7 allows for wind tunnel testing to be performed, so as to better define the wind load characteristics of specific products, by measuring the products' specific pressure co-efficients (which can then be used within the framework of ASCE7). This testing remains open to some interpretation though, which has resulted in opinion differences on how it's performed and how data is analyzed.

Racking designers also look to The Structural Engineers Association of California (SEAOC), Wind Design for Low-Profile Solar Photovoltaic Arrays on Flat Roofs – SEAOC Report PV2-2012. This report is largely based on wind tunnel testing performed over the past several years, and was written with the guidance of wind experts. Its inclusion into the 2016 update of ASCE7 will enable the industry to be more specific in its approach to testing, when used in conjunction with UL 2703.

Final thoughts

The solar industry is still relatively young, but it's been experiencing notable and sustained growth over the last decade, in particular, and developers are making substantial investments in installations. To better establish bankability of developers' products and designs, along with uniformity of standards, racking and panel manufacturers must work together to create a well-defined methodology for bringing safe, reliable products to market. UL standards for solar have made great strides over the past six years, and with further input from PV manufacturing and design experts, these standards can be shaped and cemented as relevant and effective tools that will guide the sector successfully into future.

John Klinkman is the VP of Engineering, and John Harberts is the VP Product Development for Applied Energy Technologies (AET).

A provider of solar mounting solutions, AET's roots are in the automotive roof racking industry, which has seen more than 100 years of successes, failures, and refinement of rigorous standards.

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Left Image: Photovoltaic (PV) connectors Right Image: Proper contact crimp, per DIN EN 60352.2 Middle Image: Tool-less spring contact PV connector

PV Connectors and the National Electric Code Preparing now for the solar storm By Steve Barber & Daniel J Sylawa

As the 2014 edition of the National Electrical Code (NEC) gains further adoption within the United States, the DC photovoltaic (PV) arc-fault protection requirements of article 690.11 will gain increasing attention. The key element of article 690.11 is the automation detection and the disabling or disconnection of array components when a series arc-fault is detected. DC arc-fault protection will be required for all circuits of 80 volts or greater.

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The purpose of NEC article 690.11 is to increase the safety of PV installations by preventing fires due to DC arc-faults. Disabled or disconnected array components must be manually restarted following the detection of an arc-fault. Clearly, the best way to deal with the DC arc-fault protection requirements of NEC article 690.11 is to prevent arc-faults in the first place.

PV connectors play a critical role in the wiring of solar arrays, however, they're also a potential source of DC arc-faults. As designed, they provide a high-voltage, high-current,

low-resistance DC connection in a housing that is watertight, temperature-resilient, UVand wire-pull-resistive, over the 25-year-plus life of the solar installation.

Connectors found on the back of PV modules are usually factory assembled. Connectors used in row-end cabling, particularly in rooftop applications, are often field-installer assembled. Many PV connectors use crimp-style contacts. Whether factory or field-installed, however, these connectors require the use of the manufacturer-recommended crimp tool and proper assembly for a trouble-free installation. As technology advances,

new tool-less PV connectors have now become available. These connectors eliminate the tooling and assembly requirement by the use of a temperatureand vibration-resistant spring contact.

The mating of PV connectors from different manufacturers should also be considered. Though many connectors are considered as "compatible," there's currently no industry standard for a uniform connector design. As a result, some manufacturers caution against the mating of connectors that are made from different brands. Due to the differences in design tolerances, crimp tool requirements, and contact and housing materials, optimum electrical connection cannot be guaranteed.

PV connectors: Arc-fault challenges

Arc-faults can be caused by many reasons, however, with wider implementation of the 2014 NEC, the area of improper assembly and poor PV connector contact crimps will soon take center stage as one of the prime reasons for array shutdown.

A recent study by the Fraunhofer Institute for Solar Energy Systems ISE of Freiburg, Germany, examined the causes of thermal failures of PV arrays. They found that connectors and crimps



were the largest single cause of DC-side failures. Most of these failures occurred during the first five years of installation, leading to poor installation practices as a suspected primary cause.

Discussions in the United States with electrical inspectors have also yielded the following insights into PV connector failures, including:

• Poor contact crimps, or crimps that have grabbed some of the wire insulation;

- Incorrectly installed contacts into the connector, causing high-resistance connections; and
- Water intrusion due to improperly assembled connectors.

A number of inspectors have further observed field installers crimping PV connectors' contacts with pliers. Others have noted a "loose" fit of PV connectors between different manufacturers.

Compounding the arc-fault failures of PV connectors are the difficulties in seeing improper assembly and poor contact crimps. Connection failures are often hidden within a seemingly acceptable connector. Outside of a complete failure, such as a distorted or melted connector, visual detection is nearly impossible. The repair costs associated with such hidden failures can be significant.

Beyond the safety aspect of PV connector failures, the triggering of DC arc-fault protection can become a contributing factor in lowering array performance, simply because of the time required to respond, diagnose, and repair such failures. Elimination of arc-fault failures is the best method of minimizing arc-fault protection economic effects.

PV connectors: Arc-fault solutions

The key solution to the arc-fault challenges of PV connectors is to ensure the correct installation of PV connectors at the initial wiring of the array.

This can be accomplished through:

- Proper training of installers on PV connector assembly;
- Use of the proper crimp tool and methods recommended by the PV connector manufacturer; and
- The use of tool-less spring contact PV connector, eliminating the PV crimping requirement.

Beyond the issue of correct PV connector assembly or type, remains the challenge of mating field connectors to factoryinstalled connectors on the back of PV modules. Best practices in this area involve always specifying the same brand of field connector as that supplied by the PV module manufacturer. Module manufacturers are helping to make this easier in some cases by offering a choice of PV connector brands.

Although the implementation of arc-fault protection within an array can be difficult, due to faulty PV connector installation, the use of proper training, recommended crimp tools, or even the use of a tool-less spring contact PV connectors, can help minimize the effects on array performance. The DC PV arc-fault protection requirements of article 690.11 of the 2014 NEC, combined with an arc-free PV connector installation, will go a long way to ensuring long-term performance, reliability, and safety of photovoltaic arravs.

Steve Barber is the director of Product Marketing, Device Connection, and Daniel J Sylawa is the business development manager, Renewable Energy, for Phoenix Contact USA, Inc.

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Far Left: California's 265-megawatt (MW) Mount Signal Solar plant is currently the largest thin-film solar tracking facility in North America Left: Array Technologies supplied Mt Signal Solar with its Dura Track HZ solar tracking system

Solar Tracking & Thin-film Technology Technical considerations for a winning combination By John Williamson

MOUNTING THIN-FILM SOLAR PANELS is a growing trend in the solar industry. Although these panels are typically installed on fixed-tilt racks, they're also becoming increasingly popular in utility-scale solar tracking sites. This is especially true in the Southwest United States, since thin-film modules have a higher temperature coefficient, which gives them an energy-yield advantage in warmer climates. Solar tracking technology also has a proven track record of superior performance and higher energy gains in the southern states, leading to competitive levelized cost of energy (LCOE) rates that are too good to pass up.

In addition to this trend, the recent announcement of US-imposed tariffs on Chinese module manufacturers will lead investors and project developers to look for alternative sourcing solutions to meet project deadlines and move pipelines forward. One potential option is the application of frameless thin-film modules that are manufactured in the United States.

This trend began last year, with the shipment and successful installation of thin-film modules for the 265-megawatt (MW) Mount Signal Solar, in Imperial County, California. The largest thin-film solar tracking facility in North America, Mt Signal Solar boasts more than three million thin-film modules on single-axis solar trackers.

Frameless racking challenges

The term "frameless" is somewhat of a misnomer. Although the modules arrive onsite with no frame, a custom structure must be designed and built to support them, according to manufacturer requirements. This approach can result in an extremely competitive fielded cost, but it also requires a great deal of forethought and custom engineering to bring prices to the lowest levels possible.

Frameless modules are almost twice as heavy per square foot, due to their glasson-glass design that's employed to help prevent breakage. They also have stringent support requirements, including specialty clips, rails with spacing, as well as structural requirements. Components must be tested and approved by the manufacturer, adding time and cost to the design and development process.

Proper, rapid installation is also a key requirement. Racks must be designed with innovative assembly techniques that allow field workers to quickly and safely install the modules, using proper clip attachment spacing and pressures. Breakage is a major issue with any type of glass installation, so protecting the thin-film modules during construction and over the life of the project is essential.

No substitute for experience

Crystalline modules have been designed to be universally compatible with many racking and tracking systems. Simple struts can be attached to almost any structure imaginable and, so long as the structure is robust enough, there will be few issues. This standardization is the result of many years of development, and most modules are basically interchangeable.

In comparison, however, frameless thin-film modules are still relatively young. Virtually all thin-film manufacturer modules are different in size, mounting requirements, cell design, or have other idiosyncrasies that distinguish them from their competition.

Due to the differences and nature of these modules, experience racking thin-film on solar trackers is a must-have quality. As the industry rapidly changes, tracking companies with a high level of experience and expertise will be a safe haven for installers and project owners.

When working with these unique designs, it's common to encounter unforeseen problems because of their novelty and fragile nature. They've really only been on the

market for a short amount of time. When designing the racking, small flaws in components could add up to massive costs for owners. For example, on the Mt Signal project, each set of four modules has 10 attachment clamps. Making a mistake that would require replacement of the clamps on this site would require servicing over seven million parts!

Therefore, it's crucial to gain experience with small pilot projects first to find out what unanticipated problems might arise. In addition, there's currently a profound lack of standardization in the approaches various tracking companies take when designing sites, and there are currently no official guidelines or codes for ground-mounted structures.

New companies must start from scratch, paying for wind tunnel testing on scale models to determine the design requirements for their site. Nevertheless, these types of tests don't tell the whole story. There's simply no substitute for years of practice with the hundreds of sites in the myriad of environments that exist. Experienced tracker companies will make special design considerations for wind, rain, snow, earthquakes, lightning, corrosion, and flooding—just to name some typical site problems over a 25-year life.

Safeguarding designs

A racking system created specifically for frameless thin-film modules that are mounted on solar trackers must be custom developed for each project. The system must be extremely rigid to prevent module damage, while including a well thoughtout assembly that allows for rapid deployment onsite. Moreover, a minimization of materials is required to keep costs down, along with assembly tools to reduce install time in the field.

With frameless, glass-on-glass thin-film modules, it's important to note certain considerations. For instance, although the tracking mechanism itself remains identical, less square footage can be tracked by one motor due to the heavy glass design. This must be accounted for during site layouts. Also, frameless thin-film modules require support at specific locations for attachment. To install these at the lowest possible price and support them properly, custom racks must be specifically engineered to match each module make and model.

Rapid installation times are just as important, particularly at a utility-scale site with over three million thin-film modules. Fortunately, workers can be trained in less than one day on how to properly install frameless modules on a well thought-out racking system. But, since the instructions and tools needed differ from traditional module installations, full documentation and a dedicated project management team for assistance in the field are a must. Training customers on best practices and installation techniques once a project has officially commenced is fundamental.

In the end, installation times at Mt Signal Solar were faster than expected, allowing for accelerated solar tracker shipments to the site, which were finalized seven weeks prior to the original schedule.

John Williamson is the lead engineer for Array Technologies, Inc.

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High-performance Polymers Play Pivotal Role In the growth of PV front sheets

By Philippe-Jacques Leng



ENGINEERING POLYMERS are playing a significant role in the development of lightweight front sheets for photovoltaic (PV) modules in the solar power industry. Although these high-performance materials have been used for many years in back sheets and in encapsulant layers in PV applications, they are now also being employed as lightweight alternatives to glass as front sheets for modules. The weight reduction afforded by this substitution allows the solar power industry to access new market segments, and consider innovative paths for component manufacturing.

A few years ago, the production of a c-SI PV module under the IEC 61646 standard was considered suitable and satisfactory for targeting all market segments, including residential, industrial, commercial roofing, and groundmounted fields. Since the PV market has become more mature, however, more targeted designs and quality improvements are increasingly being sought. Design improvements are meeting specific needs and constraints, such as a high moisture barrier in tropical zones, a weight reduction in roof-mounted systems, and abrasion and fouling resistance in desert areas.



Polymeric films for PV front sheets have been successfully tested on the first prototype of the Solar Impulse (HB-SIA), a Swiss long-range solarpowered aircraft which features 17,000 solar cells made of high-performance materials. The PV cells are built into the wing and supply four electric motors (17.5 CV each) with renewable energy.

At the same time, developments in crystalline silicon inorganic thin-films (cadmium telluride, copper indium selenide, and amorphous silicon), organic thin-films (organic PV), and dye-sensitized solar cells have changed material requirements for engineering polymers used in PVs, including the need for low oxygen and moisture exposure.

Meeting performance demands

To address the escalating expectations for differentiation, and to satisfy the weight reduction some PV market segments now require, UV-stable fluorinated polymers—such as ethylene tetrafluoroethylene (ETFE) and *Continued on page 18.*







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solar energy

...continued from page 16.

ethylene chlorotrifluoroethylene (ECTFE)—are increasingly being considered as a glass replacement for front sheets. An efficient front sheet must provide high light transmission (more than 90% in the relevant range of the solar spectrum), and deliver outstanding weather resistance (lasting over a lifetime of 25 years under direct exposure to sunlight and other elements, such as rain and hail), while guaranteeing adhesion to ethylene vinyl acetate (EVA).

The replacement of glass with engineering polymers in PVs allows more ultraviolet light in the 200- to 390-nanometre (nm) wavelengths to reach encapsulants made of EVA, which can cause yellowing and degradation. A challenge for polymeric front sheets has been the development of materials that can shield encapsulant materials from UV light, while still allowing a high level of total energy transmission.

To date, solutions have included:

- Organic UV stabilizers, which degrade over time;
- Stable inorganic materials; and
- Materials that shift UV light to longer wavelengths.

Front sheets made of polymeric film must also allow an acceptable level of water or oxygen ingress to sensitive inorganic thin-films. Thanks to significant research, today's solutions based on fluorinated polymers can meet this requirement, with water vapor transmission rate (WVTR) values up to 10-3 to $10-4 \text{ g/m}^2/\text{day}/\text{atmosphere}$ to protect silicon coatings.

Additional considerations

Fluoropolymer films used in front sheets have inherent fire-resistance and are seen as better than combustible films in not only meeting building code requirements, but also in allowing modules to be assimilated into building-integrated photovoltaic (BIPV) construction. Lastly, the toughness of polymeric front sheets provides a key benefit in reducing the loss of material and associated cost that occurs during manufacturing, transportation, and installation.

To meet such demands, new 50- to 100-micron films have been developed with corona treatments and special coatings. They are now easily accessible as a result of the strong efforts and partnerships developed between resin suppliers and filmmakers, who are active in packaging and specialty films. These unique film solutions give PV module manufacturers new opportunities to design innovative panels, produce roll-to-roll modules, and significantly reduce the weight of PV front sheets by 0.08 to 0.17 kilogram/meters squared (kg/m²).

These solutions have even been successfully tested on the first prototype of the Solar Impulse (HB-SIA), a Swiss long-range solar-powered aircraft. They've also been replicated on the second prototype (HB-SIB).

It's worth noting the potential limitations that should be addressed when switching from rigid glass to flexible film, however. These include the loss of stiffness and, in some cases, the increased risk of silicon cell breakage. Compensating measures might include reinforcement of the module back sheets or the frame.

With new film manufacturers strongly committed to producing custom and price competitive polymeric films, a new generation of lightweight PV panels are expected to launch in the near future. These new products will answer the growing market need for lightweight, high-performances modules—and for both crystalline silicon and inorganic thin films.

Philippe-Jacques Leng was appointed European sales development manager (films and foams) for Solvay Specialty Polymers in 2008, and in 2012 was named global business manager – films. He's responsible for setting Solvay's global market strategy for the films business and driving growth in the PV market.

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Constructing Solar Solutions In extreme winter conditions By Terry Olynyk



Strong field leadership and a tenacious team enable solar construction to succeed in all conditions

Proactive snow removal is critical to constructing solar facilities in the winter

ALTHOUGH THE IMAGERY OF SOLAR POWER may conjure up thoughts of the summer sun fueling renewable energy, construction is a year-round industry and solar sites are no exception. Experienced solar builders are skilled in construction techniques for all seasons.



r



A total of 14 solar power projects were completed in Ontario, despite 2013-2014's Polar Vortex

The Polar Vortex

Enter the winter of 2013-2014 and the bone-chilling villain, named Polar Vortex, which swept across Canada and a majority of the Eastern United States. Wikipedia defines this term as a persistent, large-scale cyclone that circles either of the planet's geographical poles. It heralded extreme cold temperatures and snowfall, prompting countless automobile accidents, highway closures, flight delays, and school and business closures.

Many Toronto residents in Canada reported waking in the middle of the night, experiencing what felt like an earthquake. These tremors turned out to be ice quakes, which occur when rigid ice expands, building up tremendous pressure that results in cracking and large booming sounds.

Though countless construction projects fell behind schedule due to this extreme weather, many projects managed to continue on course, as a result of much ingenuity and perseverance—demonstrating that renewable solar energy can be created in the face of even the most extreme winter conditions.

Despite the bitter-cold temperatures and seemingly never-ending snow experienced in Ontario, several renewable energy teams pressed on in completing 14 solar projects during the Polar Vortex. However, completing this feat was no easy task. Teamwork was essential in what became somewhat of a man-versus-nature sense. The extreme weather forced the team to be creative in finding ways to persevere.

• Meeting deadlines

These 14 solar projects each had definite end-dates, with the potential for considerable monetary penalties for those solar farms not going in-service on time and as planned. To maintain the schedules in extreme weather, it was imperative to organize for the winter conditions ahead of time.

Although the extreme of the Polar Vortex might not have been expected, planning for worst-case scenarios on a project site is always worth the effort. Knowing construction for these projects was to occur during the winter months, a step as small as ordering heating supplies for the site and for the workers beforehand was significant.

Setting the scene

Manpower productivity is reduced by 50% to 60% in extreme weather conditions. With sites as large as 100 acres, warming stations can never be too numerous or too close. Some of the solutions the solar teams dealing with the Polar Vortex employed include:

- Utilizing electrically heated winter jackets;
- Shuttling in school buses for those breaks and for relief from the cold;
- Warming up cables and heating rocks in a fire pit to keep close and warm; and
- Preparing for project duties ahead of time by warming tools and equipment, or clearing snow.

• Preparing for snow

Snow removal is critical to constructing solar facilities in the winter, not only to maintain access throughout the site, but also to clear the modules for performance testing.

Being proactive is essential when it comes to dealing with snow at a solar site, so it's important to be prepared for the first fall, lest it accumulate. Snow that's left to sit or melt only compounds and can become more difficult to remove. With foresight, all materials, tools and supplies should be moved or elevated to avoid freezing or being buried and lost beneath the snow. If overnight flurries are predicted, it's important to make sure preparations are made in advance to begin clearing for the workday ahead; even if this means clearing throughout the night.

Every site has its own unique challenges and snow removal capabilities. Because of this, individual site conditions should dictate the approach to snow removal. Some sites may focus on packing snow, while others might excel in scraping. Likewise, approaches to clearing panels are not always consistent. Different measures include: blowers mounted to front of skid steers; leaf blowers; compressed air blowers; and a variety of squeegees, brooms, and scrapers. Know what works best for the panels being installed.

Also, show consideration in the overall snow removal strategy selected. If snow that's cleared onsite is piled, consider the implications when it melts. Try to relocate snow offsite if possible to limit melt-off. Careful planning will not only ensure a dryer, well-maintained site, but will also mean that neighboring properties won't be washed out come spring.

A bright light in the midst of this peril: once panels are energized they will melt snow and ice!

• Surveying the site

There's no way around it, solar site surveying takes twice as long in winter months and technical difficulties can ensue during snowfall. The placement of survey pins becomes more complicated when dealing with snow and frozen soils. As permanent survey pins are drilled into the frozen ground, snow accumulation must be cleared to locate them.

The survey equipment itself can also experience challenges in frosty conditions. For one, extreme temperatures can cause LED screens to freeze. Secondly, although total station survey equipment is intended to operate at line of sight, note that it often doesn't work during snowfall.

• Being equipment-ready

It's no surprise that equipment is often more difficult to get started in colder conditions. And, equipment that isn't properly warmed up can be damaged. To keep battery-operated tools warm, they can be outfitted with thermal socks that are stuffed with chemical heat packs. Using insulated pipe sleeves around some specialty tools can also help.

• Knowing the limits

With a collaborative team and strong field leadership, it's clear that anything is possible project-wise, regardless of the weather. The Ontario solar teams who worked through blizzard conditions to complete multiple solar power projects are proof of that.

Trenching, for example, is a horrendous task in extreme winter weather and should be avoided at all costs if possible. It adds the additional step of first getting though frozen ground with a hoe ram just to break frost. Once that's completed, often what's left are piles of hardened, overburdened material that's not appropriate for trench backfill.

Although, it's not always possible to accurately predict the weather or to control it, it is possible to prepare for cold and even blizzard conditions. With winter 2015 on the way, remember that solar construction can succeed in all conditions—even in the face of extreme adversity, with the right team.



Terry Olynyk oversees the Renewable Energy Business Unit at PCL Constructors Canada Inc., which is based in Toronto, Ontario.

With over 180 MW AC of solar constructed in Ontario, PCL has a team of dedicated construction professionals, providing clients with quality energy solutions. The team recently completed one of the largest solar initiatives in the province involving the simultaneous construction of 14 sites.

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PV attachment system

Sno Gem Inc. recently introduced the PV Cube standing seam attachment system, a clamp-to-seam solar panel racking and mounting system. PV Cube provides unparalleled strength, thanks to a patent-pending WaveLock technology that offers three points of attachment. The Silver Bullet set screws include a rounded bullet tip to maximize strength, but they in no way damage the paint finish or pierce the seam, so they won't void warranties. Easy-to-install, the PV Cube solar panel racking and mounting system attachment is made in the USA and requires no painting or mounting kits. It's available in standard mill finish aluminum material, making it an easy item to keep in stock. **Sno Gem Inc.** | www.snogem.com



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The Sentry dual axis solar tracker was designed with one goal in mind, to be the biggest, the strongest, and the best solar tracker in the world. Sentry trackers are currently in operation throughout North America. From standalone 10KW installations to 500KW generation parks, Sentinel Solar has redefined how the solar tracker fits within the solar market. Sentinel Solar's Sentry tracker is designed to be the most efficient, reliable, and affordable solar tracker in the world. Contact Sentinel Solar for more information.

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PV metallization pastes

DuPont Microcircuit Materials has added two new products to its lineup of frontside silver metallization pastes for crystalline silicon solar cells. DuPont Solamet PV18H and PV18J PV metallization pastes offer solar cell manufacturers improved efficiency and profitability. The advanced Solamet PV18x series products deliver a step change in the power output of panels by improving the conversion efficiency of solar cells. This is due to proprietary Tellurium technology, which has been instrumental in unlocking efficiency gains by more than 0.5% by allowing contact to enhanced lightly doped emitters.

Compared to industry standard pastes on multi-crystalline solar cells, Solamet PV18H and PV18J can boost conversion efficiency by an additional 0.15%, enabling extremely fine line printability down to 35 microns. Additionally, up to 30% less material usage is required with these new materials, resulting in significant savings for manufacturers. **DuPont** | www.dupont.com http://photovoltaics.dupont.com



Mid-clamps with bonding

Kinetic Solar Racking and Mounting first engineered pre-assembled mid-clamps, and now they're offering pre-assembled mid-clamps with integrated M-KR-WEEB's. As a result, bonding can be as easy as inserting a mid-clamp assembly, at approximately a 30-degree angle (nut down), into a Kinetic Solar un-anodized, aluminum mounting rail. Installers can simply lift and straighten the mid-clamp assembly—it will pop and click into the rail. Then, panels can be positioned, sliding the assembly into place, and simply tightened to torque specifications. This will not only bond solar modules to each other, but also to the un-anodized aluminum mounting rail.

Kinetic Solar Racking and Mounting http://kineticsolar.com





1292 Logan Circle NW Atlanta, GA 30318 +1 877-847-8919 www.renusolamerica.com The Renusol MS system is a simple, compact, cost-effective PV mounting solution for trapezoidal sheet metal roofs



(f)

Renusol MS



Solar panel installer The Winlet product line has been used for glass and window installation for many years, allowing extremely heavy window elements to be lifted, transported, and installed easily. Most recently, the engineers at Winlet have worked with solar power professionals to develop a track-based Winlet, capable of meeting the requirements for solar panel installation. This Winlet technology increases efficiency and speed in solar panel installation and transportation, while improving safety in the workplace. The Winlet features four suction cups, which will hold up to 1320 pounds of material. The Winlet is also selfpropelled, and can access narrow doorways, elevators, and balconies. It also features tracks for rough terrain operation.

ReachMaster, Inc. www.reachmaster.com



Solar mounting system

Magerack designs and manufactures solar mounting systems for rooftop solar installations. Their latest product, the Magerack Mounting System, has received UL 2703 certification. The system is bonded and grounded, without using any WEEB or bonding jumper. It offers advantages that help installers reduce installation time and cost. For instance, the mid- and end-clamps bond rail and PV modules, the rail splice bonds two connecting rails, and the microinverter mounting kit bonds to rail—all with integrated bonding (so, no bonding jumper or WEEB is required). The ground lug is also installed and bonded to rail without drilling. Magerack's rooftop mounting system is not only easy-to-install, but also reliable and cost-effective.

Magerack | www.magerack.com



Pitched-roof racking

Alpha+, the new pitched-roof racking system employs Mounting Systems' all-new, patented Clickstone technology. The Clickstone works on a simple principle: click into the rail, position, tighten, done. The Clickstone's symmetrical design allows an installer to insert the Clickstone into the rail more easily, adjust it more accurately, and secure it more quickly. This, and new, economical rails, ETL listed (UL 467) bonding clamps, and rail splices result in exceptionally fast assembly, easy system installation, and safe operation. Plus, Mounting Systems' newly designed planning software (Quick Configurator) speeds project planning and permitting.

Mounting Systems, Inc. | www.mounting-systems.com







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Solar Unplugged Building smarter, safer PV with wireless monitoring

By Craig Goodwin

Solar energy operators in America and around the world are at a strange intersection. Even as the predictions for generation head toward 75 gigawatts (GW) in 2015 for North America alone, the financial picture is more complicated. A reduction in subsidies, a decline in regulation-based and renewable portfolio standards' (RPS) demand, and lower negotiated power purchase agreements (PPAs) have many operators looking closely at every aspect of operations and maintenance (O&M) to maximize efficiency and project return-on-investments (ROIs).

PV Solar Heating & Cooking

Off-Grid

H Model

Cybolnverter

Cybolnverter

MFA

As the market matures, new decisions have to be made. Growing demand requires more PV generation, typically resulting in larger fields. At the same time, concerns over transmission efficiency and environmental impacts make distributed or dispersed generation a logical choice for other developers.

Theory versus reality

Ultimately, regardless of a solar plant's size, operators know that continuous monitoring brings three powerful advantages:

- **1.** Faster commissioning;
- 2. Lower O&M costs; and
- **3.** Higher long-term kilowatt-hour (kWh) output.

In theory, quantifying the cost savings and improved revenue driven by these benefits should make decisions around solar monitoring simple and straightforward. Ideally, monitoring starts at the string-level and rolls up, system-wide. Clearly, this level of granular real-time data makes the diagnosis of performance issues easier before and after commissioning—which begs the question: where's the dilemma?

Cost details

Hot Water

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heating element.

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set higher than

the upper element.

