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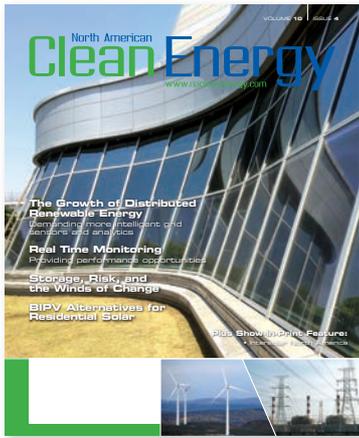
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On our cover...

This commercial installation of AGC's Sudare powered-by-Solaria product is 75 sq. meters of 24 BIPV windows with the objective to introduce thermal insulation, glare control, effective daylighting, 3.7kW of solar power production, and architectural appeal with vision glass.

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JULY/AUGUST 2016
Volume 10, Issue 4

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

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



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BEFORE THE INDUSTRIAL REVOLUTION, WE RELIED ON NATURE TO PROVIDE the energy for our heat and transportation. Wind, fire, water, and the sun were all harvested to power machines like water pumps, grain mills, and steam engines. If these resources were our first source of energy, why then do we now refer to them as “alternative energy?” Synonyms for “alternative” include: substitute, backup, fallback, and second. The industrial revolution was responsible for pushing petroleum and coal forward as our primary sources of energy.

Early innovators such as Thomas Newcomen and James Watt, both responsible for developing the modern steam engine, helped start the energy and industrial revolution. Thomas Edison and George Westinghouse brought electric power and lighting to our homes. Our demand for energy grew and with this lifted our standard of living. During these earlier years, energy production grew to meet demand and no one was concerned about efficiency.

We now find ourselves at a point where our inattention to the ramifications of cheap energy have led to some serious global issues. International organizations such as the Global Solar Council and the Global Wind Energy Council, as well as U.S. organizations like AWEA, SEIA, and ESA to name a few, are working hard to advance the widespread adoption of renewable energy in established and emerging markets. Competitors in the industry are now working together with other industry stakeholders to promote a unified view of the state of their industry, develop solutions, and drive the innovation of new technology. *(see our article on page 46)*

While we are, as a population, very energy-dependent, our focus is shifting from the gratuitous consumption of energy, to a more sensitive view of the consequences of our actions on the earth. There is a growing eagerness to become more energy efficient, and increasingly energy independent. Advancements in technology are allowing project managers, business owners, and residential customers alike to monitor their energy consumption, find areas of over-consumption, and increase safety. *(see our articles on pages 18 and 48)*

As urban development continues, there is a growing desire to not just build a building, but construct a project which does not only consume energy, but also produces it. Net-Zero Energy buildings are no longer a figment of the imagination. Innovations in the solar space, the necessity to meet new government mandates, and new design aesthetics have made residential and commercial real-estate NZE building more attractive than ever. *(see our articles on pages 10 and 14)*

As I write this on the summer solstice of 2016, the earth is at its farthest point from the sun, yet the sun and the wind are still providing us with renewable energy. Our constants, since the beginning of time are impervious to price wars, political power plays, or embargoes. I was recently visiting Columbus, OH and while we were exploring the city we found dedicated bicycle lanes, solar powered trash cans, parking meters, and community bike racks... plenty of evidence that today's urban cities are on the right track. We are at the point when we must continue pushing renewable, clean energy forward until they once again become our primary source of power. I foresee a day when we will refer to coal and petroleum as “alternative” energy.

Enjoy the read.

Jill Walters



Fuel-cell electric vehicle

So deep is Toyota's intent to facilitate widespread adoption of hybrid vehicles and support development of innovative fuel cell technologies around the world, that in January 2015, the company 'walked the walk' by releasing more than 5,600 royalty free fuel cell-related patents, including critical technologies developed for the Toyota Mirai. The 2016 Toyota Mirai delivers 151 peak horsepower and up to 247 lb-ft of torque, with a range of approximately 480 km and a refilling time of about five minutes. The Mirai's fuel tank stores hydrogen, which mixes with air resulting in a chemical reaction that produces two things; electricity and water. Electricity powers the vehicle, while the water – Mirai's only emission - leaves through the tailpipe. Beyond its power supply, the Mirai is very familiar; a stylish, feature-rich, fun-to-drive four-door sedan. The aerodynamic body is highlighted by LED headlamps and daytime running lights, touch sensor front door handles and trunk lid, and 17" alloy wheels. Noise-reducing glass contributes to a quiet, comfortable cabin, featuring eight-way power adjustable front seats, heated seats for everyone, electronic push button start with Smart Key, a heated, power adjustable steering wheel with built-in multifunction controls, a premium audio system with navigation, and more. And as a Toyota, the Mirai also delivers the peace of mind of no-compromise safety, including eight airbags, a back-up camera, blind spot monitor with rear cross traffic alert, and more.