R

Grid

Solar

Although the value of continuous solar energy monitoring seems undisputed, the consensus around the depth of that monitoring begins to evaporate as costs are considered. During commissioning, developers can price the value of traditional wired monitoring and its infrastructure—namely, connectivity and power—which require proper cabling to be installed and maintained. And, post-commissioning, operators can price the loss of performance for one or more strings, versus the expense of any repairs.

In either case, the price of wired monitoring is a disincentive for thorough, string-level, system-wide monitoring. But what if there was another option, and what if those costs

Grid AC

AC

Dual Element

Electric Water

could be eliminated? Wireless monitoring solutions provide that other option. They offer a smarter way forward, delivering detailed, continuous data during the commissioning process and throughout the life of the plant.

A wireless solution multiplies the benefits of solar monitoring exponentially by dramatically increasing cost reductions while, at the same time, strengthening the quality and reliability of the information output.

Benefits include:

- Lower, trench-free construction costs;
- Reduced or eliminated copper and fiber-optic costs (for bus-powered solutions);
- Easier access to more detailed data in real-time; and
- A longer range.

Wireless monitoring begins with commissioning and continues across a solar plant's lifecycle. But, in many cases, the cost of a monitoring system can be offset by the savings gained during the commissioning process alone.

Herein, wireless solar project monitoring allows for:

- Early and continuous performance diagnostics, even before SCADA systems are installed;
- A system-wide overview of solar panel and solar plant efficiencies and requirements;
- Reduced O&M costs due to faster troubleshooting and mitigation; and
- Best practices that become driven by data and actual need, rather than habits.

The lower price of wireless further impacts the argument for and against string-level monitoring. A wireless monitoring solution not only reduces the price of getting string-level data, it can also make that information more meaningful once gathered through Cloud-powered aggregation and analytics.

Set in the Cloud

Moving performance data into the Cloud has big advantages for solar developers and operators. While wired systems can take advantage of Internet or Cloud gateways, robust, low-power wireless networks are better suited to continuously move critical information upstream.

- Adding a Cloud platform to a wireless monitoring solution helps transform machine-to-machine (M2M) connectivity into a robust network of intelligent endpoints—the very vision that the much-hyped Internet of Things made practical and pragmatic. A wireless Cloud platform provides delivery of granular data, from string and inverter level up, onsite, across state, or around the world, and offers:
- Easy integration and analytics;
- Seamless data backup and recovery;
- 24/7 access on a mobile or other
- connected devices; and
- A simpler provisioning of information to stakeholders.



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4 DC Input channels with MPPT

for each solar panel to maximize

solar harvest

From the first module coming online to the final destination in the Cloud, wireless connectivity brings concrete efficiency and valuable insight that can reduce solar O&M costs and improve the performance of a solar farm.

Safer solar

Beyond compelling bottom line financial priorities, the challenges faced by operators are more complex than simply a question of dollars. Technical defects and failures don't just mean lost revenue; they can lead to serious equipment damage, injury, or even death.

Wireless awareness gives operators early warning and automatically notifies control boxes, disabling faulty components before the problem arises. It's a powerful example of

how machine-to-machine (M2M) connectivity and the Internet of Things can have a real impact on real challenges.

As solar operators work to improve the efficiency, reliability, and safety of their plants and processes, the integration of wireless monitoring can allow such professionals to do so on an ongoing basis—anytime, anywhere. The benefits seem custom-built for PV systems: early answers, reliable automation, and bigger data, all delivered at lower cost, in real-time.

Craig Goodwin is the senior product marketing manager of Synapse Wireless.

Synapse Wireless | www.synapse-wireless.com



PV fuses

SIBA is constantly enlarging its product range geared at PV applications. One example of this is their new 1500VDC UL listed (UL 2579) fuses to protect the next generation of solar equipment. SIBA fuses meet and exceed the 30 kA interrupt ratings requirements. The new series of fuses include 10x85/14x65, ranging from 1A to 30A. They are ideal for string and combiner protection, as both fuses are designed to use the same holder. For higher currents, SIBA offers: SQB1 (bolted) 50A to 200A, NH1XL (bladed) 63A to 200A, (SQB3) bolted 63A to 600A, and NH3L (Bladed) 63A to 600A. Custommade solutions are also available. SIBA | www.sibafuse.com



Dual-axis tracker

Sentinel Solar's Sentry Dual-axis Tracker was designed from the ground up to meet the requirements of the North American solar market and environment. The Sentry incorporates 10 kilowatts on a single-tracker design. Designed, engineered, and manufactured in North America, the Sentry Tracker is one of the most efficient, reliable, and strongest trackers on the market today. Along with being built to last, the Sentry incorporates a number of key features, including: astronomic tracking control; full remote control and monitoring via a PC or tablet; a unique tower and array design for stability and longevity; a 50 kph (30 mph) wind safety mode and snow dump feature; and battery backup capabilities. Sentinel Solar's Sentry Dual-axis Tracker is designed to meet the requirements of individual tracker applications of 10 kW or 500 kW solar tracker parks and larger. Sentinel Solar | www.sentinelsolar.com

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Solar Thermal Technology Simplifying designs for US market infiltration By Joerg Gaebler

IN RECENT YEARS, a steady growth of the market for solar thermal heating technology has brought about a large number of system installations across the globe. However, in North America, solar thermal systems are still quite complex in terms of installation and operation. And, despite an excellent and stable subsidy scheme—offsetting 50% to 75% of system costs—solar thermal technology is losing out to the popularity of low-cost photovoltaic's (PVs).

It's clear that a more simplified system design is required, allowing for a "set and forget" installation, if solar thermal is ever truly going to join the US renewables' revolution.

Performance flaws

Stagnation on a solar thermal installation is one of the most frequently discussed problems when addressing the performance of solar thermal flat-plate collectors. When the heat transfer liquid is exposed to temperatures above 220° C (430° F), rapid degradation of the anti-freeze that's used in most systems is the result. Unfortunately, this can lead to damage and eventual failure of the solar circuit.

Overheating is also a serious concern, resulting from the vapor formed during stagnation. If it penetrates into the liquid circuit, it can damage and destroy components, such as the vents, valves, membrane expansion vessels, and more. The solar liquid inside the collector will begin to evaporate when the circulation of the heat transfer liquid is stopped, and the excess solar heat of the collector can't be dissipated any more. This can happen when heat storage capacity is exceeded and solar loading continues (i.e. during summer time, especially in space heating supporting installations or in southern latitudes, when heat demand is lower than the amount of solar heat delivered).

Yet another common reason for failure of the power supply can occur if the circulation pump stops working for any reason. The heat dissipation power of the circuit depends on the heat losses of the tubing. Therefore, it might be necessary to add a heat dissipation vessel upstream of the expansion vessel as an extra heat dissipation device. This vessel serves to protect the expansion vessel, and the other components of the solar pumping group, against intolerably high temperatures by dissipating the heat of the condensing vapor.

The quantity of vapor formation in the collector can be described by the maximum vapor production power. Some existing data shows values from 15 W/m^2 for serpentines up to 385 W/m^2 at 4-bar relative pressure for vacuum tubes. The maximum penetration depth of vapor into the solar circuit can be estimated if the heat losses per length of piping, and the heat dissipation performance of a (potentially) mounted heat dissipation vessel upstream of the expansion vessel, are known. The maximum penetration depth of the vapor is reached when the maximum vapor production power equates to the heat losses of the tube, and the heat dissipation performance of the heat dissipation vessel.

Consequently, careful design of the piping and heat dissipation vessel guarantees sufficient control of the vapor penetration into the piping. To meet this demand, at least one system currently on the market offers an intrinsic fail-proof safety mechanism against overheating by utilizing a self-draining effect during stagnation (see image). Herein, the solar circuit is only partly filled with heat transfer liquid, while the remainder of the piping and the collector stay air-filled. If the temperature in the collector reaches a certain level, the pump starts pushing the liquid upstream. This movement of liquid displaces the air into a collecting vessel, and the liquid begins to circulate. When the pump stops, the liquid naturally drains back into the collecting vessel via gravity, and the air moves back into the collector. As a result, the heat transfer liquid is removed from exposure to solar heat during stagnation of the solar circuit, avoiding any thermal degradation.

To avoid the anti-freeze degradation problem, some drain-back systems operate with pure water. This is only acceptable if it can be fully assured that the water in the solar circuit will never be exposed to freezing conditions. However, experience shows that in Europe, or even in northern Africa and the Middle East, this can rarely be absolutely guaranteed. Optimal frost protection, therefore, is only provided with anti-freeze.

Installation simplicity

Solar thermal system installation and set-up errors often go unnoticed until it's too late. Only qualified plumbers are able to ensure the high level of accuracy necessary for the installation of today's complex solar thermal systems. Unfortunately, a large number of nonspecialized plumbers carry out an increasing number of solar thermal installations. One solution to this challenge is to radically reduce the complexity of the installation process.

Recently, one research and development (R&D) team carried out an integrated systems analysis with the goal of removing any device not absolutely necessary, integrating all functional components in the most compact manner possible. A solar tank development was the result, with the inclusion of intrinsically safe heat exchanger technology to avoid overheating.



A solar thermal hybrid system, SECUSOL provides for a closed-loop, indirect installation, eliminating the need to pressurize the system because of a proprietary drain-back function

Findings & analysis

Drain-back systems don't need any heat traps because thermo-siphon effects cannot occur. Insufficient deaeration, which occurs sometimes in installations, isn't an issue with drainback systems. Air vents also aren't necessary. The occasionally failing membrane expansion vessels aren't required, since the collecting vessel or the only partially filled storage tank compensate for the thermal expansion of water.

An increased heat transfer rate inside the heat exchanger coil provided a positive side effect of integrating the collecting vessel. During operation, there was a two-phase flow inside the coil. The liquid moved rapidly and turbulently along the inside surface of the coil, forming a thin layer. This is actually highly preferable for the heat transfer when compared to the relatively slow, near-laminar flow of the liquid when the coil is completely filled, as the inner-mass of the liquid contributes very little to the heat transfer.

In the end, a high level of pre-assembly, along with the reduction of the number of required components, led to a significant reduction of installation time. Steps that related to the pumping group, membrane expansion vessel, and solar controller became completely obsolete. All these components are either pre-assembled on a hybrid system, or not required at all.

Solar thermal commercialization

For solar thermal technology to survive in the US solar boom, systems should become mainstream for new construction and retrofits. In countries such as Turkey, Greece, and Cypress, for example, solar thermal installations are standard—generating between 50% and 100% of the domestic hot water (DHW) needs in households by keeping the technology simplified.

Ideally, self-draining systems should be the system of choice. Simplified systems that don't require more than 12 to 14 man-hours would not only help with installation errors, but would also help cut overall system costs by \$6,000 to \$7,000, even before the rebates and incentives kick in.

Lastly, design and system component integration should be at the responsibility of the manufacturer. Only system with an OG-300 label should be allowed to receive incentives and subsidies, thereby reducing system design errors and flaws with custom and integrated solar thermal installations.

Joerg Gaebler is managing director of Wagner Solar Inc. in Boston, Massachusetts, a 100% subsidiary of Wagner & CO, Germany.

Wagner & Co is a one-stop total systems provider in the field of solar thermal solutions and systems integrator for solar power installations of any scale—from small, off-grid solutions to largescale PV power plants. In May of 2010, Wagner & Co founded the Wagner Solar Inc. to develop the North American Market.

Wagner Solar Inc. | www.usa.wagner-solar.com



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provide the highest quality products and service available to the solar energy industry at competitive rates. Our dedicated team of sales professionals, in-house engineering expertise, and customer service specialists guarantee strong support at every level of the design and procurement process, from conception to completion.

STRUCTURAL & MECHANICAL SPECIFICATIONS			
Structure Type	Fixed Tilt Structure		
Inclination Range	5-35 degrees (configurable)		
Modules Supported	Most Commercially Available (thin film configurable)		
Module Configuration	Double module in portrait		
Module Attachment	Direct Mount to HDG Hat Channel (clip configurable)		
Materials	ASTM Certified Steel		
Allowable Wind Load	Basic Wind Speed (3 sec gust) 90mph (configurable)		
Welding	No		
In-field Fabrication Required	No		
Supply Chain	Domestically Sourced (USA)		
On-site Training and Commissioning	Yes		



Coral Wood Court Apartments, a California low-income housing community, recently had 42 flat-plate solar thermal collectors installed on the rooftop, which are expected to save more than \$175,000 in energy over the next 30 years

An Untapped Solar Market The renewable potential of multi-family housing By Zach Axelrod

SOLAR ENERGY IS RAPIDLY BECOMING A POPULAR option for homeowners as a way to save money. But, what about folks who live in apartments or condos? Multi-family dwellings, as they are known, are providing the next potential growth opportunity for the residential solar industry. Now, innovative financing mechanisms allow even low-income families to take part in the benefits of solar power.

America's multi-family housing market offers a great, untapped source of potential renewable energy. The fundamentals of these facilities match up well with what the solar industry looks for in terms of good residential customer targets. Multi-family housing units have high energy and water usage, and the residents often pay high-energy rates. These properties also tend to have stable, long-term ownership. Plus, many areas of the country are offering financial incentives for such projects.

PV versus solar water heating

Multi-family properties are good candidates for solar PV and solar water heating systems. When deciding between the two options, it's important to look at a facility's roof space to see which technology can best maximize cost savings.

For buildings that use central water heating, installing a solar heating system will often be more economical than installing PV, in part because these systems are so efficient. Thermal systems can heat the water that residents use at a significant discount compared to what is paid to heat water with gas or electricity. In fact, solar hot water systems can be one of the most efficient ways to reduce a building's carbon footprint.

Perhaps the most attractive feature, at least for the residences, are the rates when going solar. Larger buildings (think industrial users) often pay much lower rates for energy than single-family units. Despite their size and actual power usage, energy pricing for multi-family housing is often closer to single-family homes than it is to commercial rates. This presents a unique opportunity for renewable energy companies to finance solar systems, such that the customers have no upfront or out-of-pocket expenditures, and yet can receive clean energy at a discounted price—compared to the price of today's fossil heating.

Solar pros & cons

The propensity of homeowners to move can be a leading barrier when it comes to deciding

whether or not go solar. A family might not be sure if they'll be living in their home long enough to see a return on such an investment.

However, multi-family properties mitigate that risk, as ownership of the building is less likely to change hands over the lifespan of a solar system. For condos, the cost of solar can be priced into the residents' monthly condo fee. Stable ownership is true in the low-income housing market segment, as well. In many localities, the city or county government has ownership of these buildings, ensuring possession is stable over time.

An additional benefit to seeking projects in multi-family dwellings is the number of available incentives available. One example of this is the California Solar Initiative's Solar Thermal Program. The program offers rebates of up to \$500,000 for solar water heating systems on single, multi-family properties—whether it's a low-income facility or not. Many localities offer incentives or grants to companies that provide energy improvements to these facilities.

This sounds great on paper, but what does it look like in the real world?

Solar in real life

Coral Wood Court Apartments, a California low-income housing community, recently had 42 flat-plate solar thermal collectors installed on the facility's rooftop. These collectors use sunlight as a heat source for the building's hot water tank, which was previously heated by gas. The system is expected to save more than \$175,000 over the next 30 years.

And, it isn't just California that's making gains in multi-family solar. A 267-unit high-rise building located in Washington had 64 solar thermal collectors installed on its roof back in January 2012. This system is designed to fully heat 50 gallons of water per panel, per day. Over its first eight months in operation, the system consistently delivered an average of 551.5 therms of heat energy monthly, or 28.7 kBTU per collector per day. This amount of energy is equivalent to 16.2 megawatt-hours (MWh) of electricity generated monthly, or 8.4 kilowatt-hours (kWh) per collector daily.

The total cost of this system amounted to \$288,000. The system was also financed, meaning the customer paid nothing upfront. Plus, for the 10-year contract term, the customer will pay 35% less than its natural gas utility rate for each therm of solar hot water delivered—regardless of fluctuations in their conventional utility rate. This has led to residents having seen an average of 19% monthly savings in their water heating bills. For

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the six-month period between February and August of 2012, this averaged \$216 per month for a total savings of over \$1,300.

These examples show that home ownership is no longer a necessary requirement to benefit from residential solar energy. It won't be long before the industry comes to recognize this next great opportunity for tapping the sun.

Zach Axelrod is the CEO of Nextility

Nextility | www.nextility.com



Pitched-roof racking system

Enable Energy has announced the availability of Avanza, a versatile pitched-roof solar racking system. Designed with simple features, Avanza serves module and roof attachment functions with a single self-grounding assembly and integrated flashing. There are no rails. Avanza comes preassembled and requires only two tools to attach to the rooftop, reducing installation time as well as errors. The assembly has a unique adjustment feature that increases the range of tolerance in positioning on the roof, and expands the pool of installers qualified to work with the product.

The minimalist design allows installation to occur from the bottom of the roof up, or the top down, reducing fatigue and improving ergonomics making each job easier and safer for installers. The reduction in materials simplifies the manufacturing process, driving down component and installation costs. The product is compatible with a majority of the modules on the market.

ADDING

POWER

FF

Enable Energy | www.enable-energy.com



Solar analytics solution

Locus Energy has launched an advanced, irradiance modeling tool as part of their PVIQ suite of analytical tools. Virtual Irradiance (VI) provides valuable data on the amount of sunlight that's available at a particular time and location, enabling a highly accurate assessment of solar PV system performance. VI allows fleet managers to determine if a system is performing up to expectations, and which solar systems fail to meet performance standards. This information drives down costs by improving operations and maintenance (O&M) efficiency at an individual site or across an entire portfolio.

VI uses data from weather stations and satellite imagery to provide highly accurate, ground-level irradiance data for any location in the continental US. For small to medium-sized systems, VI eliminates the need for an onsite sensor, which may be prohibitively expensive. For larger projects, VI can fill gaps in and validate sensor data, which can become skewed due to mis-calibration, soiling, or other factors.

Locus Energy | http://locusenergy.com



Inverter series with DC optimizers

Bonfiglioli Vectron GmbH recently announced global availability of the Ampt Mode version of its RPS TL inverter series. The new Bonfiglioli RPS TL inverters in Ampt Mode are deployed with DC optimizers from Ampt, LLC to increase PV plant performance at a lower price. The combined solution has the ability to decrease total system costs by reducing electrical balance-ofsystem (BoS) component costs, compared to traditional systems—while increasing yield. Bonfiglioli RPS TL Ampt Mode Inverters provide: 100% longer strings at 1000 V standard system voltage; 50% less string combiners and reduced DC cable cross sections; up to 33% fewer PV stations, enabling station ratings of 3.5 MVA and higher; and increased yield using multiple maximum power point tracking (MPPT) tracking within strings. Based on Bonfiglioli's modular concept, the new Ampt Mode series of inverters are available in powers that range from 500 kVA to 1750 kVA, and as turnkey stations up to 3.5 MVA in a standard 40-foot ISO container.

Bonfiglioli | www.bonfiglioli.com

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www.cgglobal.us

solar energy



Rail-less solar mounting

With the Black Widow rail-less and stud-less tile mounting system with integrated grounding, Spider Rax has simplified solar racking. The Black Widow not only allows solar installers to cut installation costs in half, but it also allows them to cut their racking stock down to just one part number. It's easy to install the Black Widow system on all tile roofs, as there's no need for drilling or replacing a single tile—because there's only one part. Spider-Rax also offers rail-less and stud-less, fully flashed, comp shingle applications.

Spider-Rax | www.spiderrax.com





72-cell solar panel

REC Group will begin shipping its new trade-compliant, 72-cell, 1000-volt (DC) solar panels. Target markets for the Peak Energy 72 Series panels include large commercial/industrial and utility-scale PV power plant projects. The benefits of deploying solar arrays equipped with 72-cell panels, 1000-VDC modules include lower installation costs, the use of fewer balanceof-system (BoS) components, and a lower overall price per installed watt. The Peak Energy 72 Series panels are backed by the company's linear, 25-year power output guarantee. They feature enhanced power production per square foot, a robust and durable design, easy installation, and optimized performance in all sunlight conditions.

REC Group | www.recgroup.com





Solar-powered wireless camera

Sensera Systems has launched its MC-30 MultiSense Camera and Cloud Service products. The company is the first to combine cellular and WiFi, high-resolution still and video imaging, datalogging and control, with an 802.15.4 wireless sensor interface, and built-in solar power into a low-cost device. Sensera Systems' solar-powered wireless camera products are affordable and simple to use, and are ideal for monitoring construction of new solar energy sites and/or for ongoing site security to protect valuable materials and assets.

Traditional M2M applications have focused on lower bandwidth IO and control applications. By integrating imaging and IO into a single platform, the company has taken advantage of today's more capable cellular and computing infrastructures to deliver advanced remote sensing applications at a fraction of the cost of existing solutions. Plus, their MultiSense Cloud Service WebApp provides a 100% webbased graphical interface for viewing data and controlling cameras and I/O from any desktop or mobile platform with no programming and no software to install.

Sensera Systems

www.senserasystems.com



Built-in racking system

Spice Solar introduces rack-less solar modules and mounting components that directly attach to a roof. This new technology makes installing rooftop solar modules faster and cheaper by integrating the racking into the frames of the modules themselves. With Built-In Racking, installers use 50% fewer parts on the roof, reducing equipment and labor costs on every job. For a typical 20-module residential system, Spice Solar can save over \$350 in parts and \$1,150 in labor compared to an ordinary rack-mounted system.

With a unique snap-together design that reduces parts costs, Built-In Racking allows for easy portrait and landscape installations, and permits the removal of a module from the middle of an array for simpler operations and maintenance (O&M). The Spice Solar frame with Built-In-Racking is integrated directly into the modules at the factory, and is compatible with a wide range of industry standard mounting components (roof brackets, tile hooks, standoffs, etc.), as well as flashings. **Spice Solar** | www.spicesolar.com



Advanced-plate batteries

The Discover RE Tubular batteries provide maximum efficiency per discharge-charge cycle, along with proven reliability in remote, hightemperature, or unstable power network installations. The advanced tubular technology features a multitube gauntlet construction that encapsulates the active material, resulting in cyclic stability, longer life, and higher capacity. Tubular batteries avoid mass shedding, reduce corrosion, and prevent early capacity loss—offering an ideal solution for many of the common problems faced with flat-plate technologies. Available in 2 V, 6 V, and 12 V options, OPzS Flooded (Low-Maintenance) and OPzV Gel (Maintenance-Free), Discover RE Tubular batteries provide users with one of the lowest overall cost of ownership when compared to other high-quality, lead-acid batteries in stationary and renewable energy applications.

Discover Energy Corp. www.discover-energy.com



High-performance cable edge clips

Managing cable for solar PV systems is now less difficult and less timeconsuming because of the new Ty-Rap High-performance Cable Edge Clips from Thomas & Betts. The patented Ty-Rap can be quickly installed without tools to manage up to four, 10 AWG solar PV control cables. It can also be removed without tools or cutting, and is easily repositioned for ice removal, re-adjustment, or any other maintenance. Ty-Rap High-Performance Cable Edge Clips support control cables through panel rotation, environmental changes, and vibration, and can be reused. They fit frames thicknesses ranging from 0.06 to 0.12 inches, and are available in two types of non-metallic polymers, reducing the need for grounding: Acetal (polyoxymethylene), or ultraviolet (UV)- and weather-resistant nylon 6-6. The Ty-Rap comes in three configurations: 90 degrees for cable perpendicular to the frame; U style for cable parallel to the frame; and W style for extra-capacity cable management in parallel applications.

Thomas & Betts | www.tnb.com



Inverter solution for MLPE

Fronius USA's latest product significantly simplifies solar system design and installation, while delivering maximum energy harvest from complex arrays. The Fronius FE Series supports an architecture using module-level power electronics (MLPE), and is the most bankable of all MLPE technologies currently available. This solution eliminates the need for specialty cabling or standalone boxes, as the technology is directly integrated into the FE Series inverter. A full system solution for string inverter power and module-level monitoring, this inverter available for residential and commercial applications (from 3.0 kW to 12.0 kW). The Fronius FE Series seamlessly pairs with retrofit optimizers or smart modules, significantly reducing labor, complexity, and additional boxes. Fronius USA | www.fronius-usa.com





Standing seam metal roof clamp

The new L-Foot from AceClamp/PMC Industries makes installing solar racking systems quicker and easier. Installers no longer have to contend with wide, L-shaped brackets, which often prevent complete access to mounting clamp fasteners. The new L-Foot doesn't cover the top-mounted bolt on the AceClamp ML, or impede access to the AceClamp A2 side bolt, making any adjustment or re-torquing simple and accessible. The bracket's shorter foot also allows complete access to the clamp's grounding cable channel, so the bracket doesn't have to be removed to install the grounding wire.

UL 2703 compliant, the FM-approved AceClamp ML is a standing seam metal roof (SSMR) clamp system that can accommodate almost any application or roof seam profile. Its two-piece design allows installation at any point on the seam, with one of the tightest vibration tested grips in the industry. The single fastening screw is top-loaded, providing easy access for the contractor, completing installation in less than half the time of conventional side-mounting systems.

AceClamp/PMC Industries

www.pmcind.com/aceclamp-metal-roof-clamp.html



Mounting system enhancement

IBC SOLAR AG has enhanced its IBC TopFix 200 mounting system for pitched roofs, so as to now include the Mounting Plate Duo. The Mounting Plate is used in PV installations on trapezoidal or corrugated roofs, and enables more static loads to be supported for each roof connecting point. Two hanger bolts or two solar fasteners can be connected to each other using the Mounting Plate Duo. The profile rail on which the solar modules are mounted can, then, be attached to the plate. This enables the installer to fix the profile rails on the roof with twice the number of hanger bolts or solar fasteners. The load of the PV system is distributed to more points, so the burden on individual screws decreases considerably. The Mounting Plate Duo can be used to install PV systems on buildings in exposed locations where there are large loads of wind or snow, ensuring a long service life and profitability that can be accurately calculated.

IBC SOLAR AG

www.ibc-solar.com



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Instant solar quoting

Sungevity, Inc. has announced the first technology capable of generating residential solar installation quotes instantly—based on nothing more than a street address. The new quoting platform utilizes proprietary technology that combines LIDAR, aerial imagery, and real estate parcel data to produce a 3D model of the property at a given address. Hundreds of design variations may be generated for that address, based on factors such as roof pitch and shading.

Instant iQuote immediately provides the consumer with the most optimal solar configurations, installation cost, and estimated savings. Results can also be modified on the spot, based on customers' design preferences, actual energy usage, and other variables. It can also be used to rapidly assess the solar potential of entire cities, counties, as well as countries for retailers, utilities, and other partners. Sungevity, Inc. | www.sungevity.com

PV Modules

Efficient design and a high-yield performance are key factors in any solar energy project. Regardless of the project size—whether small or utility-scale—selecting the right module is extremely important. To help you find the right choice for your solar project, we've highlighted some of the top contenders in the industry.

SEE AD ON PAGE 37





LG Electronics USA

Product: LG MonoX NeON 305W

Available Power: 305 W (AC power output)

Maximum Power: 223 W at NOCT* (PmPP)

*NOCT (Nominal Operating Cell Temperature): Irradiance 800 W/m², ambient temperature 20° C | 68° F, and wind speed 1 m/s

Power Tolerance: 0 ~3 +3%

Maximum Efficiency: 18.6%

Size: 64.57" x 39.37" x 1.38"

Weight: 39.96 +- 1.1 lb (16.8 +- 0.5 kg)

Warranty: 10-year product warranty, plus an output warranty of Pmax (measurement tolerance +- 3%), and linear warranty

Certifications/Listings: ICE 61215, IEC 61730-1/-2, UL 1703, ISO 9001, IEC 61701, IEC 62716

Additional Features:

- Among the lightest modules on the market, the LG MonoX NeON is over 11% lighter than previous models, allowing installation by one technician rather than two;
- A 60-cell panel design allows for high-efficiency output of up to 305 watts, with 18.6% module efficiency; and
- The double-sided cell structure allows the light reflected from the rear of the module to be reabsorbed, also generating additional power.

www.lgsolarusa.com



Lumos Solar

Product: LSX250 Series Frameless Module & Racking System

Available Power: 250 W to 260 W

Maximum Power: 260 W

Power Tolerance: -0/+3%

Maximum Efficiency: 15%

Size: 41.0" x 65.5" x 0.3" **Weight:** 63.9 lbs (29 kgs)

Warranty: 10-year materials and workmanship warranty; 25-year linear warranty

Certifications/Listings: TUV certified to the following standards: IEC 61215, IEC 61730, ANSI/UL 1703, CAN/CSA 61730, ULC/ORD 1703; CEC Listed

Additional Features:

- Unique through-bolt mounting feature increases the architectural appeal of the module;
- The 1/4-inch module-to-module spacing allows for easy sealing of the array;
- The 6 mm thick, fully-tempered glass frontsheet makes LSX the most impact-resistant module currently on the market; and
- The only module on the market to date to receive a Class 4 Hail Rating.

www.lumossolar.com





www.solar-frontier.com

SEE AD ON PAGE 33





Solar Frontier K.K.

Product: CIS Thin-film Module

Available Power: 150 W to 170 W

Maximum Power: 170 W

Power Tolerance: +10%/-5%

Maximum Efficiency: 13.8%

Size: 49.5" x 38.5" x 1.4"

Weight: 44.1 lbs (20 kgs)

Warranty: 25-year power warranty (5-year product warranty)

Certifications/Listings: UL1703 / IEC 61646 / IEC 61730; CEC Listed, FSEC, CEC-Australia, MCS; Certification for ammonia/salt-mist resistance; CE-mark Declaration; RoHS Compliance

Additional Features:

- Made in Japan, with more kilowatthours (kWh)/kilowatt-peak (kWp) than crystalline silicon in real operating conditions;
- CIS "light-soaking effect" increases power output after exposure to light;
- Temperature co-efficient of -0.31 %/K; and
- Factory binning: 0/+5W.
- www.solar-frontier.com



BenQ Solar (an AU Optronics Company)

Product: AC Unison PM250MA1

Available Power: 260 W to 275 W

Maximum Power: 275 W (DC); 238 W (AC)

Power Tolerance: 0/+3%

Maximum Efficiency: 17.1 % (DC); 95.7% (AC inverter peak efficiency)

Size: 38.70" x 64.53" x 1.57"

Weight: 48.50 lbs (22 kgs)

Warranty: 10-year material workmanship; 25-year performance guarantee

Certifications/Listings: UL 1741, IEC 61215, IEC 61730, UL 1703, CEC

Additional Features:

- AC module includes factory installed AC inverter for plug-and-play design; and
- CEC weighted efficiency is 95%.

www.benqsolar.com



Vikram Solar

Product: Eldora Ultima Silver Series (60 cells) Available Power: 250 Wp to 260 Wp

Maximum Power: 260 Wp

Power Tolerance: -0/+4.99 Wp **Maximum Efficiency:** 15.98%

Size: 64.6" x 39.1" x 1.6"

Weight: 40.8 lbs (18.5 kgs)

Warranty: 10 years workmanship, with a performance warranty of 90% for 12 years and 80% for 25 years

Certifications/Listings: UL 1703, CEC Additional Features:

• Engineered with Tier-1 module

- manufacturing;
- Low-temperature co-efficients;
- Best performance at different light Intensity at 15°, 25°, 37°, 45°, 60°; and
- Scored #1 in kilowatt-hour (kWh)/kilowattpower (kWp) production for third-party testing in 2014, against similar competing modules.

www.vikramsolar.com



JinkoSolar (U.S.) Inc.

Product: JKM300P-72

Available Power: 290 W 310 W Maximum Power: 310 W

Power Tolerance: 0~+3%

Maximum Efficiency: 15.46%

Size: 77.01" x 39.05" x 1.57"

Weight: 58.4 lbs (26.5 kgs)

Warranty: Comprehensive 25-year warranty

Certifications/Listings: UL product certified; entire module certified to withstand high wind loads (2400Pascal)

Additional Features:

- High module conversion efficiency (up to 16%);
- Perfect module self-cleaning capability, with reduced power loss caused by dust (soiling effect);
- Excellent performance in low-light irradiance environment; and
- Extreme environment durability, with low power degradation under high temperatures.

www.jinkosolar.com



TOPSUN Co., Ltd.

Product: Mono/Poly White/Black Module Available Power: 250 W to 260 W

Maximum Power: 260 W

Power Tolerance: 0~3%

Maximum Efficiency: 16.05%

Size: 64.56 " x 38.89" x 1.57"

Weight: 49.6 lbs (22.5 kgs)

Warranty: 30 years

Certifications/Listings: UL 1703, IEC 61215; Listed in CEC California

Additional Features:

- Tier 1 quality that's cost-competitive;
- Available in 60-cell, 72-cell, and 96-cell;
- Black bachsheet and black frame options; and
- Made in South Korea, with free antidumping and countervailing tariff.

www.topsun.kr





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: 55 lbs (24.94 kgs) Warranty: 25 years Certification/Listings: UL 1703 Website: www.1soltech.com



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Upsolar

Product: Tariff-free Module
Available Power: 310 Wp (260 Wp also available)
Maximum Power: 310 Wp (60 cells)
Power Tolerance: 0/+3%
Maximum Efficiency: 16%
Size: 77" x 39.06" x 1.96"
Weight: 59.5 lbs (27.0 kgs)
Warranty: 10-year product and a 25-year performance warranty
Certifications/Listings: IEC, UL, CE, MCS

Additional Features:

• Tier-1 BoM selection; and

• Completely tariff-free.

www.upsolar.com



Motech Industries, Inc.

Product: IM60 Photovoltaic Module

Maximum Power: 260 W

Power Tolerance: 0~3%

Maximum Efficiency: 15.9%

Size: 37.1" x 65.0" x 1.57"

Weight: 43.6 lbs (19.78 kgs)

Warranty: 25-year progressive linear power warranty, with 10-year material and workmanship

Certifications/Listings: UL1703, IEC61215, IEC61730-1, -2 (Additional international certification includes JET); Listing CEC, FSEC, and ACEC

Additional Features:

- 1000V UL certified, resulting in savings from more rapid and reduced labor installations, increase maximum system voltage, and improved system performance; 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.

SEE AD ON PAGE 2





EOPLLY USA INC.

Product: Poly/Mono PV Modules Available Power: 195 W to 280 W Maximum Power: 280 W Power Tolerance: 0 to +5 W Maximum Efficiency: 17.15% Module Size: 64.96" x 39.0" x 1.57"/1.99" Weight: 40.7 lbs (18.5 kgs) Warranty: 25 years **Certifications/Listings:** UL1703, IEC 61215, IEC 61730, with PID, salt, ammonia, and thresher certifications

Additional Features:

- Offered in 72-cell mono (off-grid) and 60-cell mono/ poly;
- Made with low potential induced degradation (PID);
- Made in Japan, tariff-free; and
- Swiss RE insurance available.

www.eoplly.us



Axitec, LLC

Product: AXIpower AC-300P/156-72S

Available Power: 300 W

Maximum Power: 300 W

Power Tolerance: 0-5 Wp

Maximum Efficiency: 15.46%

Size: 77.01" x 39.06" x 1.57"

Weight: 50.7 lbs (23 kgs)

Warranty: 25 years on 85% of nominal performance, and 12 years on workmanship

Certification/Listings: ETL US, ETL Canada, CEC, FSEC listed; Salt Mist Corrosion, Ammonia Corrosion Certificate

Additional Features:

- Offers 1000 Volt DC (UL), with a positive power tolerance;
- Micro-crack and hotspot free modules, with a 100 % electroluminescence inspection;
- Snow load of up to 50 psf; and
- High-quality junction box and connector system for a longer lifetime.

www.axitecsolar.us



Silfab Ontario Inc.

Product: Silfab Smart 60-cell Module

Available Power: 250 Wp to 285 Wp

Maximum Power: 285 Wp

Power Tolerance: 0 Wp to +5 Wp

Maximum Efficiency: 16.5%

Size: 45.7" x 40.0" x 1.50"

Weight: 41.9 lbs (19 kgs)

Warranty: 25-year power warranty, at 82% rated output

Certification/Listings: CEC, UL 1703, IEC 61215, and IEC 61730

Additional Features:

- Smart module technology, with integrated optimizers in junction boxes;
- Black-on-black modules;
- 1000 V Certified; and
- Canadian-made, with no tariffs

www.silfab.ca



Hanergy Holding Group Ltd.

Product: MS Flex-01W

Available Power: 200 W to 230 W

Maximum Power: 230 W

Power Tolerance: -0/+10 W

Maximum Efficiency: 15.9%

Size: 39.37" x 66.93"

Weight: <2.5kg/m2

Warranty: Five-year workmanship, with a 5-, 10-, or 25-year power warranty

Certifications/Listings: UL 1703, IEC 61646, IEC 61730

Additional Features:

- Lightweight and flexible; and
- Direct attachment to roof membrane.

www.hanergy.com



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Solarland USA Corporation

Product: SLP150S-12 High-Efficiency Mono-Crystalline **Available Power:** 150 W

Maximum Power: 150 W

Power Tolerance: +/- 5%

Maximum Efficiency: 15.7%

Size: 26.57" x 59.06" x 1.38" **Weight:** 26.5 lbs (12.02 kgs) **Warranty:** 25-year progressive power warranty, and a 5-year workmanship

Certifications/Listings: CE

Additional Features:

• Compact, lightweight design; and

Ideal for RV's.

www.solarlandusa.com



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 corrosionresistance, and suitable for seaside environments; and
- Self-cleaning, with an anti-glaring module surface.

Website: www.canadiansolar.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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Hybrid renewable energy installation at a home in Georgetown, Maine, featuring distributed wind and solar power (Photography by Will Lones of Pika Energy)

Slow and Steady The continued growth of distributed wind By Ben Polito

OFFSHORE AND LARGE-SCALE WIND FACILITIES have been dominating the renewable energy news, but distributed wind installations at homes and farms have grown significantly within the past decade. Homeowners are seeking new solutions to reduce utility bills and take control of their own energy needs.

Since 2006, hundreds of thousands of American families have taken advantage of the Federal Residential Investment Tax Credit (ITC) to install their own renewable energy systems. The ITC has driven innovation across the renewable energy industry, from technology breakthroughs, to manufactured cost reductions, to new financial products such as renewable energy leases.

One result of the ITC is that distributed wind is narrowing the gap on reaching cost parity with grid-sourced electricity. Continuation of the ITC beyond 2016 is vital to keep this promising, domestic-based industry on this cost improvement path.

Although the terms "distributed wind" and "small wind" can be used interchangeably, "distributed" better reflects that smaller-scale wind turbines are a form of dispersed generation that's net-metered and credited at retail rates. Because distributed wind operates in the shadows of the solar industry and utility wind power, many aren't necessarily aware of the strides the industry has made over the past decade.

Present size & scope

Of the 100,360 turbines sold in the United States between 2003 and 2012, 68% are small wind turbines (up to 100 kilowatts in size), according to the 2012 Market Report on Wind Technologies in Distributed Applications, prepared for the US Department of Energy (DOE) by numerous partners, including the American Wind Energy Association (AWEA) and the Distributed Wind Energy Association (DWEA).

In recent years, two separate certification bodies, the Small Wind Certification Council (SWCC) and the Interstate Turbine Advisory Council (ITAC), have introduced much-needed standardization and consumer protection to the industry. This parallels the increased focus on third-party quality testing in the photovoltaic (PV) module industry.

The dominant trend in renewable energy for the past five years has been the notable cost reduction of solar energy equipment, which has not been matched by manufacturers of distributed wind turbines.

The initial cost to deploy a small or residential turbine varies on numerous factors, but a capacity-weighted average cost per installation was \$6,960 per kW according to the DOE. The number is even less for US-made turbines, at \$6,510 per kW, yet it's still too high for broad market penetration in the absence of incentives.

Future depth & growth

Despite their conceptual simplicity, small wind turbines are more expensive than comparable products of similar size: for example, a residential wind turbine is 10 times more expensive on a per-pound basis than a riding lawn mower. If turbines were manufactured and marketed as efficiently as lawn tractors, they would sell for \$0.46 per watt—less than the cost of imported PV modules.

To spur more growth in residential wind, manufacturers clearly have to drive down costs. Component-level innovations, designs that enable better manufacturing methods, and system-level issues that reduce installation time and cost all are needed to achieve parity with other energy costs. Innovations that increase performance and reduce maintenance also will contribute, as will technology that enables homeowners to integrate solar solutions into their home energy network to create an affordable hybrid energy solution. Turbine manufacturers are working on all of these issues, but they require investment in research and development (R&D).

The National Renewable Energy Laboratory has played a key role in recent R&D advancements in distributed wind through its recent Competitiveness Improvement Project (CIP). The CIP was developed to help the US wind industry develop competitive, high-performance technologies needed to compete in the global distributed wind market, and to lower the levelized cost of energy (LCOE) so that it can compete with retail electricity rates.

By far, the biggest factor that has driven the US renewable energy industry forward is the availability of incentives and tax credits, including the residential ITC. The ITC enables homeowners to deduct from their taxes 30% of the capital cost for renewable energy systems, such as for wind and solar power. Homeowners can fund their installation in smaller increments (say, installing a wind turbine one year, and solar equipment the next) and earn the 30% credit in each year.

The game-changing effect of the ITC is just as clear for distributed wind as it has been for solar. Since the Residential ITC was implemented in 2006, distributed wind projects have received close to \$63 million in credits. This represents approximately \$220 million in capital investment in the United States, according to the DOE. Distributed wind energy capacity has increased by more than 24-fold since 2003, according to AWEA. By comparison, solar installations have grown more than 1,600% in the country over this time period, according to the Solar Energy Industries Association (SEIA).

The ITC is good for homeowners, for US manufacturers, and for the US economy. It gives homeowners a significant incentive to choose the renewable technology that's best suited to their environment and their needs. It also enables manufacturers to make the investments that drive technological innovation. This effect is most striking in the distributed wind industry, where domestic sales from US small wind suppliers rose from 80% of the market in 2011 to 86% in 2012, according to the DOE report. And the ITC creates jobs: According to The Solar Foundation's 2013 National Solar Jobs Census, solar industry employment grew by 53% between 2010 and 2013, to more than 142,000 jobs. Wind power accounted for more than 80,000 jobs in the US, according to AWEA.

The ITC is set to expire at the end of 2016. Now is the time to ensure its renewal, so that US renewable energy manufacturers can plan on making the investments needed to drive the market forward, create new jobs, and better secure our energy future.



Ben Polito is president and co-founder of Pika Energy, which develops a new generation of cost-effective wind and solar energy technologies. Pika Energy recently received two CIP grants from the National Renewable Energy Laboratory to develop new processes, which will lower the cost of distributed wind.

Pika Energy | www.pika-energy.com

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To Test or Not to Test Evaluating small & medium-sized wind blades By Daniel Valyou, Kerop Janoyan & Pier Marzocca



A DOE SANDIA blade, manufactured by TPI Composites, undergoes static testing at the Clarkson University CECET BTF. The static test cell loads the blade at multiple locations simultaneously to match the applied load to the blade's maximum design load, which is the maximum load seen by the blade during operation.



Here, a blade goes through fatigue testing. The fatigue set-up allows the blade to be tested in one or two directions simultaneously (force-displacement test, one-direction loading is displayed in the photo), with *hydraulic actuators—so as to reproduce the cyclic* loading seen after 20 years of operation.

TO TEST OR NOT TO TEST: that is an important question when it comes to the powerful blades of a wind turbine. The answer might seem obvious when considering the massive scale of utility wind blades—and, when turbine downtime equates to lost revenue. Reliability and resiliency are keys to successful energy generation, after all, and a project owner's return-on-investment (ROI).

But what about for smaller-scale projects? As technology attempts to keep up with larger and larger projects, it seems many of the test methodologies developed are perceived to be too costly or unnecessary for smaller blades. For one, some believe there's an overall reduced risk of damage or injury from smaller turbines. Furthermore, it's been noted that as wind turbines grow in size, their blades become longer and more flexible, making it imperative to test them for endurance. At the same time, there's sometimes an assumption that smaller blades are stronger and more lightly loaded than utility-scale ones, meaning testing might not be quite so imperative.

This begs more or less the same questions: Is it really worthwhile to proactively perform third-party structural testing? Or, is the bare minimum acceptable in terms of testing smaller turbine blades?

Weighing the facts

Wind turbine blades have the highest failure rate among all turbine structural and mechanical components. When it comes to larger turbines, which are generally operated by energy companies and subject to the regulatory scrutiny of the industry at large and the Occupational Safety and Health Administration (OSHA), testing becomes equivalent to a good and sensible business practice. Companies producing utility-scale turbines have a lot more money invested in their turbine designs and, therefore, a lot more to lose from a single, possibly highly publicized failure. As a result, they are much more likely to selfregulate their products and have the capital to invest in rigorous testing programs.

Small turbines are often operated by homeowners and small businesses, and are becoming more popular with some energy suppliers in a distributed wind format to address the needs of communities and municipalities. Even though there are more of them, these turbines simply don't receive the same level of attention and scrutiny that their larger counterparts do. For the most part, small wind manufacturers don't have the same level of capital to invest in test facilities and have, in the past, compensated for this by greatly overbuilding their blades. Moreover, larger wind testing facilities have found that it's just not cost-effective for them to test blades less than 25 meters long.

Unfortunately, this increases the risk of a poor design reaching the market, and the risk of poor maintenance by the operator—thereby, increasing the loads on the turbine itself, which can lead to structural failure. This not only hinders the market through bad design and workmanship, but also by risking public opinion. In an effort to remain competitive, some manufacturers have begun designing blades out of advanced materials that are lighter and more geometrically complex. This sounds great in theory, but it also

makes these blades more difficult to built and sustain the minimum load requirements.

Taking action

It would seem like a given to provide customers with quality products that have quantitatively demonstrated reliability. Accredited, certifiable third-party structural wind blade testing provides this safeguard, and inspires consumer and investor confidence by adequately and accurately demonstrating product reliability.

Although this hasn't always been the case for smaller sized turbines,

Did you know?

To appeal to customers and manufacturers, the New York State Energy Research and Development Authority (NYSERDA) offers end-user incentives, designed to help locals explore wind power as a clean, cost-effective alternative to some or all of their purchased electricity (learn more at www.nyserda.ny.gov/ Energy-Efficiency-and-Renewable-Programs.aspx).

consumer demand is slowly changing that in the wind industry. Distributed wind power is beginning to make a strong impact by bringing together small and medium-size turbines, which range from backyard-sized residential turbines to turbines capable of providing significant power for a municipal facility, large farm, or manufacturing complex.

According to the Department of Energy (DOE), between 2003 and the end of 2013, a total of 842 megawatts (MW) of wind turbines were installed in distributed applications, reflecting nearly 72,000 units. Individuals and groups purchasing large quantities of these turbines are now expecting higher levels of product quality, along with safety assurance to protect their investment.

The Distributed Wind Energy Association (DWEA) and the DOE's Wind and Water Power Technologies Office are investing in processes to make this possible, and technical standards are currently being developed and implemented to ensure consistent certification.

To this end, manufacturers need to prove their technologies have met rigorous standards by performing third-party testing in laboratories, which ensure current and continuously evolving standards are met. Aside from offering buyers reliability, this allows manufacturers to move their products more swiftly to market, without the need to develop their own testing equipment or methodologies. It also means they can save time and avoid analyzing complex test data to determine if their product meets current regulatory requirements.

Third-party testing possesses another hidden benefit, as well. If a certifying agent performs a test, for example, it's often considered a conflict of interest for that certifier to provide analysis and/or recommendations for product improvement. Therefore, a thirdparty test lab can provide test data and analysis to a manufacturer and the certifier. The lab could perform a variety of testing, including: modal analysis to evaluate natural frequencies, structural damping and mode shapes; static testing in any direction (by applying loads at multiple locations); fatigue testing in one or even in two directions simultaneously; post-fatigue residual strength testing; and test to ultimate loading.

But, they can also offer additional services, such as design analysis, material characterization, and product improvement recommendations to the manufacturer as part of a test program. The test data and such a detailed analysis allows manufactures to validate and refine their design models and processes, improving product reliability and cost, while locating design and manufacturing process improvements: a win-win for manufacturers and potential purchasers/customers.

Testing standards

It's worth noting that testing does take time though, even for smaller blades. A complete test for an eight-meter, conventional wind turbine—from test design to report delivery to the customer—typically takes four to six months. The blade testing itself takes approximately three months (including fatigue test, which tests the full 20-year lifespan of a blade in an accelerated fashion).

For a smaller blade, under eight meters long, the minimum certification test can be conducted in as little as 30 days, and is roughly 1/10th the cost of a larger wind turbine blade certification. Such testing and certification can be used by manufacturers to market the benefits of their products, as well as to improve product standards and quality.

So, to return to the original question: to test or not to test. It would seem that if it is of utmost importance to provide customers with wind energy products that possess demonstrated reliability, then the answer is a clear and resounding "yes."

As we move toward a more highly competitive distributed wind energy market, requiring the most qualified and reliable products, third-party structural testing is moving rapidly from a nice-to-have to a must-have.

The Center for Evaluation of Clean Energy Technologies Blade Test Facility (CECET BTF) is operated by Clarkson University, in cooperation with Intertek—a unique, state-of-the-art facility created to address the market need for independent structural testing services. The facility also leverages collaborations with the National Renewable Energy Laboratory (NREL), government agencies, national and international universities, and testing equipment supplies. Intertek provides a direct link to wind turbine certification services to all current test standards, including IEC, AWEA, and MCS.

The Center for Evaluation of Clean Energy Technologies (CECET) | www.intertek.com/energy/renewable/cecet

Clarkson University Blade Test Facility (BTF) | www.clarkson.edu/btf

Optical ground wire

AFL is adding to its Optical Ground Wire product line by introducing Renewables' Optimized Optical Ground Wire (OPGW), an aerial fiber-optic cable that's specifically designed for the renewable energy markets, including for wind and solar projects. OPGW allows for greater ease and flexibility in installation timelines, while providing excellent electrical and mechanical properties. AFL's OPGW is to be placed at the topmost position on transmission lines to shield conductors from lightning and, at the same time, provide a fiber-optic communication pathway.

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Wind Turbines and Your Health Assessing electromagnetic fields

By Melissa Whitfield Aslund, PhD

As an alternative to fossil fuels, wind power offers a clean, renewable resource that produces no greenhouse gas emissions during operation. The effects on the environment are much less than those from traditional power sources. A single wind turbine alone can power 500 homes or more.

This year, wind power installations are predicted to climb to a record number, according to The Global Wind Energy Council, thanks to resurgent North American demand and growth in developing nations.

With the surge in wind power development, however, health issues have become a concern for many of those living near wind farms. There's a growing list of self-reported health symptoms that some individuals attribute to wind turbines, specifically with respect to audible noise, low-frequency noise and infrasound, as well as shadow flicker and electromagnetic fields (EMF). Symptoms reported include (but are not limited to): difficulty sleeping; fatigue; depression; irritability; nausea; headaches; and vertigo.

Although the relationship between these health issues and audible noise, low-frequency noise, and infrasound has been investigated elsewhere in the scientific literature, limited research has been conducted to date with respect to EMF and wind turbines.

Therefore, in response to concerns that have been raised by some about the possibility that wind farms could negatively impact human health by increasing residents' exposure to electromagnetic fields (EMF), a group of scientists have published a study* that reports actual EMF measurements collected in the vicinity of operating wind turbines and other relevant infrastructure.

Their research shows that levels of EMF around operating wind turbines are actually lower than anyone might have expected.







Figure 1. Magnetic fields measured at various distances (log scale) from wind turbines under three different operational scenarios. Mean magnetic field values have been provided (n = 11) in milligauss (mG). Error bars represent standard error of the mean. The three operational scenarios include: turbines generating power (high wind); turbines not generating power but still connected to the power grid (low wind); and turbines and collector lines shut off completely (no wind).

Figure 2. Comparing magnetic fields around wind turbines and a 500 kV transmission line. Mean magnetic field values have been provided (n = 11) in milligauss (mG). The "high wind" turbine scenario is presented where conditions were sufficient for power generation.

Figure 3. Comparison of the maximum EMF measured at turbine base with common household devices, and the International Commission on Non-Ionizing Radiation Protection (ICNIRP) guideline for the protection of general public health.

The study

This study was carried out at the Kingsbridge 1 Wind Farm, located near Goderich, Ontario, in Canada. Magnetic field measurements were collected in the proximity of fifteen, 1.8-megawatt (MW) wind turbines, two substations, as well as various buried and overhead collector and transmission lines, and nearby homes.

EMF measurements were taken at distances ranging from 0 meters to 500 meters from turbines under three operating conditions: high wind (generating power); low wind (drawing power, but not generating power); and shut-off (powered down completely, and not drawing power).

Measurements were also collected in the vicinity of other electrical infrastructure associated with the wind farm (collector lines and substations), a 500-kilovolt (kV) transmission line, and outside of a number of local homes in the area.

Notably, magnetic field levels detected at the base of the turbines under both the "high wind" and "low wind" conditions were only slightly higher than background, and rapidly diminished with distance—becoming indistinguishable from background within two meters (see Figure 1).

Magnetic fields measured above buried collector lines were also not distinguishable from background readings (i.e., ≤ 0.3 milligaus). Beneath an overhead 500 kV transmission line, magnetic field levels of up to 46 milligaus (mG) were recorded; however, these levels also diminished rapidly with distance (see Figure 2).

Interestingly, none of these sources appeared to influence magnetic field levels at nearby homes.

The results

Although the magnetic fields measurements taken at these wind farms weren't distinguishable from background ones, perhaps, what's most interesting is the comparison. For instance, all of the magnetic field levels measured in the vicinity of the

wind turbines were actually much lower than those produced by many common household electrical devices.

Additionally, they were far below any existing regulatory guidelines with respect to human health (see Figure 3).

These results suggest that there's nothing unique to wind farms with respect to EMF exposure or human health. In fact, magnetic field levels in the vicinity of wind turbines were lower than those produced by many everyday household devices.

Overall, these results do not support a potential causal link between power-frequency EMF and human health impacts at the low levels measured in the vicinity of the wind turbines.

* Scientists from Intrinsik Environmental Sciences in Ontario, Canada, have published this openaccess study in "Environmental Health" (McCallum et al., Environmental Health 2014; 13:9). The full text is available online at www.ehjournal.net/content/13/1/9

Dr Melissa Whitfield Aslund currently holds a position at Intrinsik Environmental Sciences as a scientist at their Mississauga office. She has a PhD in Environmental Science (Chemistry) from the Royal Military College of Canada, and an undergraduate degree in Math and Biology from Queen's University.

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Far Left: Verizon telecom site, which is wind-powered and completely off-grid, is located in Bear Mountain California

Left: A community wind site under construction in St. Maarten in the Caribbean

Sourcing Renewables In remote regions across the globe

By Ryan Gilchrist

From the icy north to the tropics, remote locations across the Americas have slowly begun reducing their dependency on fossil fuels and incorporating renewables into their infrastructure.