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Historic erection

A Liebherr tower crane recently erected a wind turbine with a hub height of 149m and a blade diameter of 115m at an altitude of around 800m in the Prechtaler Schanze Wind Farm in the Black Forest. The 1000 EC-B with its low footprint erected, for the first time, a wind turbine with a hub height of 149m on the hills between the towns of Gutach and Mühlbach. It is the largest turbine ever to be erected using this crane. With its 31.50m jib and a hook height of 164m, the crane was still able to hoist 100t using four lines – one of the main features of the Flat-Top crane built by Liebherr which has been enhanced for erecting wind turbines. The maximum load capacity of this crane is 125t in the six-line version or 100t in the four-line version.

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The Renewable Energy Professional's Guide for Erosion Control

by Harvey Stephens

For nearly 100 years, scientists have been creating mathematical models for understanding the mechanisms of soil erosion and resulting sediment surface runoff, including a paper in the early 1900s by Albert Einstein, later recognized by the American Society of Civil Engineers to recognize his outstanding achievements in erosion control, sedimentation, and waterway development.

Today, challenges in providing adequate erosion control in the field require a diverse toolbox of solutions. As lands are disturbed, erosion and sediment control professionals are demanding Best Management Practices (BMP) that can be specified, installed, and inspected with confidence. Renewable energy professionals, especially on the operations and maintenance (O&M) side, should take time now to set up proper procedures to prevent problems later. Given the natural settings where renewable energy sites are located, erosion control is essential. Effective erosion controls are not only important to protect a site, but the same techniques prevent water pollution, soil loss, wildlife habitat loss, and property loss.

Protect the site first

Erosion control measures should focus on the site's attributes. Water always behaves the same way; it seeks its own level. What changes is the topography and elevation in the settling points. As soil is deposited, it diminishes the volume of a drainage route or a retention basin. Therefore, drainage routes and basins must be cleared of accumulated obstructions, dirt, and debris. Flow channels, swales, riprap beds, and culverts must be cleaned out to allow unrestricted water passage. In addition to removing debris, trash, and silt buildup, contractors in O&M should make repairs to drain grates, catch basins, inlets, channels, and roadways to ensure storm water flows freely. Maintain a channel cleaning and maintenance program that addresses vegetation trimming, debris, sediment, and trash in those flood channels.

Blockage in culverts can cause water to flow over roadways and also erode or destroy site access infrastructure. To help prevent this, swales or drainages leading into basins must be intact and capable of carrying storm water at a controlled rate. A breach in a drainage route or flow

path negates the design capabilities to move water across the property or into an appropriate catch basin. "Inspect what you expect" by looking at the "story marks" on the property from the last wet weather event.

Hydroseeding

Good erosion control measures will go a long way when it comes to preventing or controlling erosion on both wind and solar energy projects. Hydroseeding is a quick, cost efficient way to apply seeds, mulch, and fertilizer to recently disturbed soils. The value of hydroseed can be seen in both erosion control and dust mitigation. It's also an effective revegetation strategy. Selecting the right contractor is always important and ensuring they have trained applicators who have sprayed on renewable energy projects. Seed mix, mulch rate, fertilizer, application uniformity, overspray mitigation, and other factors must be considered. Selecting the right seed mix for a projects' climate and soil content and working with an unbiased consultant to help determine the appropriate seed is also important. The seed mix can change the price per acre by hundreds of dollars. With projects ranging from 20 acres to 2,000 acres, this cost can be significant.

Weed control is a big land management issue, especially after El Nino drenched most of the nation

this year. Weeds are expected to be at an all-time high, just as fire season kicks in. It could be a good idea to budget a little more than usual for this year's O&M.

One of the biggest weed challenges is contending with tumbleweeds, or Russian Thistle. In the Antelope Valley last year, more than 2,000 tons of tumbleweeds were removed from both solar and wind projects. Tumbleweeds can cause serious problems when they get caught up in racking systems, cable trays, pylons, and inverters. In order to prevent these problems, it's best to be proactive. Each weed can produce up to 200,000 seeds and they contain flammable oils. Mow them while they're still green and physically remove them from the site. Also plan and permit a chemical weed abatement program.

Fire prevention

Dry vegetation is an extreme hazard, especially around potential ignition sources. Owners and operators may expect more visits from fire departments this year thanks to El Nino, so it's important to be in compliance. Most municipalities or county fire departments have vegetation management regulations to remove or mow to a prescribed height before the start of the fire season. Inspections are conducted throughout the dry season, and the property must be maintained in order to remain in compliance. Even if a property owner abates their property early in the season, there is potential for re-growth.

For all power facilities managing vegetation around equipment where an ignition source could occur is another BMP. Around power transformers and inverters, vegetation should be removed in a radius of not less than 15'. Clearing this radius will help prevent a fire from starting if the component has a major failure causing sparks. Inside substations, fenced parameters should be managed to bare ground or rock. In fields, low growing vegetation is often encouraged as a means of mitigating dust, mowing to a height 4" is a BMP to minimize the fire hazard while allowing low ground cover to provide dust prevention.