The rising cost of diesel is impacting the international market for distributed renewable energy, now more than ever before. In remote communities that have no access to the grid, diesel generators have typically been used to meet local energy demands—but that is all beginning to change. Governments and privately held enterprises across the globe are beginning to realize the benefits of diversifying their energy supply and reducing their dependence on the rising price of fossil fuels.

Powering Alaska

In Alaska, there are many small, isolated villages that rely on expensive, imported diesel to power their infrastructure, combusting thousands of gallons of the polluting fuel every year. Each gallon of diesel can cost up to \$10US. And, that doesn't touch on the environmental costs of such generators.

On the upside, Alaska's communities and corporations are uniquely positioned to take advantage of renewable energy development opportunities due the abundant land and



natural resources in the region. The local environment, along with favorable federal tax incentives and public policy, has been accelerating the adoption of cleaner, alternative power sources. Back in 2008, the Alaska state legislature established the Renewable Energy Grant Program to provide assistance to utilities, independent power producers, and local governments to deploy more wind and solar power projects in the state. The bill allocates up to \$50 million annually for renewable energy, at least until 2023.

The grant program has been successfully implemented in some projects, decreasing some reliance on diesel fuel. For example, the grant has been used to install a 600-kilowatt (kW) wind farm that, since its installation in 2009, has generated 2.8 million kWh of energy and has offset an estimated 212,000 gallons of diesel. However, the challenge of sizing and creating these renewable energy projects, as well as access to the grid, has slowed their development and installation.

Invested parties and renewable companies have been breaking down such barriers by performing various site analysis, and measuring how well smaller scale wind or solar system can be expected to perform in conjunction with a given area's available resources and grid capacity. By customizing modular renewable systems in remote regions, it's possible to tailor a project's capabilities to produce the maximum amount of renewable energy in any given environment.

Alaska's costly electricity rates, diesel generators, rising air pollution, and surplus of renewable resources, have made distributed wind (and solar) powered micro-grids the logical next step. Rather than size or capacity, however, the Department of Energy defines distributed wind based on a turbine or wind plant's location relative to end-use and the power distribution infrastructure. Accordingly, a distributed wind system can range in size from a five-kilowatt turbine at a home to a multi-megawatt turbine at a manufacturing facility (read more at http://energy.gov/eere/wind/distributed-wind).

In remote locations—such as in parts of Alaska that don't have access to the grid—a micro-grid can operate independently, and help serve as a scaled down version of the traditional power grid—making it ideal for renewable distributed energy sources.

The Caribbean climate

The Department of Energy's National Renewable Energy Laboratory has also been working with the Department of the Interior to implement the Remote Community Renewable Energy Partnership, which sets out to displace 75% of diesel fuel in the cirumpolar north for heat and electricity. It also intends to reduce diesel fuel usage for electricity by 75% (including cooling) in the tropics. Along with these government agencies, private corporations and investors are aiding in the process to develop modular wind and solar energy systems that will work in isolated communities all over the world.

At the same time, diesel generators are proving to be a burden more than a blessing on small island nations, particularly when it comes to the cost. In the Caribbean, for instance, the price for imported oil and diesel is four times higher than US electricity rates. Importing fossil fuel overseas results in an increased tax because of the time and resources that go into transporting it.

Producing energy onsite is favorable for island nations because it eradicates the import tariff, and has a fast financial payback. The high cost of diesel also leads to capitalistic challenges, as Caribbean companies pay higher rates for their electricity, affecting their ability to compete with US counterparts in the same industry, who pay much lower rates for the same amount of electricity.

The Caribbean Development Bank (CDB) is promoting new initiatives to attract investment into the green energy and climate resiliency projects in the region. The CDB's 27-member countries understand their vulnerability to climate change, as well as the economic incentive to investing in distributed renewable energy. As it is, many outdated generators in these locations need to be replaced in the coming years. To replace them with diesel would only result in more unreliable and ever-increasing electricity bills, and more pollution.

The Caribbean appears to be on its way to a more prosperous, environmentally friendly economy. This should only increase their competitiveness in the global market space, without the disadvantage of astronomical electricity rates. For example, in Barbados, almost 50% of the island's homes utilize solar water heaters on their rooftops, with a financial return-oninvestment (ROI) of less than two years.

Tax incentives for green businesses and consumers are currently driving the market, facilitating the installation of microgrids and renewable energy systems—and not just solar power systems. The island's year-round trade winds also serve as a quintessential option for clean, onsite energy production.

Barbados isn't the only Caribbean island taking the initiative to diminish its reliance on diesel. Aruba has made great strides to completely eliminate fossil fuels by setting out to adopt 100% renewable energy in the coming years. The island currently has enough installed renewable capacity to cut its oil and diesel imports in half, saving \$50 million a year. Plus, Floreana Island in the Galapagos and El Hierro in the Canary Islands have already made the transition to 100% renewable energy.

Alaska and small island nations are just a smaller piece of the larger international puzzle making the shift toward distributed energy. Developing countries, including Africa, India, and the Middle East, which lack existing grid infrastructure, are also beginning to tap into the power of microgrids and renewables. Note: A news broadcast featuring an off-grid house in Alaska, utilizing vertical-axis wind turbines is available for viewing at this link: www.ktuu.com/news/news/Anchorage-Homes-on-Energy-Efficiency-Tour-Show-Savings/26430034

Ryan Gilchrist leads Urban Green Energy's (UGE) Enterprise Division, delivering clean energy solutions for commercial clients.

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Sound Effects Securing noise emission measurements from turbines By Payam Ashtiani

WIND POWER IS ON THE RISE in North America. According to the American Wind Industry's (AWEA) recently released Second Quarter Market report, 15 wind energy projects have been completed and gone online since the start of the year, adding 217 megawatts (MW) in the first quarter and 619 MW in the second quarter. Installed wind generating capacity in the United States, as of the end of June, stood at 61,946 MW (www.awea.org).

According to the Canadian Wind Energy Association (CanWEA), Canada's wind power industry has also been growing. In fact, 2013 was a record-breaking year for wind energy development in Canada, with new installed capacity from 23 wind energy projects totaling nearly 1,600 MW—ranking the country fifth, globally, for new installed capacity. By next year, CanWEA expects wind power in Canada to exceed 10 gigawatts (GW).

As the number of wind farms continues to grow, however, so does the public's interest in the impact to the environment and health of the surrounding land. Although some members of the community welcome renewable energy and alternatives to fossil fuels, others require more information and assurances about the safety of harnessing wind.

With the mounting public interest in wind power, there's a growing demand for precise acoustical data from all sides. Across Canada and the US, wind farm noise regulations are



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moving toward post-construction monitoring in the years after a facility begins operations. Since measuring turbine noise is technically complicated, the post-construction measurement methodology can highly impact the results of a given study. To minimize the risk to developers and operators of wind facilities, acoustic engineers and layout designers have to be cognizant of the measurement methodology to ensure compliance after construction.

One example of the variation of post-construction noise monitoring protocols can be found in Vermont. After a permit has been issued, each project presents a methodology for these measurements—at which point, the facility layout can no longer be changed, but the agreed upon methodology can. This results in risk to developers, whose projects may be tested against something that weren't accounted for in the initial design.

In Ontario, the Renewable Energy Approvals is now required by law for renewable projects, and includes acoustic audits of wind turbine noise emissions at the source, in addition to points of reception. These new requirements are much more extensive than developers might assume, and are fully explained in detail as part of a company's "permit"—called the Renewable Energy Approval (REA).

There are three categories of requirements:

- 1. Transformer Substation Audit: The noise output of the transformer;
- 2. Acoustic Emission Audit: The sound leaving an individual turbine; and
- **3. Acoustic Immission Audit:** The sound hitting the dwelling from all the turbines in the facility.

Noise assessment testing

Prior to going into the field, acoustical engineers will review site plans and examine wind directions, as well as the proposed project's proximity to ambient sources of noise, such as highways, bodies of water, or industry. For the acoustic immission audit, data gathered during the day generally doesn't work well for analysis because of increased noise from ambient sources, such as traffic and fauna. Therefore, tests are usually conducted at night, particularly when measuring the transformer substation.

The purpose of the transformer audit is to ensure the noise output remains in compliance on site. Once equipment is installed in the field, it can be difficult to make changes, so completing an acoustic emission test at the manufacturer's facility and before the transformer is shipped is recommended. If problems appear in the test, it's generally easier to seek a remedy before the equipment is moved. This process can save time, money, and potential regulatory hurdles down the line.

Once delivered to the project site and operational, noise measurements are taken again near the dwellings to ensure the sound level limit is still satisfied. Testing involves taking several sound-level measurements surrounding the transformer, and using these measurements to calculate the envelope of sound being emitted by the transformer. Sound emissions are, then, quantified.

As per the Ontario Ministry of the Environment's specifications, in CAN/CSA-61400-11 and IEC 61400-11, a microphone must be installed on a reflective surface at ground level, with a large windscreen placed over a smaller windscreen. This helps to help reduce false low-frequency readings caused by high winds when testing noise levels.

Testing turbine sounds

When examining the sound leaving an individual turbine, tests involve detailed measurements of a select sample. Engineers take synchronized measurements of sound and power output. Typically, the manufacturer is required to be involved to ensure the turbine parameters are met. These are attended measurements, and can take up to three windy days per turbine to complete.

Immission audits at the receptor are unattended, with noise monitors placed in two or three locations for a period of approximately two to three weeks. Noise measurements are carried out simultaneously with wind measurements at the same location.

Unfortunately, accurate testing requires that certain turbines in the vicinity of the measurement location be shutdown for a few nights to assess the ambient noise level. As a result, the audit can be costly in terms of potential lost revenue during windy, high-period production times. One of the key challenges to performing noise assessment tests is to determine the contribution of operational wind turbines with the highest degree of accuracy possible.

The following are a few things to consider for the most accurate results...

• **Plan wisely.** Ideally, it should take three to four weeks to complete receptor measurements. However, if not planned properly, it could take months. Avoid testing during the

summer, and instead plan for the spring or fall because winds tend to be more consistent and strong during these seasons. The leaves on trees have either not yet bloomed or have already fallen, so ambient noise from wind blowing through them is minimized. The summer also brings more noises from small creatures, such as crickets and frogs.

- **Consider operations.** Before testing, ensure the wind plant is not only fully operational, but also running smoothly. Many companies prefer to have the noise assessment testing done as soon as a plant is online. But operational issues in the early stages may negatively affect the noise audit. It takes time to test and ensure all of the turbines are working properly. If one turbine isn't working, it can delay the entire process.
- **Ensure quality.** As wind turbine noise is a sensitive issue, supplying trusted, high-quality, unbiased technical measurements to developers, operators, and manufacturers is of utmost importance. In the event of any noise issues with a turbine, precise acoustic measurements from an accredited organization are required for warranty claims against a manufacturer.

Even after noise testing has been successfully completed, a wind farm might be subject to re-testing. Depending on the province, and what's stipulated in the contract, it might be necessary to test again within the first two years. Some regulatory bodies require testing every five, 10, and 15 years. Plus, this timeline may be altered by a noise complaint, which could lead to year another required round of noise immission testing. Nevertheless, such measurements can go a long way to ensuring a longterm, successful wind farm.

Payam Ashtiani, BASc, PEng, is a noise and vibration consultant and principal with Aercoustics Engineering Limited. His experience includes wind farm noise modeling, prediction, measurement methodology, and data processing with various wind farms, and he has authored multiple research papers on the topic.

Aercoustics Engineering Limited is a Canadian engineering firm, specialized in acoustic design, noise, and vibration control. Aercoustics recently became the first organization in Canada to become an ISO 17025:2005 accredited lab to conduct IEC 61400-11 measurements—an international accreditation for noise testing of wind turbines.

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Energy needs

As times have changed and the need for cleaner, alternative forms of energy has become not only more evident, but also more accessible, the Doody's haven't missed a beat. With the amount of energy their dairy farm consumes each month, they knew a renewable energy system of some type would serve them well. The only question was: what type?

After attending a community open house, hosted by Cazenovia Equipment Company (CEC) in April of 2010, Edward Doody discovered that the farm's site had one of the



Left: The Doody's family dairy farm operates in Tully, New York, and is now powered with a single-phase wind turbine

Above: Dairy farmer, Edward Doody, is protecting his farm against escalating energy costs with a 50 kW wind turbine—it produced 2,000 kilowatt-hours (kWh) of power within its first week of operation

As long-time small business owners, Lawrence and Avis Doody have taken notice over the years of the rising costs of their day-to-day expenses, and the ever-increasing price of energy has been no exception. Back in 1949, the couple founded a dairy farm in Tully, New York, which they've since handed over to their son, Edward, along with his brothers Kevin and Rich.

Energy certainly doesn't come cheap in New York. In fact, compared to the rest of the United States, energy costs rank among some of the highest. According to the Energy Information Administration (EIA), New York had the fourth highest average electricity prices in the country in 2013—and they're still increasing. Up from the same time last year, electricity prices averaged 19.6 cents per kilowatt-hour (kWh) in the New York/ Northern New Jersey/Long Island areas in April of 2014, based on a report from the US Bureau of Labor Statistics.

The Doody Family Farm consumes approximately 15,000 kWh per month. Lighting and heating for 400 cows, plus the essential milking process, consumes most of their power requirements.

Over the past couple of decades, the Doody's have implemented several changes on their farm—not only as cost-saving measures, but also as a means of sustainability. Environmentalists at heart, it's always been important to the family to ensure their farm runs as efficiently and as eco-friendly as possible. As a result, the Doody's have



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highest wind regimes among all the attendees—12.4 meters-per-second (m/s), and an annual average wind speed of 5.58 m/s.

It was clear: the next logical step on the journey toward sustainability for the farm would be the installation of a wind turbine. Not only would wind power help secure the family from rising energy costs, but it would also fit with their model of conservation.

After much discussion, including research on the various incentives available to the Doody's through the US Federal Government and the State of New York, Edward knew that purchasing a wind turbine would be the next best thing he could do for his family. Based on the farm's energy consumption requirements, it was decided that a 50 kW wind turbine would offer the best match in terms of productivity.

Today, the Doody Farm sports a single-phase electricity supply, with what's currently the largest singlephase wind turbine on the market. Within its first week of going online, it produced 2,000 kWh. NYSERDA, the New York State Energy Research and Development Authority, funded 35% of the Doody's turbine project.

So far, the Doody's have been impressed with their turbine, and are looking forward to energy production well into the 100,000 kWh range—with projections based on their 5.58 m/s average annual wind speed.

It seems Edward's mother, Avis, is the turbine's biggest fan. In fact, the 86-year-old regularly checks the remote interface, an online tool that shows a live, energy production feed of the turbine's energy production on the farm.

Although since the installation, Edward Doody has been quite pleased with turbine himself. "Our neighbors are happy to see it, and many honk their car horns as they drive by," he shared. "Plus, we regularly have passers' by take pictures."

Endurance Wind Power is a manufacturer of advanced wind turbines, designed specifically for distributed wind power applications. The company's E3120 50 KW turbine was successfully installed, and continues to perform well in the Lawrence Doody and Sons LLC, Dairy Farm.

Endurance Wind Power Inc. www.endurancewindpower.com



Axial excluder seals

The new SKF axial excluder seal provides a high-performance alternative to conventional rubber seals for protecting wind turbine main shaft bearings from contaminants. Ultimately, the seal represents an advanced first line of defense against any debris or contaminants the wind may carry, helping wind farm operators significantly reduce the risks of contaminant-related bearing failures—as well as the high costs of associated unplanned downtime, repair, and lost productivity.

Unlike conventional rubber seals typically prone to excessive wear and subsequent failure, the SKF axial excluder seal (designated HRC1) is manufactured from a proprietary SKF polyurethane material, exhibiting excellent resistance to wear, abrasion, UV radiation, and ozone. Early field trials confirmed the HRC1 seal's performance levels and robustness. Seals installed on 40 separate 2.5 MW turbines operated continuously under real-world conditions and, after three months, an initial inspection revealed only normally expected run-in wear—with no dramatic changes six months later. HRC1 axial displacement seals are available in standard solid and split versions for shaft sizes from 1 m to 3 m, with options for custom solutions. **SKF USA Inc.** | www.skfusa.com



Online asset management tool

Emerson's Power Transmission Solutions introduces the industry's first online tool for tracking the location, life history, and latest revision drawings and installation instructions for all critical drivetrain couplings owned by customers—whether installed or in spares inventory. Ideal for turbine generators, the Asset Management Program (AMP) is a web-based tool for couplings that: accurately identifies couplings; graphically displays the location in a specific drive; identifies parts/couplings at a site that are interchangeable; ensures assembly drawings are only a click away; and gives a detailed service history and action to be taken during service intervals.

Developed by a global engineering team experienced in coupling design, maintenance, repair, and troubleshooting, Coupling AMP has been carefully built to categorize, display, and log information in the exact same way plant engineers work with and visualize it. The custom graphics also display specific drive configurations for rotating equipment. By clicking on a coupling, AMP opens a "coupling card" with all related information, including records on customer training and service reports. **Emerson** | www.emerson.com



Small has never been bigger.

Not every job calls for a Goliath sized solution. The Compact Filter Unit provides you with the best filtration at a size you can take *and* leave anywhere. Perfect for when space is limited or when you've got multiple places to be. And with a range of elements for any job, you can rest easy knowing you won't be changing that gearbox oil any time soon.

www.hyprofiltration.com/CFU



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- Make confident energy scheduling and trading decisions with our renewable energy forecast services

Vaisala is your renewable fuel expert! Visit our web site to learn more.

www.vaisala.com/renewable



Carbon brushes

Morgan Advanced Materials Electrical Carbon business' range of carbon brushes are now offered with new designs and materials, resulting in longer brush life and increased generator uptime. Ideal for wind turbine applications, Morgan's brush grades are created to be environment-specific, offering maximized performance in low or high-load conditions. Leading-edge laboratory equipment, coupled with years of experience in carbon brush technology, has led Morgan to develop advanced materials to address the environmental extremes experienced by wind turbines, including scorching heat or corrosive sea salt. The brushes are also engineered to deliver high performance in low-humidity atmospheres, a common environmental factor affecting many wind farms. In addition to being able to endure extreme atmospheric conditions, Morgan's range of carbon brushes are tolerant to contamination and provide an excellent lifespan with minimal slip ring wear and a low brush-to-brush wear differential. **Morgan Advanced Materials** www.morganadvancedmaterials.com



Tower alignment tool

Equalizer International, global expert in flange maintenance tools, offers the TFA15TI Wind Turbine Tower Alignment tool. This is an integral hydraulic alignment tool that has been developed to aid the alignment of large flanges on the inside of wind turbine towers. Much like all Equalizer products, it's designed to make work easier, in this case ensuring the assembly and installation of wind turbine tower sections can be done safely and efficiently.

Wind turbine towers are made up of pipe sections with internal bolted flange connections, and sometimes during fabrication these sections can become "ovalized." This can result in misalignment of the bolt holes, so assembly becomes slow, difficult, and more dangerous. The new TFA15TI addresses these misalignment issues, offering an innovative approach to an industry challenge.

Equalizer International www.equalizerinternational.com



Low wind-speed turbine

AMSC has announced the availability of its newest wind turbine design. The 2 MW wind turbine has a rotor diameter of 113 meters and a swept area of 10,039 square meters, making it an ideal wind turbine for low windspeed regions. AMSC has also successfully completed the A-Design Assessment, according to the latest GL2010 onshore guideline, for its 2 MW wind turbine design with 93-meter and 100-meter rotor. Low wind-speed turbines open up new markets in regions that are already saturated with wind farms, and can also be located close to population centers.

AMSC's new, low wind-speed turbine is expected to lower cost of energy by as much as 12%, compared to previous AMSC designs, increasing its competitiveness with traditional fossil fuels. The turbine is available for all climate conditions and various hub heights. It's also available with doubly-fed and full conversion drivetrain architectures, as well as with the proven and certified AMSC grid support solutions—such as low-voltage ridethrough capability and wtWPC wind park controller for grid integration, both of which enable enhanced power quality and reactive power support. **AMSC**

www.amsc.com

www.amsc.com/documents/wt2000-data-sheet



Aerodynamic turbine blade

Suzlon Group announced that it has successfully completed the production of its first blade for its best-in-class S111 2.1 MW turbine. The S111 is a technologically advanced product of the S88 and S97 2.1 MW family. This product has been specifically designed for Suzlon's next-generation 2.1 MW turbine, and is engineered to deliver a 62% increase in annual energy production (AEP) at a 120-meter hub-height (compared to Suzlon's S88 wind turbine model). The blade is designed to harness the optimal available wind resources and deliver higher energy productivity, which in turn ensures a higher returnon-investment (ROI) to customers.

Measuring 54.8 meters in length (that's ~80% longer than one wing of a Boeing 777), the blade is the longest and cleanest aerodynamic profile Suzlon has produced to date. This milestone has been achieved due to an effective integration between the product design, the production unit, and the tool design. The turbine design makes it ideal for low-wind sites in growth markets, such as the United States. **Suzlon Group** | www.suzlon.com



Impact bolting gun

HYTORC has released the Z-Gun, the first precision impact bolting gun available worldwide. This gun offers extremely fast rundown speed and unmatched torque output accuracy, which allows it to safely and effectively complete almost any industrial bolting job. It fills a major gap in the wind energy industry, eliminating safety hazards and reducing frictional variances to significantly improve load precision. The Z-Gun works in conjunction with the Z-Washer, eliminating the need for reaction fixtures, which are the leading cause of safety incidents in industrial bolting. The washer can be used with any of HYTORC's latest hydraulic and pneumatic bolting systems to add safety and speed, while eliminating unwanted nut loosening and/ or leakage on pressurized connections. One of the top benefits of the Z-Gun is the level of safety it provides, making it much less likely that users will pinch their fingers—a common problem with hydraulic and electric torque tools. HYTORC | www.hytorc.com







From blades to towers, wind energy components being discharged at various ports in Canada, including Trois-Rivieres, Quebec and Thunder Bay, Ontario

Meeting Cargo-handling Challenges Transporting wind energy components

By Emily Toms

WIND TURBINES CAN HAVE OVER 8000 PARTS, sourced from manufacturers throughout the world. If assembling all of those parts can sound like a challenge, just imagine arranging the transportation of them across cities, states, and often countries. Delivering the blades, towers, turbines, nacelles, hubs, and all of the many other nuts and bolts and components required isn't always an easy task—particularly, considering most wind power farms are located in remote locations that aren't always quick or simple to access.

Most manufacturers use shipping agents, freight forwarders, or in-house logistics experts to find the right ports and transportation methods to efficiently move their merchandise. The role of a cargo-handling firm is to help ensure the quality and safety of that move, while ascertaining that the products shipped reach their final destination in flawless condition. After all, wind components shipped aren't only numerous in quantities, but they're typically oversized and distinctively shaped, often making logistics and transportation a unique and significant planning process.

Cargo handling professionals help customers choose the best routes, ships, and carriers for their particular product. They can add value to this process by managing the operational details when, for example, transitioning cargo from one point in the logistics chain to another.

A reputable transportation and logistics company should be able to provide answers to questions, such as:

• What is the best way to pack/stow goods, so they don't shift during transport?

• How will the goods be transferred from one mode of transportation to another (i.e. from truck to rail or port to ship)—undamaged, and without compromising personnel safety?

• What regulations or cross-border legislation must be adhered to (and what papers or request forms must be filled out prior to shipping)?

• How can shipping deadlines best be met (and at reasonable costs)?

• Is product insurance necessary when shipping?

Safeguarding shipments

Many wind energy components are made of carbon fiber and lightweight alloys. They're prone to damage from being bumped and coming into contact with other pieces of cargo. Dents or scratches could mean the difference between delivering on time, or sending components back to the factory for costly repairs.

The extensive scale of many new wind farms also means that larger shipments are on the move. In some cases, individual pieces have doubled in size over the past 10 years. The growing size and weight of the components themselves has been a challenge for the cargo handling industry. Modern wind cargo often requires large, flat open-space or "laydown" areas, so that various components can arrive separately (often weeks apart, and from different origins), but leave port together (usually by rail or in a convoy of specially designed flatbed trailers).

"When I started, blades were 15 meters long and now they're up to 50 meters. Nacelles have grown from 30 tons to 110 tons, and we recently worked with 70-ton towers," shares Anthony Steele, a cargo operations' manager in Halifax, Canada, who says that even with the right equipment, these type of shipments require specialized rigging and experienced operations' staff. "For example, blades are meant to cut through the air, and we need to compensate for that—keeping them stable when lifting from inside a ship, and across 10 to 12 meters to rest on a concrete terminal."

The cost of transportation

Cargo-handling companies and port authorities have adapted to meet the demands of the wind energy industry by investing in cranes, slings, and spreaders, which are specifically designed to hoist colossal items from within the confines of a ship's hold and position them precisely for delivery to the final construction site. In some cases, permanent heavy-lift cranes have been installed as part of a terminal's infrastructure, while other ports have mobile cranes on standby.

"Permanent cranes are more expensive upfront for the service provider, but the decreased mobilization costs can translate into savings for the customer," explains Vasko Popovic, a cargo manager in Ontario, Canada. "In other cases, bringing in mobile equipment from another location means higher mobilization costs, but the port's proximity to the customer's end-market is such that savings come elsewhere."

Ideally, Popvic says, that a cargo-handling partner should have enough locations in their portfolio to tailor a solution that's right for a customer's needs. He works in Thunder Bay, Ontario, which has been handling wind project cargo since 2001—making it one of the first ports along the Great Lakes to do so. In addition to ample laydown area, the port has access to equipment such as a Liebherr 320 crane, and is serviced by CN and CP railways.

This Ontario port is an effective gateway to move components from the east coast to western Canada, or from Canada to the United States (or vice versa). A ship's cargo can be loaded directly onto a train, ensuring it spends as little time on the road as possible before reaching its destination—as was the case fairly recently for 34 units headed to Dawson Creek, British Columbia, including nacelles, hubs, and blades.

Interesting, the west coast isn't the only part of Canada that's seen an increase in wind-related shipments. In the east, the Maritimes have experienced a rather large increase in wind cargo over the past two years. The Port of Halifax has been stringently working with nacelles and hubs, loading them for rail transport because of their shape and weight. In Sheet Harbour, a sister port to Halifax that's located about two hours away, blades and towers are being discharged to a 12-acre laydown area adjacent to the wharf. Or, when possible, they're loaded directly to trucks and trailers because of the site's convenient highway access.

Wind components are worth millions of dollars, so it's important to work with a knowledgeable cargo-handling company that not only uses the right equipment and techniques, but also with one that's aware of the fastest and most efficient ports and modes of transportation available. Most wind power projects have tight deadlines, and shipping shouldn't get in the way of project success.

Logistec Stevedoring Inc. Logistec Arrimage Inc. www.logistec.com



Multi-turbine tower

Field tests of multiple turbines used in a row or series has demonstrated an even greater electrical power output. SheerWind's INVELOX system, a new concept in wind power generation, is a large funnel that captures, concentrates, and accelerates wind before delivering it to turbines safely and efficiently. By placing two turbines in a series in an INVELOX system, power showed an increase of 1.7 times when compared to single turbine. In other words, one 1,000-kilowatt turbine-generator system in an INVELOX produces electrical energy for 341 houses. Two turbines operating in succession produce electrical energy for 579 houses in United States.

With INVELOX, turbines are installed safely and conveniently at ground level, making maintenance less costly, safer, and more efficient. Using multiple turbines in a single INVELOX tower means nearly zero operational downtime because maintenance can be done on one turbine while the other continues energy production. A single INVELOX tower is able to increase production capacity and output—reducing cost per kilowatt—all without additional structure or land use. Operating at wind speeds as low as two miles per hour, SheerWind's INVELOX requires no subsidies, is price competitive, and has less environmental impact than traditional generation technologies. **SheerWind** | www.sheerwind.com



Shaft grounding & monitoring ring

Electro Static Technology's new AEGIS iPRO-MR Ring combines shaft voltage bearing protection with continuous monitoring of shaft voltage levels from a remote location—all in real time. The AEGIS iPRO-MR is an AEGIS Shaft Grounding Ring and a shaft monitoring ring in one, ensuring optimum uptime and reliability of large motors and generators in critical applications. The iPRO-MR is ideal for the protection of motors in remote locations that cannot be easily monitored or maintained. The rugged, reliable, and maintenance-free split-ring AEGIS iPRO prevents damage that could otherwise cause generator or motor failure, unplanned downtime, costly repairs, and lost revenues.

Available in a range of sizes to accommodate even the largest motor shaft diameter, the iPRO shaft grounding ring comes in mating halves to facilitate field retrofits on coupled equipment. With multiple rows of conductive microfibers completely surrounding the shaft, it provides millions of discharge points for harmful shaft currents and is ideal for high-current motors controlled by variable frequency drives (VFDs), including low-voltage motors over 500 HP, medium-voltage motors, power generators, and OEM systems.

Electro Static Technology

www.est-aegis.com | www.est-aegis.com/iPro-MR.htm



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Transportation & Logistics

With all of the equipment, carriers, size, and specialized handling requirements, getting all of the right turbine components to the right project sites for construction can be a challenge in the wind industry. Safety and efficiency are important keys to ensuring projects and timelines run smoothly. Here we focus on some of the top Transportation & Logistics companies in the industry that provide the specialized services required for getting all of those wind power parts, components, and machinery where they need to be for a successful wind farm.

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Challenger

Services: 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 39 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.

www.challenger.com



Logistec provides high quality cargo-handling services to marine and industrial customers through a strong network of strategically located facilities in the Great Lakes, the St. Lawrence River, the U.S. Gulf, and on the Eastern Seaboard of North America



Port Corpus Christi

Services: Many services that meet the requirements of the wind energy industry, such as: truck; rail; shipping; RO/RO; heavylift; breakbulk; bulk; liquid bulk; as well as logistics, warehousing, storage (laydown), and bagging

Min/Max Loads/Tonnage: 750 to 1500 lbs/sq-ft (60 to 200 tons)

Location/Logistics: Located in Texas, Gulf of Mexico, with service to Mexico, Columbia, Latin America, Europe, and Panama

Qualifications: Established in 1926. providing 88 years of service

Additional Key Features:

- Three Class 1 railroads:
- Adjacent to IH-37 and Hwy-181;
- FTZ #122 servicing six counties; and
- Environmental Management System with ISO 14001 Certification.

www.portcorpuschristi.com



Port of Longview

Services: Change in mode of transportation of cargoes; modes accommodated include: ocean-going ships and barges; Columbia River barges; rail; and truck

Min/Max Loads/Tonnage: Single-truck loads of approximately 20 metric tons, up to Panamax-sized vessels of approximately 80,000 metric tons.

Location/Logistics: River mile 66 on the Columbia River, and mile point 36 on Interstate 5 in Washington

Qualifications: Incorporated in 1921; received President's "E" award for Export Service in 1988

Additional Key Features:

- On-dock rail service;
- A direct rail line to Port;
- Two Liebherr 500 mobile cranes (100 tons and 140 tons) onsite; and
- Export grain terminal.
- www.portoflongview.com



Equipment Express Inc.

Services: Specializing in the movement of transformers and machine tools, Equipment Express' current line-up includes 250 trailers, 80 tractors, and 25 escort vehicles—managing wind power projects of any size, anywhere

Min/Max Loads/Tonnage: Hauling capacities of up to 1500-metric ton, and mobile cranes up to 1500-ton capacities

Location/Logistics: Serving Canada, Mexico, and the continental United States

Qualifications: Providing 55-plus years of experience

Additional Key Features:

- In-house custom fabricating allows Equipment Express to cater to the most challenging transportation problems, and enhances their rigging capabilities;
- Dock, warehouse, and storage facilities at terminal; and
- T/L carrier specializing in O/D commodities.

www.equipmentexpress.com





SIGN UP FOR YOUR FREE SUBSCRIPTION



All the options for project cargo to get to its destination

Ship - Truck - Train - Barge

The Port of Stockton, which specializes in bagged rice, steel, project cargo, refrigerated, dry bulk and liquid bulk cargoes, has added major components for electricity-generating wind farms to its growing list of energy-related port business. The Port has become one of the U.S. West Coast's top entry points for wind energy equipment manufactured overseas and bound for U.S wind farms. The Port's infrastructure improvements for yard, dock and rail direct transfers and open staging areas present a great opportunity for importers and exporters.

Port of Stockton

209.946.0246 portofstockton.com



SEE AD ON PAGE 54

LOGISTEC

Logistec

Services: A variety of transportation solutions for the wind power industry, including: cargo handling; port logistics; stevedoring; terminal operations management; inventory management; warehousing; transloading; trucking; environmental rehabilitation; aqueduct repair; and hose manufacturing

Min/Max Loads/Tonnage: Able to accommodate various tonnages and dimensions depending on the port (ranges from heavy lift to bulk to break bulk)

Location/Logistics: A total of 29 ports and 45 terminals throughout Eastern Canada, the Great Lakes and St. Lawrence River, as well as the United States' East Coast and the Gulf Region

Qualifications: Founded in 1952, and a member of Green Marine

Additional Key Features:

- Experienced provider of value-added cargo handling services for industrial customers in the renewable energy sector, and especially wind components;
- Utilizes the latest technologies throughout its network of strategically located facilities; and
- A hands-on partner with a dynamic team who manage each cargo handling operation and ensure the best solutions for each project.

www.logistec.com

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Port of Stockton

Services: The Port of Stockton provides facilities not only to support break-bulk and general cargo, but also project and heavy-lift cargoes, which make it ideal for wind power transportation. The port offers 15 berths with draft of 35' mean low water (MLW); 70-plus miles of industry rail on port property, as well as 12,000 lineal feet of true on dock rail; allowing for direct discharge from ship to rail

Min/Max Loads/Tonnage: Reinforced wharves of up to 1,500 pounds per square-foot, providing excellent heavy-lift and project cargo capabilities

Location/Logistics: 75 nautical miles due east from San Francisco Bay, the Port of Stockton trades with 55-plus countries

Qualifications: Opened for business in 1933, and has more than 80 years of direct-operating experience.

Additional Key Features:

- Foreign Trade Zone #231/Enterprise Zone, as well as Electrical Utility;
- Railroad-joint facility, with reciprocal access for the Union Pacifica and BNSF railroads;
- With 2,000 acres of land, the port also offers more than seven-million square feet of covered storage; and
- Imports/exports nearly five million tons per year.

www.portofstockton.com



C.H. Robinson Project Logistics

Services: 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 available, as well as inland transport by truck, rail, and barge
- Route/port surveys offered; and
- Onsite supervision and project management.

www.chrprojectlogistics.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

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Solar Power International (SPI) is powered by the Solar Energy Industries Association (SEIA) and Solar Electric Power Association (SEPA). SPI has been designed to serve and advance the solar energy industry by offering an annual forum to learn, explore, and bridge related products, knowledge, and opportunities. Bringing together more than 15,000 professionals in the field, this event focuses on creating an environment that fosters the exchange of ideas, information, and expertise for furthering solar energy developments.

www.solarpowerinternational.com

show in print

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



Solar structures & carports

Baja Construction provides pre-fabricated, preengineered, high-tensile, and light-gauge steel structures that serve as the mainframe of a solar energy facility. They design, engineer, supply, and install Solar Support Systems, an integral component of a solar ground-mount, solar carport, and/or solar RV and boat storage solution. Baja's Solar Support Systems are being built at schools, train stations, sports complexes, shopping malls, medical facilities, office buildings—and any place where a parking lot is a location for solar shade that can generate power to offset energy costs or generate revenue from a feed-in-tariff. Baja is a nationwide company with its own in-house engineers.

Baja Construction www.bajacarports.com Booth 3118



PV module hardware

AK Solar Products (AKS) is a provider of cost-effective and functional solutions for PV module bonding and grounding hardware. AKS product innovations allow for simplified installation and high reliability, designed to reduce solar installation balance-of-system (BoS) costs. AKS recently expanded their line of solar products with new conductive mid- and end-clamps. Three styles of mid-clamps have been custom engineered to meet all top-mounting systems. These contain sharpened teeth for strong electrical conductivity with a 5/16 bolt size. Unique features include an alternate method of direct grounding, with a removable lug for clamping of copper wire and panel spacing flaps. All of these products come in stainless steel for durability, maximum strength, and corrosion-resistance. End-clamps accommodate PV module thicknesses of 30 mm to 55 mm. **AK Solar Products**

www.akstamping.com/solar **Booth 1645**



PV microinverters

New from APS America is the APS YC1000—the first true, three-phase microinverter to meet the demands of large-scale commercial applications. Designed to work with three or four PV modules (depending on panel output), the APS YC1000 provides 208 V and 277/480 V, three-phase grid voltages. APS also presents their flagship product, the YC500 microinverter, which handles two modules per unit (dual-MPPT) with 500 W of maximum output. All APS microinverters are compatible with 60- or 72-cell modules, making solar arrays more powerful and economical, as well as dependable and safe. **APS America** | www.apsamerica.com **Booth 3124**

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solar | Resource Assessment

Renewable NRG Systems | Hinesburg, Vermont 05461 | USA 802.482.2255 | renewableNRGsystems.com



Touch-safe fuse cover

SCHURTER's ESO 10.3x38 touch-safe fuse cover is designed to safely and securely insert and extract 10.3 mm x 38 mm fuses. The ESO cover, with captive fuse, is inserted into fuse clips mounted on the PCB, and serves to extract a blown fuse. No additional tools are required. The ESO 10.3x38 is deemed touch-safe according to IP20 specifications and, together with SCHURTER's CSO fuse clips and ASO 10.3 mm x 38 mm fuse, is ideal for use in PV applications up to 30A@1000 VDC. Specific applications include solar inverters, string fuse boxes, and battery charge controllers. The ESO 10.3x38, used in combination with SCHURTER's CSO fuse clips, carries cURus certification; it also meets UL 2579 and IEC 60269-6 PV standards. SCHURTER | www.schurterinc.com Booth 1563

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- Moxa ART 32-bit ARM 9 Industrial Processor
- 4 DIs and 4 DOs with 3 KV digital isolation protection
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Rcore Software Platform

Moxa's Rcore ready-to-run platform makes it easy for programmers to develop embedded software. Rcore includes easy-to-use application libraries, tested bug-free sample code, and requires less time for the concept validation and development cycle enabling a faster time-to-market that meets or exceeds customer requirements. The Rcore Community also offers our partners easy access to software and technical knowledge about embedded systems, along with an interactive forum to share knowledge with embedded computing professionals.

Visit http://rcorecommunity.moxa.com/ for details.





Project development and O&M

EDF Renewable Services ensures ongoing project profitability for solar power project owners and investors by providing a full range of operation and maintenance (O&M) services and expertise. These include: total project operations/balance of plant (BoP); asset administration; warranty inspections; as well as engineering support and analysis. From the Operations Controls Center, the company provides a full suite of standard and advanced services, including 24/7 remote monitoring, project performance evaluation, SCADA support, and remote resets and technician dispatch. Their development affiliate, EDF Renewable Energy, is an expert in all areas of development, including: site selection; procurement; financing; permitting; project planning and construction; and long-term management.

EDF Renewable Energy | www.edf-re.com | www.edf-renewable-services.com Booth 1310





Pitched roof system

The HatiCon Solar alHome pitched roof system features the new UL listed HatiBond tool-less splice. The selfbonding splice installs instantly with no tools required to create an electrically bonded structural connection between two rails. This drastically improves the speed and ease of installation, while decreasing the part count of the alHome system. Made from non-corrosive, lightweight aluminum, the alHome system has an onsite leveling capacity of up to 1.5" and can be installed on a wide variety of roofs up to 70° slope. Longer spans require fewer penetrations. Patented click technology and universal preassembled parts saves time and money. The new HatiBond technology enhances the versatility of the alHome pitched roof system for a simpler, faster installation.

HatiCon Solar | www.haticonsolar.com Booth 2515



Extruded aluminum

Sapa Extrusions, a global manufacturer of extruded aluminum, is a key supplier to the solar industry. 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 (CSP) collectors; inverter housings and components; and thermal management solutions. Supporting Sapa's North American Technical Center (NATC) works with customers to establish finished designs for innovative 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 supplies critical components for solar applications that help customers optimize the value of their products.

Sapa Extrusions North America www.sapagroup.com/NA Booth 3512



Ground-mount solar system

Meeting peak morning and evening power production demands are easily accomplished with Schletter's FS Uno-100 steel ground-mount system. Through extensive analysis and design, Schletter engineers have developed a single post system that accommodates east-west module tables. Specifically designed to meet or exceed applicable IBC, ASCE, and UL Standards, the FS Uno-100 uses 100% galvanized steel to meet the rugged demands of a ground-mount installation. Regardless of the design specifications, the FS Uno-100 upholds the quality standards for which Schletter is known—the result is a steel, solar mounting system designed to last over time.

Schletter | www.schletter.us Booth 506



Scalable batteries

Aquion Energy's Aqueous Hybrid Ion (AHI) batteries deliver a quality combination of price, performance, safety, and sustainability for stationary, long-duration applications. Aquion's modular and scalable battery products are designed for easy integration, and can be configured to meet a wide range of system requirements. AHI batteries can be assembled into systems ranging from 48 V to 1000 V, and from low kilowatt-hours to hundreds of megawatt-hours. Aquion's S-Line Battery Stacks and M-Line Battery Modules are approximately 2 kWh and 20 kWh respectively, and deliver very long cycle life at 100% depth-of-discharge with minimal degradation, excellent abuse tolerance, and a wide temperature operating range. AHI batteries are constructed using a water-based electrolyte and abundant, non-toxic materials, which result in safe, sustainable products that are pricecompetitive with lead acid technologies. Aquion delivers batteries worldwide for off-grid, microgrid, energy management, and grid-scale applications. Aquion Energy | www.aquionenergy.com Booth 3821



CAB Cable Rings use a time-tested design that offer proven performance, product cost savings, ease of installation, lower shipping and storage costs, and excellent access for troubleshooting. CAB has manufactured Cable Rings for over 30 years for use in electrical, utility, and other industries, including for solar power projects. They are available in a variety of sizes and shapes, and can be customized to meet specific project needs. CAB Cable Rings are available with a PVC Plastisol coating that's flame-, chemical-, and UV-resistant and also with a high dielectric grade as well. CAB Products also offer a unique, patent-pending design that allows for separation of AC and DC cabling, and that offers support for communication/control wiring. **CAB Products** | www.cabproducts.com

Booth 1643

Cable rings





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solar power international 2014



Solar rail roof mounts

IronRidge has expanded its XR Rail Family to include three new rail sizes, all featuring the company's signature curved profile. The new offering empowers solar designers to improve solar mounting system performance, while reducing costs by as much as 15% to 20%. Each size supports specific design loads, while minimizing material expenses. In addition, IronRidge offers a number of new accessories, including Slotted L-Feet and T-bolt Grounding Lugs, as well as an upgrade of its webbased Design Assistant software to support ASCE 7-10. **IronRidge, Inc.** | www.ironridge.com

Booth 2109

Leading Tracking Technology

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



Sonnen System Dual-Axis Tracking Systems features:

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



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proud to announce the release of our new UL Listed PV fuses and holders to meet the UL 2579 standard.



SIBA's third generation photovoltaic fuses are designed for the global market. The package is complete, PV fuses and holders are both UL and IEC approved for inverters, combiners or re-combiners, small or utility scale. PV fuses start at 600VDC up to 1500VDC



NH1 &NH3, 1100V DC PV,-35A to 450A NH00, 600V DC PV, 35A to 200A SQB, 1100V DC PV, 32A to 450A NHL, 1500V DC PV, Contact SIBA 10x38mm, 1000V DC PV, Contact SIBA 10x38mm, 600V DC PV, Contact SIBA



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, postdipped 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 2116



Solar contractor

M BAR C Construction, Inc. is a full-service design/build steel contractor. M BAR C has multiple full-time, fully trained crews capable of completing several contracts simultaneously. Regardless of project size, M BAR C can satisfy an architect's demand for design integration and a contractor's competitive budget requirements. As the premiere installer of the new Solar F.I.T. System, M BAR C can complete any job specifying this system significantly faster with impressive savings. M BAR C has over two decades of experience, with a reputation for top safety and on-time delivery. In addition to its wide array of completed project types and designs, M Bar C offers a DSA pre-check approval number for its PV canopy design that's more versatile than any others currently on the market, shortening CA school project submittals from months to days.

M Bar C Construction, Inc. | www.mbarconline.com Booth 3624



PV performance monitoring

Locus Energy, a solar monitoring and data analytics platform provider for the distributed solar PV market, recently announced the launch of an advanced irradiance modeling tool. Virtual Irradiance (VI) provides solar fleet operators with valuable data on the amount of sunlight that's striking the ground, enabling a highly accurate assessment of solar PV system performance. The first release as part of Locus Energy's PVIQ suite of analytical tools, VI allows fleet managers to determine if a system is performing up to expectations, based on the amount of sunlight that's available at a particular time and location. Such information drives down costs by improving operations and maintenance (O&M) efficiency, thereby helping to accelerate the widespread adoption of solar.

Locus Energy | www.locusenergy.com Booth 3518



Rail-free mounting system

Quick Rack is a simple, cost-effective, railfree solar mounting system from Quick Mount PV. Featuring QRack technology, Quick Rack is an integrated roof mount and racking system that's engineered to be robust and structurally sound. Quick Rack is fast and easy to install, requiring only minimal standard tools. The system features integrated grounding, with just a single ground lug for up to 300 contiguous modules. Eliminating long rails significantly reduces material handling, installation time, and labor costs. Quick Rack also comes with proprietary design software, ensuring every solar array is accurately designed and code-compliant. The Quick Rack rail-free system features Quick Mount PV's quality waterproofing, with patented Elevated Water Seal technology. Made it the USA, the system is certified with UL System Fire Class Rating A, Type 1 Modules.

Quick Mount PV www.quickmountpv.com Booth 1412



Panel washing

The Bitimec-Messersí RoboCleen is a washing machine for large PV arrays that's able to wash two megawatts of flat panels in one day, using only 3000 gallons of water. The system runs smoothly on a rubber track dumper undercarriage. With twin joystick controls, a telescoping boom, ultrasonic sensors, and a closed porefoam brush, feather-light and mechanized panel washing is done simply and gently. Operators and owners can now avoid losing up to 10% of their revenue due to soil film deposits that accumulate on panels, usually over a relatively short period of time. This ability to economically wash solar panels can repay buyers many times their investment. Bitimec | www.bitimec.com Booth 2558



Solar plant protection

Solar plants are soft targets for copper and module thieves because there's little risk of electrocution removing cables at night when they aren't energized by the sun. Viasys Solar Secure, Inc. is a security partner for solar developers, operators, and investors seeking plant protection and peace of mind from system downtime and the expensive repairs caused by theft and vandalism. Viasys Video Alarm System infrastructure creates an electronic fence around a solar plant, sending video alarm images only when a breech attempt occurs. The heart of the concept is an advanced video analysis software, which identifies intruders against a dynamic outdoor environment providing actionable intelligence, situational awareness, and early warning before any damage is done.

Viasys Solar Secure, Inc. | www.viasys-iv.com Booth 3330

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Backtracking optimization

Operators can now further optimize Exotrack HZ equipped solar plants by implementing Exosun's unique backtracking program, called SMARTracking. Going beyond simple backtracking (shifting tables' positions to avoid panel-on-panel shading during periods of low solar height), SMARTracking takes into account a plant's field irregularities (3D site topography) to achieve maximum system performance. The SMARTracking program integrates seamlessly into the Exobox control system, and is fine-tuned for each solar project based on each tracker's real positioning and height. Based on projects with topographic challenges, the implementation of SMARTracking helps generate up to 5% more energy yield annually, maximizing ROI compared to other traditional single-axis trackers or fixed-tilt structures. This patent-pending innovation has been validated by an independent third party. Exosun | www.exosun.net

Booth 4906



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Solar resource assessment system

Renewable NRG Systems, manufacturer of decision support tools for the global renewable energy industry, offers the SRA System—a complete measurement station for the prospecting and finance-grade resource assessment of utility-scale PV projects. Site-specific solar resource assessment (SRA) campaigns provide accurate context to correct long-term satellite derived irradiance data. The combination provides the lowest resource-related uncertainty, which drives financial terms and, ultimately, project ROI. Renewable NRG Systems' latest generation SRA System includes improvements to the tower, datalogger, and pyranometer. All elements are designed to work together for ease-ofuse, from installation to redeployment. With a choice of industry standard ISO 9060 pyranometers, the system provides accurate and repeatable measurements in any terrain. All Renewable NRG Systems solar products are backed by world-class logistics capabilities, free lifetime technical support, and a two-year warranty.

Renewable NRG Systems www.renewablenrgsystems.com Booth 1444



Extension platform

In many PV site evaluations, it may be difficult to access the exact location of the solar array. Solmetric has released a new version of their SunEye Extension Kit. The SunEye Extension Platform enables surveyors to mount the 210 model SunEye on an extension pole to take accurate shade measurements above ground level. The new design of the SunEye accessory was developed to allow installers greater flexibility. The Extension Kit Platform attaches to common telescoping poles founds in most hardware or specialty stores. The design includes a tightening mechanism that allows customers to choose their own telescoping poles.

Solmetric Corporation www.solmetric.com Booth 1457





Solar thermal system control

The Steca TR A503 TTR U is a solar thermal control system that provides high power, with convenient installation and operation. The Steca TR A503 TTR U offers two triac outputs, one relay output, and numerous additional functions, including BTU metering, system pressure monitoring, datalogging, back-up heating, drainback, and more. Along with the TR A502 TT U and TR A501 T U solar thermal controllers, the TR A503 TTR U is the third product in this series with a compact designer casing, making it suitable for integration into solar stations. It can also be universally mounted on a wall or top-hat rails. The new solar thermal controller has five inputs, and two RPM-controllable triac outputs that can also be used for controlling (0 V to 10 V) high-efficiency pumps. It also has an extra relay output for individual programmability. System data can be completely stored on a Micro-SD card, which can be directly plugged into the TR A503 TTR U controller.

Steca Elektronik GmbH www.stecasolar.com Booth 2004



PV wire

INDUSTRIAL WIRE & CABLE CORP. manufactures high-quality, singleconductor PV wire in either integrally XLPE insulated, or XLPE insulated with non-integral thermoplastic jacket constructions. Available with a 600 V or a 1000/2000 V rating, INDUSTRIAL WIRE & CABLE CORP. is currently the only manufacturer of PV wire approved for use with the City of Los Angeles. UL Listed and CSA Certified, their PV wire has been designed and tested to perform.

INDUSTRIAL WIRE & CABLE CORP. www.industwire.com Booth 2560

PV tile system

The recently launched Tile Flashing Systems from EcoFasten Solar have been specifically designed for use on new or existing roofs. They are available in three profile options for flat, "W," and "S" tile roofs. Each innovative flashing system replaces one complete tile, eliminating the need for cutting, drilling, grinding, or replacing of any tiles. Multiple fastener points in the system's base plate allow for attachment into the rafter, regardless of flashing alignment. The embossed cone-shape stamped into the underside of the flashing is fitted with an EPDM rubber bushing, creating a watertight seal when paired with any compatible EcoFasten Solar Compression Bracket. The system attaches to a roof deck with as little as two lag bolts, resulting in a fast and easy installation. An optional second flashing at the roof deck is available for jurisdictions that demand it. Made in the USA with recycled materials, The Tile Flashing System is third-party tested for pullout and shear. **EcoFasten Solar** | www.ecofastensolar.com **Booth 2351**



Clipping Right Along

Long-lasting, Customizable Wire Management Clips

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

wiley

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Solar PV under-clamp

Sol Attach introduces their new under-clamp, which eliminates the need for bulky mid-clamps and end-clamps as solar PV attachments. With a patented design, the under-clamps have eight sharp point set screws that grab each module frame from underneath. This way, the modules don't move around as they are mounted into place. The new under-clamp means ordering and stocking long rails is now unnecessary. Plus, with the Sol Attach under-clamp installers don't need to reach out over modules to tighten them down, attach clamps to the rafters, or disrupt neighboring modules when servicing (as each module can be removed independently). By eliminating these obstacles—including the need to ground module-to-module—the Sol Attach under-clamp makes for a more aesthetically pleasing, safer, efficient, and less expensive installation. Certified to UL 2703.

Sol Attach, LLC | www.solattach.com Booth 2027



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SULAR DURING STOTES

Solar water pump

Franklin Electric introduces SubDrive SolarPAK, a system solution for solar pumping requirements. Using quality components, combined with technical expertise, Franklin Electric has developed a rugged, high-output system, which harnesses the power of the sun to pump water as needed. Tackling the challenges of remote and harsh environments, SubDrive SolarPAK offers a high-flow system for faster tank fill and significant water output. With proven motor and pump technology, features include: DC and AC power inputs with auto-switching to generator back-up; maximum power point tracking (MPPT) for efficiency of input power; a soft start feature to prevent water hammer and increase the system life; and remote telemetry capabilities through a RS-485 continuous data port. A robust IP55, NEMA 3 drive enclosure minimizes impact to wildlife, insects, dust, and weather. Diagnostics and protection are built-in. C-tick and UL approved.

Franklin Electric http://solar.franklin-electric.com Booth 2835



Carport & groundmount solutions

Powers Solar Frames offers solar carport and ground-mount solutions, featuring their new selection of innovative Slide-In Super Purlins. These products help project developers and owners save considerable costs due to a reduction of purlin usage, including up to 42% when compared to conventional methods—thereby, reducing installation time, labor, and material costs. Three men can install up to 600 solar panels per shift from a scissor lift, with no need to be on top of the structure. With a focus on conserving resources, Powers Solar Frames also offers a new five-panel ground-mount svstem.

Powers Solar Frames www.powerssteel.com Booth 3533

CONTINUOUSLY SHAPING INNOVATION



PV testing & certification

TÜV Rheinland offers the UL 1703 testing and certification services to manufacturers of building-integrated PV modules, rack-mounted PV modules, and mounting systems. They do so in conjunction with the 2014 revision of the standard, which introduces new PV module fire type classification and system rating tests (effective January 1st, 2015, rooftop mounted systems in California shall be tested, listed, and identified with a fire rating in accordance with UL 1703). TÜV Rheinland offers a state-of-the-art fire test laboratory, with full capability to test PV modules, PV systems, and mounting racks to the requirements of the UL 1703, UL Subject 2703, and UL 790 standards.

TÜV Rheinland | www.tuv.com/us/ptl Booth 2224



Ground-mounted tracking & racking

Array Technologies, Inc. (ATI) ensures value, reliability, and bankability for solar projects through its proven ground-mount tracking and racking solutions. ATI's flagship product, the DuraTrack HZ single-axis solar tracker, has been redesigned to further reduce installed cost, increase power density, accelerate installation, and reduce maintenance requirements—enabling a highly competitive levelized cost of energy (LCOE) for solar projects at a time when the industry needs it most. The completely re-designed DuraTrack HZ combines years of product innovation with proven reliability, helping to transform the standard in solar tracking.

Array Technologies, Inc. www.arraytechinc.com Booth 1042



Solar jacks & actuators

Joyce/Dayton is a global provider of solar tracking actuators. Their products are currently in service on major installations worldwide to move PV systems, large commercial arrays, heliostats, CPV systems, as well as in ingot production. For example, Joyce/Dayton ComDRIVE jacks include gear reducers and motors, and can move up to 50 tons or more. Their solar actuators move smaller trackers up to two tons, and are powered by DC motors. Joyce/Dayton engineers and solar specialists offer creative and cost-effective solutions to meet challenging solar project requirements. Joyce/Dayton | www.joycedayton.com Booth 2125



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Fullriver batteries are available through our world-wide distribution network. For more information, please contact us toll-free at (800) 522-8191 or visit our website at www.fullriverbattery.com



Solar consulting & engineering

Luminate is a solar resource consulting and independent engineering firm, supporting the development, financing, construction, and operations of solar PV and thermal power generation. The Luminate team is led by authorities in solar energy research, development, resource, energy projections, and power project finance, and offers the full complement of resource consulting and independent engineering services in-house, ensuring seamlessly integrated work product. Luminate has provided solar advisory services on behalf of Fortune 500 and smaller project developers, tax equity investors, investment funds, senior debt lenders, capital markets, and governmental agencies. Luminate's experience includes dozens of utility-scale and distributed solar projects and portfolios comprising over 3.5 gigawatts (GW), ranging from rooftop installations to some of the world's largest utility-scale PV and CSP projects.

Luminate | www.luminatellc.com Booth 2103



Sun Bandit[®] is a revolutionary new hybrid energy system that makes choosing, installing and enjoying a solar water heating system more practical and affordable than ever before. This innovative new patent pending technology creates a cleaner, quieter, more comfortable living environment that is a great choice for homeowners and an even better choice for your business.

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Visit sunbandit.us to learn more.







Perimeter security system

Optellios, Inc's FiberPatrol line of security products leverages patented, fiber-optic sensor technologies to provide advanced and cost-effective security solutions. Optellios recently released the industry's First Zone-based Perimeter Intrusion Detection System (PIDS), the FP1400. Featuring cut immunity (meaning it remains operational even after the cable is cut), the FP1400 offers 8 to 28 virtual detection zones (software configurable), multiple I/O options for integration, EMI/RFI and lightning immunity, and a convenient camera interface. Ideal for solar power projects, the FP1400 can be installed on a variety of different fences and offers simultaneous alarm detection coverage on all zones. It's cost-efficient, simple to install, and requires no electrical power in the field. Optellios, Inc. | www.optellios.com Booth 2010



Solar wire & cables

The BURNDY line of Wiley wire management solutions provides flexibility, high functionality, and lasting durability. Wiley cable clips provide management of solar cables that fit every need. Manufactured with 304 stainless steel, wire management clips allow for excellent corrosion resistance and longer service life than traditional nylon or plastic varieties. The durability of Wiley wire management solutions decreases the cost of overall operation by minimizing system maintenance. Products are offered in 90 mounting orientations that can be mounted to module frames or racking components. Compatible with: cables from PV modules; microinverters; optimizers; and various stainless steel cable ties.

BURNDY | www.we-llc.com Booth 451



End-to-end solar project solution

Panasonic Eco Solutions has joined forces with financing partner Coronal Group to deliver the first truly endto-end solution, facilitating solar projects from inception and financing, to installation and maintenance, and beyond. Virtually every solar model today requires the engagement of a third-party vendor at each phase of development. This fragmented, often inefficient process can raise barriers to successful implementation, increasing costs, and potentially stunting long-term project growth. However, Panasonic's joint turnkey model offers a viable strategic partnership for organizations across a wide spectrum of markets, including: universities; commercial enterprises; shopping centres; municipalities; and utilities. This unique model has already helped bring dozens of solar projects to light by simplifying the solar process. **Panasonic Eco Solutions** http://us.panasonic.com/solarsolutions



Booth 801

Flush-to-roof or tilt racking

Unirac's SOLARMOUNT allows installers to quickly set modules flush to the roof or at a desired angle, so as to maximize the output of a solar array. Installers can change module orientation to portrait or landscape, while securing a large variety of framed modules on flat, low-sloped, or steep-pitched roofs. Unirac is also launching enhancements, designed to get installers on and off the roof faster than ever before. Components will be received by installers, pre-assembled and optimized to improve installation speed and reduce labor costs. Plus, their new and improved bonding process provides classification to UL2703 for easy permitting. New accessories include a bonding mircoinverter mount, with a wire management clip, for a clean installation. Unirac | www.unirac.com Booth 306



One-piece mounting system

Sollega Inc., a commercial solar PV racking manufacture, announces the FastRack FR510-FS (First Solar Thin-film), universal, one-piece modular mounting system. Specifically designed for commercial low-pitch roofs, the lightweight, stackable design is only being offered through First Solar's modular commercial rooftop solar PV package. Fully ballasted with mechanical attachment options and integrated grounding, the pre-panel, three-module assembly easily mounts First Solar's frameless thin-film modules. One tool is all that's required for this top-mount installation. Efficient to ship, stage, and install, full engineering services are also provided.

Sollega Inc. | www.sollega.com Booth 1906

Maximizing Your Energy Yields Is Our Goal

When it comes to supersizing your energy yields you only need to plug into SolarMax and our state-of-the art inverters. We know what is important to you – **Maximized** energy production.

SolarMax, a Swiss maker of high quality and dependable photovoltaic inverters is renowned for superior products and outstanding customer support. SolarMax offers string and central 3-phase inverters in sizes ranging from 12kW-2MW for commercial and utility projects.

Our US headquarters is based in Atlanta, GA and we look forward to helping you **Maximize** your energy yields with SolarMax inverters in your projects.



Rooth: 4514

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solar power international 2014



PV solutions

Hanergy's suite of lightweight, solar roof products (FLEX Series and Powerflex) offer up to 15.5% efficiency, while bonding directly onto a roof's surface. Leveraging the expertise in copper indium gallium selenide (CIGS), this technology enables simple, low-cost installation, with a clean, sharp-looking aesthetic. By using the same core CIGS technology, Hanergy can also deliver high-density, lightweight, and extremely flexible PV solutions for off-grid applications, including for trucks, RVs, and busses, as well as for solar cell phone chargers.

Hanergy Holding Group Ltd. | www.hanergy.com Booth 1160



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Battery charge controller

The Solar Boost SB3024 MPPT solar charge controller is capable of charging 12V or 24V batteries at up to 800 watts. Multiple power point tracking (MPPT) delivers up to 30% more power than pulse width modulation (PWM) charge controllers, while multi-stage charging increases battery life and reduces the need for maintenance. The SB3024 can charge flooded lead-acid, AGM, gel batteries, and can be configured for all common types of lithium batteries. It features an optional display, user-configurable auxiliary/load output, and IPN network. The IPN network allows up to eight charge controllers to communicate and operates as a single-charging machine, allowing system monitoring via a remote display or over the Internet with the UCM. The DUO software option allows the SB3024 to control a wind or hydro turbine, in addition to a solar array. Excess power can be diverted to a useful purpose (heating water), and can be ordered as SB3024iL (basic) or SB3024DiL (includes display).

Blue Sky Energy, Inc. www.blueskyenergyinc.com Booth 2736



Renewable energy batteries

Specializing in the manufacture of premium sealed batteries that are ideal for renewable energy systems, Fullriver Battery DC series AGM line of batteries is specially constructed for either rigorous deep cycling or backup power applications. Their batteries are used in a variety of mission-critical solar applications, including pipeline protection, border control, mining safety, ocean exploration, police surveillance, and even for military equipment. Fullriver's best-selling six-volt model, the DC400-6, is now joined by their latest DC series battery line addition—the DC1150-2. An industrial-grade, two-volt cell, the DC1150-2 offers a full 1,150 amp hours. Fullriver batteries come in wide variety of sizes, coupled with a new, seven-year energy battery warranty. **Fullriver Battery**

www.fullriverbattery.com Booth 1749

AD003-140805-PV E-v02



PV fuses

SIBA photovoltaic fuses are designed to protect solar technology investments. Whether for the protection of string inverters, central inverters, or directly on modules, SIBA offers a variety of fuses for PV applications. SIBA fuses do their job in the most diverse of installations, and meet a broad range of requirements (UL 2579 and IEC). SIBA PV fuses will not trip prematurely, and yet react reliably. They range from small sizes, such as the 600VDC 10x38, up to 1500VDC NHL3 (600A). Both, fuses and fuse holders are available. Custom-made solutions are also available upon request.

SIBA | www.siba-fuses.us Booth 1618



Solar energy solutions

Travelers has more than 25 years of experience insuring clean energy and technologyrelated businesses. They are able to leverage the company's long-term knowledge and expertise to effectively deliver and implement industry-specific solar solutions. Travelers' Renewable Energy Practice offers policyholders a total account solution, with specialized underwriting and tailored services that support a broad range of renewable energy industries. Travelers provides products and services for solar energy businesses, including: software developers; research and development (R&D); metal goods manufacturers; contractors; operations; maintenance services; and power providers. Travelers

ITavelets

www.travelers.com/energy-practice/index.aspx Booth 2920



High-power solar module

The new LG Mono X ACe solar module is designed to generate more power per square foot than other solar panels on the market today, integrating a high-efficiency micro-inverter to deliver increased AC output. Building on the success and proven technology of the LG MonoX NeON DC series, this 305-watt AC solar module combines a new level of performance and installation flexibility. The LG MONO X ACe includes an all-in-one design, the industry's highest AC output, and a "monitoring anywhere" capability—a web-based monitoring solution that allows users to check power generation on a smartphone, tablet, or PC at any time. LG | www.lg.com/us/commercial/solar Booth 2303



Energy meter

The eGauge energy meter is Revenue-grade Accuracy Compliant, offering two levels of high accuracy at ANSI-C12.1 (1%) and ANSI-C12.20 (0.5%). The new version of the eGauge offers an extensive list of features, including an ability to measure electric power on up to 12 circuits, a built-in web server, and a solid-state memory and datalogger. With a foundation of robust and dependable hardware, the eGauge is easily installed and monitored over the web anytime and anywhere. There's no software to install and no monthly or ongoing fees. And, like its predecessors, the Revenue Grade eGauge also offers 16 recorded register values and an open API for software developers. It's offered in three different models, the most accurate of which is the ANSI C12.20 model at 0.5% accuracy compliance, and it comes with a printed verification certificate.

eGauge Systems LLC | www.egauge.net Booth 1554

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info@AETenergy.com 586.466.5073



One-hook mounting solution

Designer and engineer of innovative products for mounting solar panels onto residential roofs, SolarRoofHook.com now offers a onehook solution for tile roofs. This product can be used on flat, as well as Spanish (curved) tiles. Currently used by some of the largest solar panel installers in the industry, the one-hook solution's adjustability provides ease and flexibility for a quick and seamless installation. **SolarRoofHook.com – a division of Quickscrews International Corp.** www.solarroofhook.com



SALES OFFICE

KIPP ይ

Kipp & Zonen USA Inc.

T: +1 (0) 631 589 2065 ext. 338

rodney.esposito@kippzonen.com www.kippzonen.com

125 Wilbur Place

Bohemia NY 11716

Rodney Esposito

Passion for Precision

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LISA

ONEN



Solar racking

RBI Solar has developed many new products and services to make solar racking more robust and more cost effective. They are presenting a wide selection of solar carport solutions, including singleslope, double-slope, inverted-slope, and full-coverage designs. All the RBI Solar mounting systems are fabricated by a team of qualified engineers and designers to real site conditions, and are backed by end-to-end technical support and a 20-year product warranty. RBI also offers installation of racking products at a competitive cost. Their skilled crew is equipped with high-tech, post-driving machines, and certified operators. RBI Solar | www.rbisolar.com Booth 1400



Grid-tie solar inverter

SIEL's new SUNSIEL TL is a grid-tie solar inverter that's in combination with an external transformer. Available in three versions (400 kW, 500 kW, and 600 kW), which can be connected to an external power plant controller, SUNSIEL TL's IGBT-based architecture enables achievement of extremely high efficiencies. For utility-scale applications and medium-voltage power plants, SIEL offer the SUNSIEL POWERSTATION, a plug-and-play solution that's extremely compact. Able to serve plants from 500 kW to 3.3 MW, it can also be easily connected to other power stations on the MV side—forming a chain through a simple in-out connection from one container to another. It's equipped with an integrated communications platform that allows monitoring of the entire system remotely.

SIEL AMERICA INC. www.sielamerica.com Booth 1624



Helical pile installation

Cantsink Manufacturing manufactures and installs helical piles for a wide variety of applications, including solar power projects. In addition to the large selection of standard-sized piles they keep in stock, Cantsink is one of the few manufacturers that offer custom foundation pile design. If a special bracket is needed for ground-mounting solar panels, their in-house engineering team has it covered and can also provide geotechnical testing for turnkey foundation solutions. Cantsink features a patented helix plate that's cold-formed and corrugated, which makes it up to 50% stronger than those of competitors. They also robotically weld each pipe to its helix to provide the strongest, most precise connection possible. **Cantsink Manufacturing** www.cantsink.com Booth 2554

Accurately Monitoring the Performance of your Solar Energy System



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

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



Utility-scale ground-mount

Applied Energy Technologies (AET) recently launched its Rayport-G ECO utility-scale, ground-mounting system. The Rayport-G ECO is fast becoming an industry standard for large-scale developers and EPCs looking for a high-quality racking solution that promises strength and durability—as well as significant savings on installed costs. It has been engineered to ensure easy installation, and is lightweight and compact, reducing freight costs and allowing for safer handling onsite. The Rayport-G ECO has achieved UL 2703 listing, having undergone rigorous atmospheric and corrosion testing, including temperature and humidity cycling tests, and bonding path resistance tests. The Rayport-G ECO fits all solar panels available on the market.

Applied Energy Technologies www.aetenergy.com Booth 2327


Revenue-grade meters

Continental Control Systems highlights its new 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 ANSI C12.1, and most recently to ANSI C12.20—currently considered to be the most economical revenue-grade meters on the market. This quarter both will be certified by Met Labs, a nationally recognized testing laboratory and listed as PBI eligible by Go Solar California. Because of their price point and compact design, WattNode Revenue meters are an ideal OEM designin for PV production monitoring. **Continental Control Systems**

www.ccontrolsys.com Booth 1656



Power conversion & inverter solutions

Bonfiglioli designs and manufactures power conversion systems and turnkey inverter solutions up to 2.8 MW, which are specifically designed for commercial and utility-scale PV power plant installations. The UL-approved RPS TL-UL offers one of the widest inverter ratings on the market today, from 367 kWac to 1.4 MWac, allowing for design flexibility and ensuring an optimal matching with any size PV array. This unique system is designed to optimize ROI, while the modular architecture guarantees maximum energy harvest. These inverters are the heart of the RPS Station, a climate-controlled, plug-and-play solution for any type of environment. Bonfiglioli offers rapid, localized support in commissioning and maintenance by highly qualified experts, as well as pre-sales, installation, aftersales, and user documentation services. Bonfiglioli inverters have a 99% uptime and are covered by a warranty of up to 20 years.

Bonfiglioli | www.bonfiglioliusa.com/pv Booth 542



Ballasted flat-roof mount

Spider-Rax introduces the Tarantula ballasted flat-roof mount. Developed with the installer in mind, this ballasted roof-mount system requires only one tool for installation and has only one part number to order. Tarantula has integrated grounding and integrated wire management built in to every unit. Moreover, the Tarantula ballasted flatroof mount offers one of the fastest installation times on the market, along with a tilt-up feature for easy wire management and ballasted weights as low as 3 PSF.

Spider-Rax | www.spiderrax.com Booth 2723

Surge protective

DEHN announces the new

DEHNcube PV a Type 1 UL

Listed surge protective device

(SPD), compliant to UL 1449 3rd Ed for PV DC applications

with a nominal system rating of

string inverters and PV panels

from lighting-caused transients

SPDs within an enclosure. The

rated for outdoor mounting to

a panel by a 3/4-inch threaded

size is already connected to the

SPD. The SPD is based on DEHN's patented SCI technology, which

improves safety. It also has a visual

status indication. The DEHNcube

PV has a discharge current rating

of 40 kA, and a unique high SSCR

DEHN, Inc. | www.dehn-usa.com

of 2,000 A.

Booth 1648

when there's no place or preference to install DIN rail-mounted

DEHNcube PV 3-pole device comes

nipple. Sufficient wiring length and

housed in a NEMA 4X enclosure,

600 VDC. It's intended to protect

device



Utility-scale PV & energy storage

RES Americas offers in-house development, engineering, construction, and operations expertise for the utility-scale solar PV and energy storage markets. This expertise results in quick responses, as well as cost-control on solar energy projects. In conjunction with solar PV, RES Americas is committed to providing, safe, reliable, and economical energy storage systems. Their storage systems help solar PV developers meet interconnection ramp rate requirements, and provide fully developed frequency regulation projects with interconnection.

Renewable Energy Systems Americas Inc. www.res-americas.com

Booth 5216

U.S.Battery



is where Reliability and Necessity meet







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 2052



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 flatroof, 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 2749



Deep-cycle batteries

U.S. Battery RE Series deep cycle batteries are designed with features that provide the highest peak capacity, longest cycle life, and greatest reliability for use in industrial or residential renewable energy applications. To improve performance, RE Series batteries utilize the company's XC2 formulation and Diamond Plate Technology to create one of the most efficient battery plates—delivering greater watt-hours per liter and watt-hours per kilogram than other flooded lead-acid battery currently on the market. U.S. Battery RE Series also reduces mossing and sulfation conditions by incorporating the Defender moss shields and Outside Positive (OSP) plate battery designs. Defender moss shields are effective in preventing mossing shorts caused when positive active material particles dislodge from the battery plates, and collect under the plate connectors. Also, unlike chemical carbon additives intended for use in AGM batteries, the OSP battery design mitigates the effects of positive and negative plate sulfation, further increasing battery life. U.S. Battery | www.usbattery.com Booth 2930



Fixed tilt racking The ElexBack Series G3L is the late

The FlexRack Series G3L is the latest fixed tilt racking system from Solar FlexRack. This system ships in a pre-assembled folded position that can be easily unfolded and set into place on the jobsite, offering speed and ease of installation that's unlike other systems on the market today. This speed of installation for the FlexRack Series G3L has been verified by a third-party industrial time study institute. The FlexRack Series G3L offers unique module mounting options, allowing an installer to use clips, direct bolt, or a combination of both for a flexible module mounting solution. The FlexRack Series G3L also offers integrated bonding and wire management options.

Solar FlexRack www.solarflexrack.com Booth 1212





Grounding & bonding connectors

ILSCO's solar line of mechanical grounding and bonding connectors has been improved to incorporate exclusive Viritium plating. The Viritium plating resists corrosion, and is bright green, which is a universal color to identify ground. The primary impetus in moving to green plating is providing ease of inspection once installed. ILSCO will provide this product enhancement at no additional charge. The offering continues to be UL467 Listed for Grounding and Bonding, CSA Certified, and UL2703 Certified (which covers: "rack mounting systems and clamping devices intended for use with photovoltaic module systems").

ILSCO | www.ilsco.com Booth 2118



Inverter mounting kit

Advanced Energy's (AE) 3TL Horizontal Mounting Kit provides a compact and costeffective means to install AE 3TL string inverters in a horizontal orientation—an option essential for complying with NEC 2014 Rapid Shut Down requirements by enabling a low-profile installation at the edge of the solar array. The kit enables the 3TL to be installed in direct sun, rain, and snow, at a range of angles from horizontal up to a 30-degree tilt from horizontal. It also facilitates more profitable system designs by eliminating shading setbacks for inverters, thereby enabling the installation of additional panels in most cases. It also includes a sun shade, two low-power cooling fans, and a base assembly. The mounting flanges are compatible with DURA-BLOK and UNISTRUT hardware, which allow for site-specific, customized mounting solutions. This solution also enables rapid conversion to AC power, which can reduce cost and simplify system design and installation. **Advanced Energy**

www.advanced-energy.com
Booth 551



Utility-scale inverter solutions

LTi REEnergy develops and supplies central inverter solutions for large-scale PV power plants, between the ranges of 250 kW up to 2 MW as turnkey stations. The intelligent architecture of the inverters reduces the costs of transporting and installation. Additionally, the scalable value-added model meets the requirements of local content. The UL certification will be available in Q4/2014. The PV portfolio incorporates various topologies, products, and services geared to meet the differing needs of customers all over the world.

LTi REEnergy USA Ltd. http://reenergy.lt-i.com Booth 2041



High-accuracy pyranometer

Kipp & Zonen's new SMP10 pyranometer offers all of the performance advantages of the successful SMP11 model with Smart interface, but without the need to regularly inspect the drying cartridge and change the desiccant. The design of the SMP10 enables the internal drying agent to last for up to 10 years. In solar energy, especially for solar monitoring stations in remote locations, low maintenance of instruments is a major advantage. When the SMP10 is combined with the new Kipp & Zonen CVF4 ventilation unit, manual cleaning of the dome is needed less frequently. The swirling airflow reduces soiling and keeps the dome free of dew and precipitation. SMP10 is the next step in further improving the accuracy, and reducing maintenance, of the most reliable range of pyranometers worldwide

Kipp & Zonen | www.kippzonen.com Booth 2218



GERMAN HEART



- UL certification available by Q4/2014
- Flexible modular system allows global production of turnkey solutions
- Newest technology offers highest efficiency
- Compact power electronics in a robust housing ensures easy maintenance
- Localization of individual value chain levels reduces transport costs and delivery times





LTI REENERGY

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Prospecting, assessment & forecasting

Vaisala 3TIER Services' Solar Prospecting Tools enable developers, manufacturers, and installers to quickly explore solar potential worldwide. Plus, their Solar Energy Assessment offers accurate, long-term estimates of net-energy production and uncertainty, by taking into account all of the factors that affect production at a proposed location. For post-construction operations, Vaisala's Solar Forecasting service was developed through a partnership with one of the southwest's largest utilities and solar energy producers. The resulting system was piloted, tested, and improved based on performance in real-world applications at actual utility-scale solar projects. This system is capable of providing an irradiance and power-forecast specific to a site's distinct geography and climate. In addition, Vaisala provides Solar Performance Reconciliation to compare power production, with actual irradiance conditions on a daily, weekly, or monthly basis to help clients make informed decisions about power management, system improvements, repairs, and maintenance.

Vaisala 3TIER Services www.vaisala.com/renewable Booth 1451



Horizontal solar tracker

NEXTracker represents a significant breakthrough in horizontal tracking, with lower costs, better performance, and more flexibility. As incentives in the solar industry taper off, economic fundamentals increasingly determine which projects are developed and financed. NEX-Tracker eliminates many of the design, cost, and performance compromises inherent in linkedrow trackers, increasing solar project profits by 10%+. Its unique balanced-mass, self-grounding, and independent-row design significantly reduces foundations and enables wider rotation angles. NEXTracker empowers solar project owners to maximize profits: offering up to 40% few foundations per megawatt; requiring no grounding materials or installation labor; providing site flexibility with more megawatt capability per site and higher energy yields; and reducing O&M costs. NEXTracker is uniquely positioned to deliver long overdue cost and time-saving innovations to large-scale solar projects.

NEXTracker | www.nextracker.com Booth 2715



Aerodynamic flat-roof system

Aerocompact specializes in the production of an aerodynamic flat-roof system for PV modules and their integration and structural analysis. The system is wind tunnel tested up to 150-mph, conforms to UL 2703 certification, and is delivered pre-assembled with protection mats included. With Aerocompact S, an assembly time of five minutes per kilowatt-peak (kWp) can be reached. With new, specially developed software, customers receive a complimentary designed layout and ballast calculation already in the quoting phase of a project. Aerocompact S has a market leading 25-year product warranty.

Aerocompact (by SST Solar) | www.aerocompact.com Booth 2500



Utility-scale inverters

SolarMax is a manufacturer of grid-connected solar inverters. Their line of inverters includes the RX A series, a central inverter that delivers output power of either 500 kW or 600 kW, addressing the needs of large-scale solar farms. The RX A consists of four independent power units, each with an independent, fast, and precise MPP tracker. It also features independent DC-wiring input, which eliminates the need for fuses and reduces balance-of-system (BoS) costs. The RX A delivers high efficiency and availability, as well as straightforward serviceability to lower lifetime costs.

SolarMax | www.solarmax.com Booth 4515

In-line solar fuse

Littelfuse's new SPXI in-line string fuse provides a full range protection for solar installations, through integration with the solar cable, and 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 onto a cable installation and over-molding—or providing other protection from the elements. Available at 1500 VDC and 1000 VDC, Littelfuse In-line string fuses are offered in multiple ratings up to 30 amps. The SPXI (1500 VDC) and SPFI (1000 VDC) are approved to UL2569.

Littelfuse | www.littelfuse.com/solar Booth 1566





Circuit breaker re-combiner enclosures

AMtec Solar Products and Custom Solutions offer an advanced, installer-friendly line of circuit breaker re-combiners. Available in standard, bi-polar, and ungrounded configurations, this line is ETL listed to UL1741 and CAN/CSA C22.2 No. 107.1-01, 3rd Ed. for use in 600 V or 1000 V systems. Thoughtful standard design features include pre-wired 90° C (194° F) inputs up to 1000 MCM, in a single- or dual-hole NEMA lug configurations for fast and easy installation. Additional features include: NEMA 3R modular freestanding enclosures; liftoff, silk-screened, dead front panels; lock-out, tag-out UL489 and UL489b breakers from 60A to 400A; and a fully open bottom cavity with plenty of space for easy field wiring. Optional features include: input level monitoring; shielded electronics' control housing with viewing window; GFCI detection; oversized enclosures; and more. **AMtec Solar Products and Custom Solutions** | www.amtec1.com

Booth 1739



PV mounting solution

Mounting Systems, Inc. introduces Lambda Light EW+, a fully wind-tunnel tested flat-roof PV mounting solution. The east-west orientation of the modules provides numerous advantages over the traditional south-facing flatroof mounts, including higher energy yields and improved grid-tied performance factors. The east-west orientation provides similar advantages to a single-axis tracking system with none of the moving parts. It also allows fitting more modules in the same space compared to a south-facing array. This system is modular and uses Mounting Systems' patented Clickstone technology, integrated electrical bonding, and extensive preassembly to make installation fast, easy and reliable.

Mounting Systems, Inc. www.mounting-systems.com Booth 3106



Central controllers

Moxa Americas offers complete industrial embedded computing solutions for renewable energy applications. Moxa's V468 and IA3341I embedded computers can serve as the central controllers for mapping and tracking the sun in solar power plants, and data can be sent back and forth between the tracker and control center via the EDS-408A and EDS-508A Ethernet switches. All Moxa products are rugged to overcome harsh environments, ensuring consistent operations, even in the most demanding conditions. **Moxa** | www.moxa.com **Booth 2106**



Smallest sealed contactors

GIGAVAC's HX Series Extended Performance Impervious Ceramic (EPIC) hermetically sealed, high-voltage DC contactors are currently the world's smallest UL508-approved contactors for 1000 V hot switching. Since first introducing the EPIC seal in 2006, GI-GAVAC sealed contactors have become the preferred choice for any application requiring sealed switching. Utilizing the EPIC seal means these high-voltage contactors exceed sealing requirements of IP67 and IP69. Going beyond hermetic sealing, the HX series can withstand the rigors of virtually any harsh environment, whether underwater or in the desert sun. HX series High-voltage Hermetically Sealed Contactors are particularly suited for inverter systems, battery packs, and combiner boxes in solar or wind power systems. Additionally, the HX series is ideal for EV's with high-voltage battery systems, such as high-performance electric vehicles, electric buses, and electric trucks. **GIGAVAC** | www.gigavac.com Booth 137

PV batteries & energy storage

MK Battery, the global supplier of Deka Solar Batteries, provides high-quality and environmentally conscious battery solutions. Deka Solar Photovoltaic Batteries are manufactured in the USA, and exceed the stringent performance standards of the renewable energy industry. The Deka Solar line includes Sealed VRLA Gel and AGM batteries in multiple configurations. as well as select flooded products. The new UltraFlex storage system features the UltraBattery, a completely new class of advanced lead-acid battery technology that manages the variability of renewable energy, smooth power, and shift energy in a safe, reliable, and simple way.

MK Batterv

www.mkbattery.com www.ecoult.com/technology/ultrabattery Booth 336



The invasion for global measurement dominance has begun...

No alien to the high performance solar resource instrument assessment market, Hukseflux solar irradiance sensors are revered worldwide for both accuracy and reliability. When it comes to value and performance, the SR20 Secondary Standard pyranometer is second to none!

- Fastest response time in class
- > Best achievable temperature response
- Lowest calibration uncertainty
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- Exceeds Secondary Standard performance criteria

Hukseflux offers a comprehensive range of ISO-9060 compliant pyranometers, pyrheliometers and related accessories, for virtually any solar irradiance measurement and PV performance testing application.



800-381-8274 info@HuksefluxUSA.com | www.Hukseflux.com

Solar monitoring



Campbell Scientific offers solar-monitoring solutions for all phases of solar power projects. The Solar1000 is an automated data-acquisition package, designed for flatpanel 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. The CSP100 system is also intended for operational assessment of power-producing utilities. With its automated sun tracker, it's used where direct normal and diffuse irradiance measurements are required, such as CSP and CPV sites. Both it and the Solar1000 are designed for SCADA connection. The Solar800 is a turnkey data-acquisition system for solar resource assessment of a project's solar resources and variability. It has fast-to-field features, with easy, flexible data retrieval. Though offered as turnkey packages, these systems retain the powerful, modular nature of the Campbell Scientific product line, with nearly every aspect customizable—from sensors and communication to mounting and power supply.

Campbell Scientific | www.campbellsci.com/solar1000 Booth 245



ESO 10.3 x 38 touch-safe fuse cover is designed to safely and securely insert and extract midget fuses from fuse clips.

- Compact design is touch-safe according to IP20 specifications
- Rated 32A @ 1500 VAC/VDC
 cURus approved when ESO 10.3 x 38 cover is used with SCHURTER CSO fuse clips
- ASO 10.3 x 38 fuse is also available: 1 30A @ 1000 VDC meets gPV compliance to UL 2579; IEC 60269-6

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Ideal for PV and other DC applications including inverters, battery charge controllers, and string fuse holders

SCHURTER





Steel solar structures

Arning Companies, Inc. is an AISC certified steel fabricator with over 30 years experience, specializing in the design, engineering, manufacturing, and installation of carport and canopy solar structures. Arning's in-house architects and engineers can design a custom canopy to cover any specific project requirements. Service and installation are available nationwide by factory trained crews. **Arning Companies, Inc.** www.arningco.com Booth 242

Maximize your Return On Irradiance[™]



O&M is critical to the ROI of your PV projects, and so is your choice of curve tracer

The Solmetric PV Analyzer I-V curve tracer:

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- Largest display with best array troubleshooting features
- Database of 50,000 PV modules
- 1000V, 20A and 30A models
- 300ft wireless sensor range



www.solmetric.com

Renewable energy battery

Crown Battery's 2CRP3690 Power Module offers notable ampere-hour capacity availability to renewable energy system users. With a rugged internal construction, the 2-Volt 2CRP3690 has a heavy-duty plate, cast-on strap, and terminal post components, which deliver strong performance and durability. Posi-Wrap Plate Protection ensures active material retention, protecting the module from internal short-circuits to deliver proven ROI for customers. The low-maintenance design delivers application flexibility, while providing a better solution for temperature management and electrical isolation. It also includes fixed handles and can be installed with or without battery racks.

Crown Battery

www.crownbattery.com www.crownbattery.com/applications/ renewable-energy-systems Booth 2921



Solar management & advisory

Radian Generation (RadianGEN) is an independent solar asset management and advisory firm focused on managing solar assets to maximize return on investment (ROI). RadianGEN offers comprehensive asset management services to operating projects, including financial asset management, contract administration and compliance, and technical oversight. With customers that include utilities, private infrastructure funds, solar developers, and more, the RadianGEN team is comprised of industry executives with experience and expertise in solar project development, acquisition, finance, as well as operation and management (O&M). Managing solar assets from a contractual, technical, and financial standpoint, RadianGEN delivers tremendous results for it clients and investors.

Radian Generation www.radiangeneration.com Booth 151



PV test tools

HT Instruments offers a complete line of quality PV Test Tools for the installation, auditing, troubleshooting, and performance monitoring of solar power projects. The IV curve tracer HT IV 400, for instance, rapidly searches for possible system problems or failures through an intuitive and efficient process. Together with the IV characteristics and main parameters of the device being tested (either for single modules or module strings), this instrument measures the values of temperature and incident irradiation. Acquired data are, then, processed to extrapolate the IV characteristic at standard test conditions (STC), so as to provide a platform for comparison with the nominal data declared by the modules' manufacturer. The IV curve tracer provides results automatically, ensuring the operator doesn't have to perform any calculations or difficult operations. Designed specifically for the needs of the PV professional, HT Instruments' products are cost-efficient and include a three-year warrantv.

HT Instruments www.ht-instruments.com Booth 1754



Solar project contractor

Mortenson Construction is widely recognized for their expertise in renewable energy, as well as 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, designbuild, and 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 145 solar and wind projects, totaling more than 15.000 MW.

Mortenson Construction www.mortenson.com Booth 345



Solar post driver Mojave Industrial Tools Inc. introduces ViperTrack VTA-21, a high-powered solar post driver that's designed specifically for speed and accuracy. The ViperTrack VTA installs 21' piles inline, or articulated 90° models with low transport height. Many powerful features have been added to this model for speed and ease of operation, including additional hydraulic power (up to 99 HP) and twin power-stroke (2500 ft/lb). With patented options available, the ViperTrack provides: strength and speed; height and accuracy; auto-tilt, shutoff, and level; side-shift with joystick control; five-axis authority; and many other features, such as hard rock drilling. Highly accurate helical earth anchors and ground screws can also be installed. ViperTrack is made in the USA, with 24x7 worldwide service.

Mojave Industrial Tools Inc. www.mojaveindustrialtools.com Booth 1561



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Installation Testers

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PV tilted mounting

Advanced Racking Solutions offers innovative mounting systems for all types of PV metal roofs. VICERACK tilted mounting is the preferred solution for low-pitch, standing seam metal roofs. Superior to flush mount, VICERACK design enhances system ventilation and reduces roof loading (with less than 2 psf). Available in a range of inclinations, up to 30°, VICERACK's thoroughly engineered and patented design means that all areas of a roof can be populated, including the north and negative pitch for optimum system performance. Aisles and walkways provide access to all modules in the array for operations and maintenance (O&M).

Advanced Racking Solutions | www.advancedracking.com Booth 2064

Industry Leaders in Solar Boost[™] Charge Controllers Maximum Power Point Tracking (MPPT)



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SB3000i

Next generation Solar Boost[™] Charge Controller with built-in digital display and packed full of features. The SB3000i includes 30 amp MPPT solar charging for up to 400 watts PV in 12V lead-acid/AGM/gel or lithium systems and is suitable for low cost 60 cell grid-tie modules too.

This feature rich controller includes our popular IPN[™] network technology, a built-in amp hour counter, auto night time dimming, 3 stage charge control and 2 amp auxiliary output or load control. Settings are fully adjustable for charge and load control at the controller.

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Key Benefits

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* 20 Year Warranty

* Few components for greater

* Components available separately

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- Geotechnical Testing
- Engineering Services
- Installation

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Your turnkey solution for ground-mounted solar projects.

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Pyranometer with digital output

The latest SR20-D1 pyranometer from Hukseflux features a digital output signal for communication over RS-485 RTU (MODBUS protocol). Suitable for continuous GHI, POA, or diffuse solar irradiance measurement, the SR20-D1 pyranometer is performance-validated during production on an individual sensor basis to ensure the utmost quality and performance compliance—in accordance with the ISO-9060 standard as a 'Secondary Standard' compliant sensor. The SR20-D1 electronics process the raw detector and temperature signal data onboard, then output the raw and temperature processed corrected real-time solar irradiance in W/m^2 measurement units, when polled by the host SCADA/logger system. HuksefluxUSA | www.huksefluxusa.com Booth 1560



Flat-roof mounting solution

EkonoRack 2.0 is the flat-roof mounting solution made up of only three major components for a straightforward and rapid installation. The economical system is made with high-grade aluminum components, featuring integrated roof protection mats. EkonoRack 2.0 is ETL certification to UL 2703 standards, allowing it to be grounded only once per array. With the EkonoRack 2.0 an installation rate of 2 kW/man-hour can be achieved. The simple, durable mounting solution is designed to be modular and flexible to meet a variety of project needs. KB Racking | www.kbracking.com Booth 2741



Plug-and-play energy storage

JuiceBox Energy introduces plug-and-play advanced energy storage for renewables. The JuiceBox system is an 8.8 kWh lithium-ion battery and system controller that provides peak shifting, demand charge management, and backup power for solar and wind energy installations. The system controller provides a robust interface between the battery management system and the inverter/ charger. It determines the optimal charge and discharge schedule, based on electricity rate schedule, predicted building load, and customer operational priorities. The system is designed and tested to ensure safety, reliability, and a long life over all operating conditions. The JuiceBox enclosure is floor or wallmounted, and connects to an external third-party inverter/charger. The system is designed for residential and light commercial energy storage. JuiceBox Energy | www.jboxenergy.com Booth 4218



Multi-function junction box

Multi-Contact's new, open-format Multi-function Junction Box (rated 12 A, 1000 V), with integrated MC4 connector, allows for countless possible configurations to suit a wide range of applications. The base enclosure PV-JB/MF carries certification, allowing for minimal re-test requirements. The junction box is available with several tiers of engineering and manufacturing support. It can be supplied as complete solution or be purchased as stand-alone enclosure for a complete customergenerated solution. Customers can use the same base enclosure for several different product offerings, allowing cost-optimization without performance or reliability loss. Time and cost savings are achieved via a cable-free, automation-friendly, and greater packaging density design. The PV-JB/MF has been designed for Multi-Contact's MC4 photovoltaic connectors, meeting the global industry standard. Multi-Contact www.mc-pv-portal.com Booth 3127



Customizable solar proposal software

The ModSolar Platform enables users to quickly and easily generate commercial and residential proposals in the office or on the road. The platform provides users with the ability to automatically layout solar panels on a pitched or flat roof, or on the ground. It also allows the user to choose which panel is the best fit for the space and desired outcomes. Additionally, the ModSolar Platform offers customizable options, such as panel size, manufacturer, or color to match a brand. There are financial parameters for ROI calculations, energy inflation, and cost of electricity, and proposals can be further customized by inserting data values. The optional CRM integration allows users to share leads on the platform with an individual CRM system. ModSolar | www.modsolar.net Booth 2104



PV battery & financing model

Solar Grid Storage has developed an innovative business model that allows batteries to be added to commercial solar photovoltaic installations. This solution eliminates the need for PV developers to purchase a solar inverter, lowering costs and adding new benefits. The company's technology, PowerFactor, helps balance power on the grid and provides emergency power. The Solar Grid Storage offering is the first time in the solar industry that a financeable model has been developed to deploy commercial level storage with solar energy. Solar Grid Storage

www.solargridstorage.com Booth 1545



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Enclosures



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Solar monitoring & control

OPTICS RE is a Cloud-based system monitoring and control application that provides installers and owners of OutBack Power systems the ability to easily track PV/solar system operation, performance, and output via an intuitive dashboard from any Internet-enabled device in real time. Paired with OutBack's newest Radian inverters—which feature GridZero technology and Advanced Battery Charging for compatibility with any future or existing utility energy scenario—OPTICS RE gives installers more control over their renewable energy production and higher returns on their system investments. **OutBack Power**

www.outbackpower.com
Booth 2312



General Cable's SunGen line of

while meeting the demanding

copper and aluminum PV wire is

specifically designed to effectively and efficiently connect solar panels,

environmental requirements and

installation challenges associated with

solar projects. SunGen PV wire offers

superior resistance to UV sunlight,

provides stable electrical properties

90°C wet or dry. General Cable's PV

over a broad temperature, and is rated

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Wire is made in accordance with UL

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General Cable | www.generalcable.com

CSA RPV90 and RPVU90 Listed.

Booth 3421

Sarr Intensium Max U-Ion energy stores of som

Li-ion battery system

Saft, manufacturer of high-tech batteries for industry, has announced its Intensium Max containerized Liion battery system. Now capable of delivering an industry leading 1.8 MW peak power in a 20 foot container, the upgraded Intensium Max 20P High Power (IM 20P) is ideally suited to address the ramp-rate challenges of renewable-energy resources, especially large-scale solar PV installations. The IM 20P ensures safe, controlled rampdown of output essential to maintain grid stability, particularly in weak or island grids. The key benefit of the IM 20P is that it offers high peak power without the need to increase the energy capability (MWh) and consequent size of the installation. The result is a competitive solution that enables Saft to meet the application's required power profile within a smaller footprint and volume.

Saft | www.saftbatteries.com Booth 1927



Dual-MPPT string inverters

Chint Power Systems now offers CPS Americas 23 kW and 28 kW 1000 VDC string inverters. A UL-approved and cost-effective alternative to central inverters, these models enable balanceof-systems (BoS) cost savings, high harvest performance, and modular design building blocks. The latest string inverters from Chint Power provide up to 98.6% conversion efficiency, as well as a wide operating window of 400 VDC to 900 VDC. They also offer dual-MPPT's for maximum cash-flow generation.

Chint Power Systems America www.chintpower.com/na Booth 1621



Arc-fault enabled string combiner

Solectria Renewables' ARCCOM offers its customers high quality, ease-ofinstallation, mounting flexibility, safety, as well as protection features. It's compliant with NEC 2014 arc-fault and rapid shutdown requirements, and contains a contactor disconnect, lockable switch, and string-level arc-fault protection—allowing it to detect and interrupt a series arc. The ARCCOM is designed and built for rugged conditions with wide temperature ranges. It's HALT tested to its limits, guaranteeing all components are carefully vetted for the highest reliability. It can have 8, 12, 16, or 24 fused positions, and features standard, oversized compression lugs that allow for long-run output conductors and multiple conduit entry locations. This allows it to be mounted vertically or horizontally, thereby eliminating the need for laborintensive conduit bends. Additional options include surge arrestor and connector plates for those installers who prefer to field-crimp oversized output conductors.

Solectria Renewables www.solectria.com Booth 842



Power harvesting & centralized inverter

Alencon's utility-scale power harvesting and inverter system increases the financial return to developers and owners by increasing PV system yields and reducing capital costs of installations. The reduced capital costs are a combination of its 2,500 V harvesting system that employs smaller cable sizes and reduced installation labor costs. The distributed harvesting system increases yield through string level DC-to-DC converters with individual MPPTs. The centralized inverter further reduces installation costs and operates at an efficiency higher than current industry bests. The system is based on Alencon's patented Harmonic Neutralization technology.

Alencon | www.alenconsystems.com Booth 4125



Solar racking system

Ready Rack Solar, a division of AP Alternatives, engineers and manufactures racking systems for large, utility-scale and small, commercial projects. The core focus of the Ready Rack Solar team is making quality solar racking more affordable for customers. The Ready Rack system reduces costs by optimizing material usage, utilizing only components that are economically manufactured. The system design is a simple configuration that allows contractors to install at lighting-fast speeds, with integrated adjustability features for aesthetic appeal. The selection of foundation options allow the system to be installed on even the most challenging site locations. The Ready Rack has also been designed so customers can easily install the system themselves with basic tools. However, for larger scale projects, foundation, racking, and module installation services are available. **AP Alternatives, LLC**

www.apalternatives.com www.readyracksolar.com

Booth 1668



www.franklin-electric.com/solar

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Strengthening the Domestic Market US distributed wind shows promise By Nikolas Foster



Six 10 kW Bergey wind turbines at Dull Homestead Farm in Brookville, Ohio, (courtesy of Bruce Hatchett; Energy Options)

DESPITE FIGURES INDICATING THE UNITED STATES' distributed wind energy deployments dropped last year to their lowest numbers since 2005, the industry is still standing fairly strong. In fact, signs are pointing toward a modest upswing. More distributed wind projects have already come online during the first two quarters of 2014 than during all of 2013.

Based on a review of the American Wind Energy Association's (AWEA) mid-year project records and small wind sales reports, the market for distributed wind seems right on track to outpace last year's deployments.

Interestingly, one of the key findings of the US Department of Energy's recently published 2013 Distributed Wind Market Report is a 70% increase in small wind exports. The \$103 million value of 2013 exports of small wind turbines (up through 100 kilowatts) is significant, considering that exports of utility-scale, wind-powered generating sets for the same year have been valued at \$421 million. US small wind turbines were exported to more than 50 countries in 2013, with top destinations including Italy, UK, Germany, Greece, China, Japan, Korea, Mexico, and Nigeria.

Granted, this growth in exports was partially driven by the weaker domestic market and, therefore, a shift in small wind manufacturers' focus toward growing international markets. Representing nearly 2,700 units across 36 states, Puerto Rico, and the US Virgin Islands, 2013 US distributed wind deployments totaled 30.4 megawatts (MW)—just 17% of those seen in the record year of 2012.

This figure was not quite as severe as the drop for all wind turbines (greater than 100 kW) installed in the United States in 2013, which stood at just eight percent of those installed in 2012. These market slowdowns, undoubtedly, correspond to the expiration of federal tax credits and other reduced state and federal programs.

Capacity trends

The Distributed Wind Market Report made note that more than 80% of new 2013 distributed wind capacity was from projects using turbines above 100 kW in Colorado, Kansas, Ohio, Massachusetts, Alaska, Indiana, North Dakota, and Puerto Rico. Texas, Minnesota, and Iowa retained their positions as the top three states with the most distributed wind capacity deployed since 2003.

Distributed wind involves the use of wind turbines in smaller capacities, whether off-grid or grid-connected, to offset all or a portion of the local energy consumption. These wind systems are either behind the meter, or connected directly to the local grid to support grid operations and local loads.

Although the size of wind turbines in distributed applications can vary, residential-scale wind turbines are commonly up to 10 kW, offering renewable energy for households and smaller infrastructures, such as ranches or farms and off-grid sites. But distributed wind projects up to multiple megawatts can serve to reduce energy costs for larger agricultural, industrial, commercial, and institutional sites. Turbines up to 100 kW, for example, are still eligible for the 30% federal Business Energy Investment Tax Credit through 2016.

For 2013, the sales of small wind turbines (up through 100 kW) were primarily in Nevada, Iowa, Minnesota, Oklahoma, New York, Texas, and Hawaii. Iowa, Nevada, and California remained the leading states for cumulative small wind capacity.



Figure 1. Cumulative Distributed Wind Capacity – 2003 to 2013



Figure 2. Top states in terms of Cumulative Distributed Wind Capacity – 2003 to 2013

A wind-powered future

From an industry perspective, 2013 was a difficult year, but positive notes for 2014 include: • New financing models;

- Certifications increasing consumer confidence; and
- Stable funding for US Department of Agriculture Rural Energy for America Program, which will have mandatory funding of \$50 million per year for 2014 through 2018.

These new developments might already be having an impact in 2014. Industry leaders are confident about the future of US distributed wind, thanks in part to innovative wind leasing products. These third-party financing options are building on the success of distributed solar, by reducing the resource and operational risks to the customers, while reducing upfront costs. As with solar, customers can now either sign a traditional lease and pay for the use of a wind energy system, or they can sign a power purchase agreement (PPA) and pay a specific rate for the electricity that's generated each month.

"Distributed wind power is poised to be a true American small business success story, with 90% of all distributed wind turbines sold in the US manufactured here," notes Jennifer Jenkins, executive director of the Distributed Wind Energy Association (DWEA). "And distributed wind power is generating clean, affordable and homegrown electricity across all 50 states, keeping the lights on and Americans at work."

Indeed, small and distributed wind power's impact on the domestic manufacturing sector and labor market is reflected in the findings of the 2013 report. The local supply chain is comprised of hundreds of manufacturing facilities, with vendors spread across at least 34 states—where dozens of facilities actively assemble, manufacture, or refurbish wind turbines, towers, blades, drive trains, and other components. In 2013, self-reported small wind turbine manufacturers' domestic content levels ranged between 80% and 95%, with more than two-thirds of generator/alternator, electrical systems, and blades sourced domestically.

According to the DOE-funded Distributed Wind Policy Comparison Tool—which can be used to examine what incentive levels are needed for various scenarios to design successful small wind market environments—the states with currently the most favorable economics for small wind economics include Hawaii, Massachusetts, New York, and Oregon. But that doesn't mean communities in nearly every state across the country can't benefit from distributed wind power.

Access the Distributed Wind Policy Comparison Tool at www.windpolicytool.org.

The US Department of Energy's full 2013 Distributed Wind Market Report is available at www.energy.gov/wind-report.

Pacific Northwest National Laboratory | www.pnnl.gov

Attempting a Step into The Mainstream A look at renewables in Ontario, Canada By Sharolyn Mathieu Vettese

ELECTRICITY IS AN INTERESTING COMMODITY. We depend on it, often without fully understanding it. Many people know little about what goes on behind the switch: the complexities of how energy is generated, distributed, or paid for.

Wrapped up and bogged down in the day-to-day, a lot of people pay little mind to what isn't broken. And human nature, being what it is, can mean that little gets fixed until it is broken— and sometimes only when it's broken beyond repair.

For the most part, this is how the status quo is being maintained for non-renewable energy sources, which are no longer sustainable. Fortunately, there are signs that a shift toward greater renewable energy is beginning to take place, at least in Ontario, Canada. And even despite recent setbacks, including government reductions, feed-in-tariffs (FIT) removals, and reduced financial or incentive support for renewable energy projects.

The Green Energy Act

It seems it was a long time ago when the Ontario government first introduced its 2009 Green Energy Act, which was lauded as groundbreaking because of its FITs for different types of renewables, including wind and solar power.

Today, it is as good as gone. But, The Green Energy Act did make an impact. It opened up a lot of discussion on related subjects, such as:

- The vulnerability of the electrification system to terrorism and severe weather;
- The need to modernize the system to the smart grid (integrated decentralized energy systems);
- The value of educating the public about the complexities of energy generation and pricing; and
- The capacity of the grid, energy storage, even electric vehicles and greater accountability in terms of sustainability.

Nevertheless, there is still much more to do. To better understand what needs to be done, it's worth looking back at what was already done. To ensure the success of the Green Energy Act, the Ontario government relied on two drivers to start this renewable energy initiative: **1.** The micro-FIT, which provides homeowners and other eligible participants with the opportunity to develop a small or "micro" renewable electricity generation projects (of up to 10 kW) for solar power on their property; and **2.** Utility-scale wind farms.

Their successes made them both targets by investors and vested energy players.

fixed charges of delivery, regulatory, and debt retirement—which add up to being around the same cost as the electricity. (Implemented in 1998, the debt retirement has been the government's accounting solution to deal with its Ontario Hydro's stranded debt of \$19.5 billion for nuclear reactors.)

Lastly, the other cost distortion is that the FIT remains fixed over 20 years, while the price of electricity has been rising. So, that gap will decrease or eventually completely close. Currently, the micro-FIT solar contracts are closer in line with the market price of electricity, to reflect the reduction in solar panels prices.

Education & the energy pie

On the upside, the government in Ontario did pay to thousands of small solar generators, as well as to several wind farms. But even so, renewables only account for seven percent of Ontario's total energy pie. This seems hardly deserving of the opposition received, which almost defeated the governing party on this issue. Interestingly, the biggest slice of the province's energy pie is for nuclear power, which is close to 60% (and, many of the opponents of wind farms have come from proponents in the nuclear industry).

It is becoming clear, however, that the real driver for shifting toward renewables is that the government can no longer afford to subsidize the energy status quo. Government is running persistent deficits, and there isn't any additional money to support the energy sector as is, especially when other sectors (such as health care) are adding fiscal pressure.

The Ontario government's long-term plan now is conservation, which is the cheapest option, followed by a variety of energy generations—including renewables. To its credit, the government is acknowledging the value of keeping consumers informed about how energy is generated, and its complexities, by setting up a new website, "emPOWERrme," on the Ministry of the Environment's website (check out www.energy.gov.on.ca/en/empowerme). The question is whether a website is enough.

The value in educating consumers is that there will likely be less resistance to price increases, and less information manipulation. What's missing from "emPOWERme," however, is the total transparency and accountability of the real cost of energy generators, including all government subsidies. If this were visible, then it would be easier to make a true cost comparison.

Education will also likely encourage conservation, as there will be a greater understanding and appreciation for the costs of generating power and electricity, which is still undervalued today. Alternatively, the government may consider supporting all forms of energy with a FIT, and regulation. However, this is unlikely to happen.

Sharolyn Mathieu Vettese is the president of SMV Energy Solutions.

SMV Energy Solutions | www.smvholdings.ca

The price of success

When the solar micro-FIT was introduced, it caused a stampede. It was an obvious opportunity to make money when the going rate for electricity was \$0.06/kWh and the micro-FIT was paying \$0.802/kWh. The government was overwhelmed with tens of thousands of applications, which simply couldn't all be processed.

The generosity of the solar micro-FIT and the visibility of the mega-wind turbines became lightning rods for opposition parties' election campaign. But, both government and opposition leaders seemed unaware of the fact that the FIT is only paid for by the amount of energy generated over a 20-year contract—so, no money was allotted for the capital and installation expenditures.

What this means is that the government subsidy for renewables wasn't on the same basis as non-renewable sources, which are heavily subsidized from cradle to grave and have been for decades. Therefore, the price comparison between the existing price charged to the customer and the price paid for solar energy wasn't a direct comparison. It seems this misinformation has often directed public opinion in favor of the status quo.

At the same time, another distortion to the cost comparison existed. The real cost of electricity was not \$0.06/kWh, but closer to \$0.13/kWh, because of the required additional





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www.canwea.ca

show in print



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 longstanding 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



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. With over 1,370 MW throughout Canada, they are experts in all areas of project development, including: site selection; procurement; financing; permitting; project planning and construction; longterm management; operations 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 over 8,095 MW of energy under contract, EDF Renewable Services is a provider of third-party operation and maintenance services in North America.

EDF EN Canada

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Renewable energy consultant

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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 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. AMEC Black & McDonald has constructed over 1,000 MW of wind and 50 MW of solar development, with another 600 MW of wind and 25 MW of solar currently underway. **AMEC Black & McDonald**

www.amecblackandmcdonald.ca





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TWR Lighting www.twrlighting.com



Tower switches G&W Electric provides switches to the renewable energy industry, including for wind and solar power projects. These products comprise of in-tower and padmount out-oftower switches, as well as primary metering options. G&W Electric products are maintenance-free, weatherproof, and can be used in submersible applications, as they are impervious to the environmental elements typically found in offshore wind applications. Ratings include 38 kV, 630 amps continuous, as well as fault interrupting up to 25 kA (-40° C to +50° C \mid -40° F to 122° F). Certification includes IEEE, ANSI, and CSA Approvals. **G&W Electric** www.gwelec.com



Utility-scale wind & energy storage

RES Canada offers in-house development, engineering, construction, and operations expertise for the utility-scale wind and energy storage markets. With development and construction teams under one roof, collaboration is increased, enabling RES Canada to be more efficient and proactive when developing wind or energy storage projects. They also offer safe, reliable, and economical energy storage systems that can provide ramp mitigation, in addition to offering fully developed frequency regulation projects with interconnection. **Renewable Energy Systems**

Renewable Energy Systems Canada Inc.

www.res-americas.com/en/about-us/ res-canada



/acuum circuit breaker & grounding switch EMA Electromechanics, LLC is

the designer and manufacturer of the VDH/GSMI combined 34.5 kV outdoor

vacuum circuit breaker and high-speed mechanically interlocked grounding switch. This is a unique, patented system for switching and grounding of wind and solar power collection circuits with noticeable technical and economic advantages in comparison with traditional grounding systems. EMA also offers 34.5 kV metal-clad switchgear, power control centers, and conventional 34.5 kV outdoor substation vacuum circuit breakers. **EMA Electromechanics, LLC**

www.emaelectromechanics.com



Wind power freight & transportation

Challenger Special Commodities Division offers an array of specialized equipment for wind power freight requirements, whether it's oversized machinery that's required or a custom-built assembly. They also provide crane and rigging services, project management, comprehensive pre-planning, routing, and viability research. They further offer fully computerized satellite tracking to reinforce peace of mind when it comes to important project deadlines. Meeting any transportation and supply chain challenges, Challenger Special Commodities Division has one of the best safety records in North America, guaranteeing freight arrives at its destination safe, on time, and damage-free. **Challenger Special Commodities Division** www.challenger.com



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



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Land



Wind energy construction

Lafarge is a provider of construction materials, with a strong focus on building better cities and communities across Canada. Within the wind energy sector, Lafarge offers innovative solutions and services anywhere in Canada that explore new

and accelerated ways to construct turbine foundations, concrete turbines, surrounding access roads, and transmission lines, utilizing cement, concrete, and aggregate technologies. Working with Lafarge can directly result in time, labor, and transportation cost savings, as well as environmental impact reductions. Lafarge's experts design and collaborate with project owners, developers, designers, engineers, and local communities to resolve even the most complex project challenges.

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



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Joining Forces to Save Energy With geothermal heating & cooling

By Will Lange



The geothermal industry's first launched variable capacity residential unit (the 7 Series), which surpasses both the 41 EER and 5.3 COP efficiency barriers

AS GEOTHERMAL HEATING AND COOLING gains in popularity, the relationship between geothermal contractors and electric utilities becomes increasingly important to both parties. From the contractor's perspective, utilities control electricity, as well as many of the rebate and incentive programs that make the installation of a geothermal system an attractive proposition. Just as importantly, utilities regularly interact with their customers—including potential geothermal customers—and have the ability to influence buying habits, particularly as customers look for new ways to reduce their energy usage.

At the same time, utilities are aware of the service contractors' provide. After all, contractors install the systems, educating consumers on how geothermal energy works and benefits system owners. This is critical to the success of the incentive programs created by utilities. Moreover, by working with contractors to help sell consumers on geothermal systems, utilities are experiencing reduced electrical demand—by as much as one kilowatt per ton. Reductions like this can help utilities avoid investing millions of dollars in additional capacity.

It should come as little surprise, therefore, that contractors and utilities are beginning to work together to encourage geothermal investment. In addition to rebate and incentive programs sponsored by equipment manufacturers and federal, state, and local governments, contractors' selling efforts are becoming more recognized and supported, and some utilities have offered to assume the costs associated with installing and maintaining the loop field.

Loop ownership

The main part of a geothermal system that drives potential ownership out of most people's price range is the ground loop. However, the ground loop is an essential component, making all the difference in the cost of operation between a conventional air-source system and a geothermal heating/cooling system.

Loop ownership by utilities provides a solution, offering advantages to multiple parties. Homeowners pay much less in installation costs, bringing the investment in a new geothermal system much closer to that of a more traditional, high-efficiency heating and cooling system. This, in turn, benefits contractors, who can anticipate increased sales by offering customers a much lower installation cost.

Even utilities, which assume the cost of loop installation and ownership, benefit and are well positioned to take this step. First, by doing multiple loop fields, they can secure a volume discount for the work. Second, utilities are well versed in creating easements. Third, these loop fields become assets, and a steady source of income, as homeowners pay a monthly service fee. Depending on the situation, this fee can be a flat rate or a metered rate, which reflects actual usage. In either case, the asset is durable, and the half-life of the loop is long—some as many as 150 years—ensuring a long-term cash flow benefit.

Policy standards & limitations

Unfortunately, not all utilities are able to take advantage of the benefits that geothermal technology offers them. That's because utilities in the United States are hampered by public policy in states that don't recognize geothermal as part of their energy efficiency portfolio standards.

In some states, geothermal doesn't quality because of fuel switching, a term that originally meant the changing out an electric furnace with a propane or gas furnace. In

these cases, efficiency did not change, just the fuel source. Today, however, switching from an 80% efficient gas furnace to a 500% efficient geothermal system is a case of improving energy efficiency more than it is fuel switching. Herein, the goal is to enable utilities to provide incentives to customers for geothermal installations out of their energy efficiency portfolio standards by eliminating barriers to promoting the technology.

To date, Illinois, New Hampshire, and Maryland have all taken the bold step of classifying "thermal energy," meaning geothermal heat pumps, into their definitions of "renewable energy." Forward-thinking states such as Arizona and Massachusetts may soon follow suit. This means contractors and utilities promoting renewable energy can derive similar benefits from geothermal energy that previously were restricted to technologies such as wind and solar power. Perhaps, the most enticing point here is that geothermal heat pumps offer the highest financial viability of all renewables—even without government supports.

Making progress

As utilities struggle with these issues, rural electric cooperatives (which are largely self-regulated and not subject to PUC approval) and municipal electric systems (which are overseen by city councils), find it easier to support geothermal with incentives and loop ownership. And, much like investor-owned utilities, they benefit from both. In an uncertain regulatory and financial environment, cash flow from thermal services gives these utilities a rock-solid investment in infrastructure at a very low risk.

In Oklahoma, for example, Western Farmers Electric Cooperative (WFEC) and its distribution co-ops have launched a program providing geothermal loops to members for low monthly fees. The program has contributed an average reduction in peak load of 0.65 kW per ton. This represents major progress toward the co-op's stated goal of removing more than 100 megawatts (MW) off their peak load and avoiding construction of another power plant.

Meanwhile, in the city of Wyandotte, Michigan, Wyandotte Municipal Services is drilling ground-source wells in utility easements—at a cost of about \$10,000 per home and connecting several houses to each well. A local contractor, Capp Heating and Air Conditioning, Inc., is installing the heat pumps and connecting them to the wells. When it began, the program identified 48 installations, including 25 new residential installations, 19 retrofit residential installations, three commercial installations, and one new 20-unit multi-family development.

These, and other examples, indicate an increase in the partnerships being forged between geothermal contractors and utilities, as well as electric cooperatives and municipal electric systems. The goal is to demonstrate the benefits of geothermal technology and shape public policy, offering everyone interested—from the homeowner to the utility owner—the opportunity to experience those benefits firsthand.

Will Lange is the director of Distributor Sales and Utility Development at WaterFurnace International.

WaterFurnace International, Inc. is a manufacturer of residential, commercial, industrial, and institutional geothermal and water source heat pumps.

WaterFurnace International, Inc. | www.waterfurnace.com



Large-diameter pipe

REHAU introduces its new 1-1/4" RAUGEO U-bend. Previously available only in one-inch diameter, the new larger diameter pipe brings the benefits of cross-linked polyethylene (PEXa) technology to larger, more demanding geothermal projects. The new, 1-1/4" U-bend makes it possible to utilize deeper boreholes, increasing the heat exchanged and potentially reducing the total number of boreholes required for a project.

Single or double U-bends are now offered in continuous coil lengths of 360, 410, 460, and 510 feet. Composed of PEXa pipe, EVERLOC fittings and balancing manifolds, the RAUGEO ground-loop heat exchange system is a high-efficiency geothermal energy source for heating and cooling.

REHAU | www.na.rehau.com/raugeo



Hydronic valves

Caleffi's Z-one Series valves are used to automatically shutoff the flow or to redirect hot and chilled water in geothermal, hydronic heating and cooling systems. They are UL listed for plenum installations. Plus, when a Z-one Zone Valve is installed together with a ZVR Z-one Relay, both qualify for Caleffi's industry exclusive five-year warranty. The ZVR Series of controls are used for zoning up to six zone valves (model dependent), along with a system pump, secondary pump(s), and primary pump **Caleffi** | www.caleffi.us



The TRIAC SY Series Scotch Yoke Actuators provide an ideal solution for applications where steel actuators are required

due to corrosion protection requirements that aluminum actuators don't adequately handle. Available in Double Acting and Spring Return, these quarter-turn actuators cover a broad range of torques (from 800 to 12,000 torque). The SY Series offers easy rotation selection from fail-closed to fail-open, by simply turning the actuator over and re-mounting. ISO mounting pad and Namur slots allow for quick, precise adaptation of control accessories, including limit switches, positioners, and feedback devices. Convenient jackscrew manual overrides provide for operation in the event of loss of plant supply air. A-T Controls

www.a-tcontrols.com



Geothermal heat pump

WaterFurnace International, Inc. has introduced the new Envision2 NXW Chiller, providing water heating and water cooling for a wide range of applications. Available in 10- to 50-ton capacities, the NXW will fit through most doors and features external fork truck lifting points for easy installation. Designed to perform to the highest standards in the industry, the NXW can be used as a water source heat pump or as a geothermal heat pump.

Equipped with an improved control box that provides clean wiring and easy accessibility, NXW includes an emergency shutdown button and a user interface to aid in setup and diagnostics. Additional features include: Class J fuses for short-circuit current rating (SCCR) up to 100 kA; temperature sensor wells for accurate water temperature sensing; copper-brazed, oversized, stainless steel heat exchangers for high-efficiency and low waterside pressure drop; and optional temperature set-point control software to control leaving load temperature. The Envision2 NXW Chiller is controlled using FX10 microprocessor controls, enabling an easy connection to a Building Automation System with N2 Open, BACnet, or LonWorks protocols. WaterFurnace International. Inc.

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www.geo-energy.org

show in print

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



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Geothermal power applications

Geothermal Development Associates (GDA) is a privately held company with over 35 years of experience in geothermal power and direct-use applications. Their staff of engineers, geologists, and geoscientists have 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 highquality 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



Geophysical exploration firm

The Dewhurst Group, LLC (DG), together with RESPEC, Inc., specializes in discovery, characterization, drilling management, economic, environmental and social impact assessments, and feasibility studies of geothermal resources. DG/RESPEC features internationally recognized geologists, geophysicists, and engineers. In addition to proven ground techniques, DG is currently developing small, Unmanned Aerial Vehicle (UAV) platforms for the collection of airborne magnetic, photographic, and thermal imaging data. Their goal is to mitigate and manage risk. Methods include: cost-effective identification; location and characterization of exploitable geothermal resources (or conversely verifying that none exist); as well as optimizing the placement and well designs for exploration, production, and injection drilling campaigns. DG is the only geothermal exploration company that's an institutional member of the Washington Chapter of the Society for International Development (SID). The Dewhurst Group (DG)

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Airborne full-tensor gravity data

Bell Geospace acquires airborne fulltensor 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



Turbine & ORC solutions

Cryostar specializes in rotating equipment for various industries, including the geothermal sector. Cryostar started its activity with liquefied gas distribution pumps manufacturing, and extended rapidly to process pumps and turbines production for air separation units, including equipment for clean energy projects. The company offers engineering and procurement of customized turbine and ORC solutions, based on their technology of radial inflow turbine with variable nozzles, which is ideally suited to binary cycles. Cryostar's technology of highly efficient radial inflow turbine matches the needs of geothermal applications, either with Kalina Cycle or Organic Rankine Cycle (ORC). Their Turboexpander-Generators offer exceptional off design performances. The Cryostar ORC effectively harnesses the potential of a given resource for a maximized annual production.

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Left: City of Tulare's floating gas collection cover collects up to 600,000 ft³ of biogas per day

Above: Aerial shot of the four-acre floating gas collection cover at the Tulare Waste Pollution Control Facility

Leading by Example City of Tulare puts waste-to-energy into practice By Darin Evans

LOCATED IN CALIFORNIA'S RENOWNED SAN JOAQUIN VALLEY, the city of Tulare is bordered by coastal mountains and three beautiful national parks (Yosemite, Kings Canyon, and Sequoia). The city's long-standing mission statement is: "To promote a quality of life, making Tulare the most desirable community in which to live, learn, play, work, worship, and prosper."

What's not mentioned in this statement, however, is the city's ongoing desire and commitment to a more sustainable way of life. This fact is worth noting considering that

Tulare just celebrated 25 years of dedication to producing energy from the industrial wastewater being sent to its treatment plant. This is an impressive achievement considering most regions have only begun to consider how alternative forms of energy can fit into their community's power plans.

Making use of industry

As California's top agricultural-producing region, the San Joaquin Valley is sometimes

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with its rich agriculture, Tulare is known for its dairy industry and is home to six large-scale dairy producers. Like many municipalities, the city faces challenges to meet industrial wastewater treatment requirements at a reasonable

treatment requirements at a reasonable cost, while maintaining harmonious relationships with the surrounding community. To this end, the Tulare Board of Public Utilities (BPU) and city council have been innovative in selecting technologies that leverage its unique environment, and that provide maximum value to the Golden State's industries and residents.

referred to as "the nation's salad bowl" because of the great array of fruits and vegetables grown in its fertile soil. Along

From wastewater to biogas

Conservation and energy efficiency are extremely important to Tulare and its local industries—and have been for many years. Back in 1989, the city selected anaerobic digestion technology as an efficient means of treating local wastewater to meet state regulations. The dairy facilities in Tulare—including Nestlé-Dreyer's, Saputo Cheese, Kraft USA, and Land O'Lakes—produce large volumes of high-strength industrial wastewater that's sent to the city for treatment. Anaerobic digestion of industrial wastewater causes naturally occurring micro-organisms to break down organic materials and produce biogas, which is a mixture of methane and carbon dioxide. The technology has allowed Tulare to comply with strict discharge limits. Moreover, it also offers an ability to convert waste to energy. As part of the anaerobic digestion process, the biogas produced can be combusted to produce renewable electricity, or further processed into compressed natural gas (CNG) fuel. But first, biogas must be safely and reliably captured.

Beyond power production

Since biogas can be used as an alternative fuel to generate green energy, the city of Tulare had been searching for a means to collect biogas from the digester. Such a system would not only help with the city's bottom line by providing attractive energy savings, but it would also contribute to environmental protection efforts by reducing harmful greenhouse gas emissions. Additionally, the right cover would help control foul odors from the Tulare Waste Pollution Control Facility, strengthening the city's reputation within the community.

As a result of these considerations, the solution turned out to be a floating gas collection cover. Typically used for lagoon or large-tank applications, gas collection covers are ideal for applications requiring complete gas containment and gas collection.

The gas collection cover was customdesigned, manufactured, and installed over the complete four-acre surface of the city's digester at the facility. The cover is engineered to be gastight, so that it contains all the biogas generated by the digester, thereby eliminating odors. It is also chemical- and UV-resistant, a necessity in the region to properly withstand the tough environment of the digester and the hot California sun.

Beyond providing an energy alternative, the city of Tulare's gas collection cover is strong and stable, allowing personnel to safely walk across the digester for easy operation and maintenance. Even the rainwater that pools on the cover's surface is collected and drained.

Recognizing sustainability

Tulare certainly leads by example. The city was recently recognized with the Green California Leadership Award for its energy efficiency strategies, which include the waste-to-energy initiative designed to reduce the generation of overall greenhouse gases. This award offers a unique and rare recognition of public sector accomplishments in sustainability. According to the Green California website: "All nominated projects must be publicly financed and executed, and must have provided a measurable benefit to the natural or human environment" (www.green-technology.org).

Today, the gas collection cover installed at the Tulare Waste Pollution Control Facility collects up to 600,000 ft³ (16,990 m³) of biogas per day from the digester. This is enough biogas to generate a significant portion of the plant's required power, making the facility less dependent on the area's electricity grid, while helping to offset Southern California Edison energy costs.

Darin Evans is the VP of GTI Product Management.

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The SHARC Series is a sewage heat recovery system that utilizes raw sewage to heat and cool buildings, and to provide domestic hot water. Environmentally friendly and cost efficient, the system provides a solution for multiple-unit residential or commercial buildings, as well as energy districts.

Doubling Down on Energy-efficient Buildings Adding sewage heat recovery could make geoexchange more viable

By Lynn Mueller

ACCORDING TO THE US DEPARTMENT OF ENERGY, heating and cooling residential, commercial, and institutional buildings account for 40% of the total energy consumed in the United States, and 40% of carbon emissions. And, despite energy-efficiency efforts, this number is likely only going to get worse. "Over the long term, buildings are expected to continue to

Over the long term, buildings are expected to continue to be a significant component of increasing energy demand and a major source of carbon emissions, driven in large part by the continuing trends of urbanization, population and gross domestic product (GDP) growth, as well as the longevity of building stocks," the Department of Energy (DOE) noted in a recent report. However, most discussions around climate change and reducing greenhouse gases tend to focus on automobiles, energy, and industry. Often times, the buildings that serve as home and workplaces are largely ignored in terms of their contribution to global warming.

At the Canadian GeoExchange Coalition's conference in Vancouver, BC last year, energy economist Mark Jaccard maintained that ground-source heat pumps (GSHP) were an extremely effective way of reducing energy consumption, and he believed that they should be mandatory in all Canadian buildings.

Nevertherless, this isn't happening anywhere in North America, primarily because of the upfront costs.



GeoExchangeBC defines geoexchange as, "low-temperature earth energy (commonly used for building heating and cooling with a heat pump), to distinguish it from medium- and high-temperature geothermal technology (commonly intended for power generation or direct heating applications)."

Geoexchange systems involve no combustion, so they are cleaner and safer to handle than oil or gas. Once installed, these systems can provide 98% of a building's heating and cooling requirements. Geoexchange systems also take up much less space than traditional heating, ventilation, and air conditioning (HVAC) systems, and qualify as "renewable energy"—meeting the requirements of some provincial and state rebate programs.

Nevertheless, it's tough to get past the upfront costs. On a 100,000-square-foot building, it can cost from \$750,000 to one million dollars just to drill the boreholes. So, what if it was possible to cut those costs while, at the same time, saving energy?

Heat recovery

Water enters a building at about 7° C to 9° C (44.6° F to 48.2° F). It, then, leaves the building and enters the sewers at 20° C to 25° C (68° F to 77° F). Most of that heat energy is from showers and dishwashers, but even cold water circulating in a building's pipes picks up heat. And, much of this energy is wasted—literally flushed down the drain. It's estimated that about 20% of the world's energy is simply dumped down the sewer systems.

It's not just heat energy that's wasted, either. Clearly, a lot of water is lost during this process as well. Moreover, air conditioning systems in large commercial and institutional buildings use cooling towers in the evaporation process, which helps in removing heat from a building, but they also use water. In a typical hospital or office building, 20% to 28% of the water used is for heating and cooling, according to the US Environmental Protection Agency.

One way to prevent all of this waste is through sewage heat recovery systems. Simple in design, these systems essentially take all of the wastewater from a building and screen out the solids. At the same time, they re-circulate the filtered water to a heat pump to extract the heat. All the waste that's filtered out is, then, flushed into the cooler water as it continues on its way to the sewer system. Sewage heat recovery can also eliminate the need for cooling towers because it puts that heat into the sewer system.

Cutting costs

In addition to the high upfront costs of only using a ground-source heat pump system, there's the problem of capacity. The ground is a bit like a battery: it can only absorb or give up so much heat on a limited footprint, which is typically the footprint of the building. It reaches a kind of saturation point, becoming less and less efficient in its ability to absorb or give up heat.

So, let's say it's necessary to bore 500 holes for a large building's geoexchange system. Obviously if it was possible to cut that in half to 250 bore holes, it would save about a third of the project's capital costs. Not bad. Beyond that, however, it would also provide a denser energy battery. A sewage heat recovery system, used in tandem with geoexchange, makes this possibility a reality.

If a developer's aim is to meet LEEDs gold or platinum standards, then adding a sewage heat recovery system in conjunction with geoexchange, makes even more sense. (To receive LEED certification, building projects must satisfy certain "green" pre-requisites, earning points to achieve different levels of certification; learn more at www.usgbc.org/leed). What's ideal about combining GHSP with sewage heat recovery is that the two can be retrofitted into existing building applications, so aren't just viable for new construction.

Considering that ground-source heat pumps can provide 98% of a building's energy needs, and sewage heat recovery dramatically reduces capital costs, it's simple to see that combining the two technologies saves costs. Moreover, together, they provide an energy solution for buildings that's sustainable, practically self-sufficient, and economically feasible.

Of course, it's important to continue the search and research for cleaner ways to produce energy. But, in the meantime, it's just as important to stop wasting it. Seems we don't have an energy crisis on our hands, so much as we have an energy waste crisis.

Lynn Mueller is the president of International Wastewater Systems, located in Vancouver, British Columbia. She has been a leading advocate of sustainable space conditioning energy systems for the last 25 years, and has pioneered many innovative energy approaches.

International Wastewater Systems was developed to help recover the 400-billion kilowatthours (kWh) of energy that goes down the drain every year in North America.

International Wastewater Systems | www.sewageheatrecovery.com



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More Opting for Gas HVAC Systems

LAS VEGAS - Whether you knew it or not, Americans started 2014 paying the highest electrical rates in the country's history, at least according to the Bureau of Labor Statistics *. And Intellichoice Energy knows all too well how this is impacting their clients and potential clients in the commercial and residential real estate markets.

"When we show potential buyers how much they can save operating our Nextaire HVAC systems versus their conventional systems, they're shocked at the amount of money we can save them!", states John Cole, CEO of Intellichoice. "We're the only company in the United States that sells and distributes a natural gas-based HVAC system. These units are used all over the world and have been for decades, so the technology is proven and the quality is outstanding, but what's best about them is their efficiency. For example, in the heat of our Las Vegas summers, we can save a client over 80% on their electric bill used for their air conditioning system - it amazes a lot of people!", he added. Additionally, the heating side of their Nextaire unit is even more efficient. Intellichoice knows all too well from its research that electric rates are much higher than natural gas rates in many parts of the country, and their Nextaire products take advantage of that disparity.

Add to that the fact that 1) electricity production in the United States is declining (and has since 2007), 2) some area electrical infrastructures are at such a full capacity, that they cannot expand and must incentivize local businesses and citizens to begin using alternative energy products to save electric grid capacity, 3) the aging of the power grid infrastructure is also causing more outages and problems, and by one account, would cost \$107 billion by 2020 to fix and upgrade **, 4) electric companies are being pressured to use less coal by environmentalists, and must resort to more expensive plant firing fuels, and 5) the growing threat of electro-terrorism increases in probability, and therefore, increased security costs are being implemented by many electric companies, the costs of which are passed on to the consumer.

This combination of increasingly critical factors does not bode well for those looking for declining electric rates that drive more conventional HVAC systems anytime soon. Rate projections by the US Energy Information Agency confirms that through 2015, rates on both residential and commercial customers will continue to increase ***. In fact, as Daniel Kish, senior vice president at the Institute for Energy Research puts it, "Everywhere you turn, there are proposals and regulations to make prices go higher. The trend line is up, up, up. We are going into uncharted territory."

"We absolutely have the right product for the right time! At locations all over the country, our clients are saving substantial dollars on their utility costs over what they'd be paying with more conventional units. And with electric rates continuing to climb as fast as they are, natural gas rates staying relatively stable because of production increases, and given the quality of our Nextaire product line, it makes a lot of sense for new and retrofit projects to consider the Nextaire brand for their HVAC systems. We even put together free value engineering reports for potential clients!"

"We absolutely believe we have the best HVAC product on the market for today's residential and commercial new building or retrofit needs", Cole concluded.

- * Source: http://cnsnews.com/news/article/terence-p-jeffrey/electricity-price-index-soars-new-record-start-2014-uselectricity.
- ** http://www.naturalnews.com/036808_power_grid_collapse_outages.html#
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30-02	Energy Storage North America San Jose Convention Center—San Jose, California; www.esnaexpo.com	
ОСТО	RED	
01-02	CanSIA Solar West Calgary, Alberta; http://solarwestconference.ca	
07-08	AWEA Offshore WINDPOWER Conference & Exhibition Atlantic City, New Jersey; www.awea.org/events	
13-15	National Advanced Biofuels Conference & Expo Hyatt Minneapolis—Minneapolis, Minnesota; www.advancedbiofuelsconference.com	
20-21	AWEA Wind Energy Finance & Investment Seminar The Roosevelt Hotel—New York City, New York; www.awea.org/events	
20-23	Solar Power International Las Vegas Convention Center—Las Vegas, Nevada; www.solarpowerinternational.com	
22-24	Greenbuild International Conference & Expo 2014 Morial Convention Center—New Orleans, Louisiana; www.greenbuildexpo.com	
27-29	CanWEA 2014 Palais des Congrès de Montréal—Montreal, Quebec; http://canwea2014.ca	
27-29	World Bio Markets USA San Diego Marriott Mission Valley— San Diego, California; www.greenpowerconferences.com	
28-29	27th Annual Industry Growth Forum Marriott Denver City Center—Denver, Colorado; www.industrygrowthforum.org	
29-30	7th Annual Nebraska Wind & Solar Conference LaVista Conference Center—LaVista, Nebraska; http://nebraskawindandsolarconference.com	
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01-03	Canadian Bioeconomy Summit Westin Harbour Castle—Toronto, Ontario; www.greenfuels.org	
02-03	AWEA Wind Energy Resource & Project Assessment Seminar Wyndham Orlando Resort International Drive—Orlando, Florida; www.awea.org/events	
07-09	Pacific Rim Summit on Industrial Biotechnology & Bioenergy Westin Gaslamp Quarter—San Diego, California; www.bio.org/events	
08-09	SOLAR Canada 2014 Metro Toronto Convention Centre—Toronto, Ontario; www.solarcanadaconference.ca	
09-11	POWER-GEN International Orange County Convention Center (West Halls)—Orlando, Florida; www.power-gen.com	
JANU 19-22	ARY National Biodiesel Conference 2015 Fort Worth Convention Center—Fort Worth, Texas; www.biodieselconference.org/2015	
19-22	World Future Energy Summit Abu Dhabi National Exhibition Centre—Abu Dhabi; United Arab Emirates www.worldfutureenergysummit.com	
EEPP		
02-03	AWEA Wind Project O&M and Safety Seminar Hotel Del Coronado—San Diego, California; www.awea.or/events	
04-05	7th Annual Solar Power Generation USA Congress '15 San Diego, California; www.solarpowergenerationusa.com	
18-20	Renewable Energy Exhibition McHewel Metro Toronto Convention Centre—Toronto, Ontario; www.planetfriendly.net/calendar	
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