Most fire requirements ask for a defensible space of 500' for the site, but codes vary by region. Clearing around power poles, transformer pads, and junction boxes is essential. A 10' radius around power poles will help prevent a fire from starting if there is any arching due to a failed component. Trees and large brush should be cleared at least eight' below a power line.

Most roads in high risk fire areas are left 20' wide after a project has been constructed, allowing for access, and acting as a fire break. Using parameter roads and fence lines as a fire break is a site's best defense for the spread of fire whether the source is internal or external. Keeping the ground cover and fence line maintained may require seasonal inspections and services to remove accumulated windblown vegetation.

Given all of the potential devastating effects from erosion, O&M professionals should take every necessary step they can to minimize damage and protect their projects. The past decade of droughts and catastrophic wildfires have left parched landscapes ill prepared, so site assessments and maintenance practices are particularly critical.



Harvey Stephens is the vice president of operations at World Wind & Solar. Harvey is a true solar industry pioneer with 30 dedicated years of utility scale solar experience starting in 1986 with construction and operation and maintenance of the first solar thermal projects in the US. Harvey is a co-owner of WWS, an energy service provider in the renewable energy sector. Providing complete services including land management, reflectivity maintenance and panel cleaning, predictive and preventative maintenance, and full service electrical capabilities from new construction through operations and maintenance, the company also provides staffing and QA/QC services for both the wind and solar industries. WWS successfully services all major turbine and panel manufacturers at scores of renewable energy facilities throughout the United States from New Hampshire to Hawaii.

World Wind & Solar | www.worldwindsolar.com



Key points to consider when using hydroseeding:

- It's a great option for disturbed soil.
- Hydroseeding is normally done after a project is built in accordance with a revegetation plan.
- Selecting a vendor with experience spraying in this array is critical. This is certainly an instance where choosing the best quality is more important than price alone. The lowest costs don't mean the highest values.
- Selecting the right seed mix is also critical. It will impact the overall cost and success.
- Find unbiased insight into the right seed. Some seed suppliers will recommend a seed only they carry, which may or may not be the best value or most effective.
- Hydroseeding should be applied prior to the expected rainfall. Generally, this is October through March.

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REPOWERING THE PLANET

Leveraging BIPV to Transform Buildings, Unlock Power & Meet Renewable Energy Mandates

by Udi Paret



TO PRIVATE AND PUBLIC REAL ESTATE OWNERS, INVESTORS, FINANCIAL INSTITUTIONS, AND INNOVATORS

in green building, it is clear we are past saying, “ultra-high energy efficiency,” and “net zero energy” to sound trendy. It is time for action. Now we need to truly commit to improving energy efficiency and reducing carbon emissions across the global energy and construction industries. Smart leaders are already evaluating their options in energy efficiency and sustainability and will avoid scrambling to meet mandates at the 11th hour. Innovators in solar energy have been working diligently to keep up with the critical demand for solutions that will help us on our path to net zero energy (NZE). One solution that is commercially available and has been tested and validated at Lawrence Berkeley National Lab’s FLEXLAB is building integrated photovoltaics (BIPV). BIPV at its best is a highly energy efficient, architectural glass product that allows uniform view while generating solar power.

BIPV has been gaining momentum over the last ten years and has overcome the key barrier to adoption – a risk adverse construction market. For BIPV to reach mainstream acceptance, two important hurdles needed to be surpassed. First, it was necessary the solutions themselves meet a unique combination of needs including attractive aesthetics and compelling economics, along with seamlessly integrated high performing glass with high power density. Without all of these in conjunction, the benefits did not outweigh the investment in a new technology. Second, decision makers in building and development tend to be conservative and must avoid liabilities at all costs. They prefer to use products from large, reputable, bankable companies they trust will cover certifications, design requirements, and warranties. Having developed partnerships with glazing companies for years, construction companies have been hesitant to consider solutions from emerging innovators. Rather, they are now confident in new technologies as long as they are accessing them through the established leaders in the industry, with whom they already have relationships.

With both of these hurdles behind us, more and more organizations are working with their customers to integrate BIPV into projects to hasten their path towards NZE.

With industry validation and the availability of solutions offering quick paybacks, transparency for optimized daylighting and glare control, energy efficiency, high energy yield, design flexibility, and higher glass to wall ratio, building owners now have a viable way to turn facades into generating assets with clean energy technology that is easy to integrate into existing construction practices. In addition, BIPV can help improve Global



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on all new commercial buildings ten stories and under. There is a huge opportunity to unlock the power potential in building facades. BIPV solutions are poised to take advantage of that opportunity by easily replacing traditional windows, and overcoming cost and technology limitations, and will be critical to helping municipalities reach current and future goals.



Udi Paret is the general manager, Building Solutions for Solaria Corporation

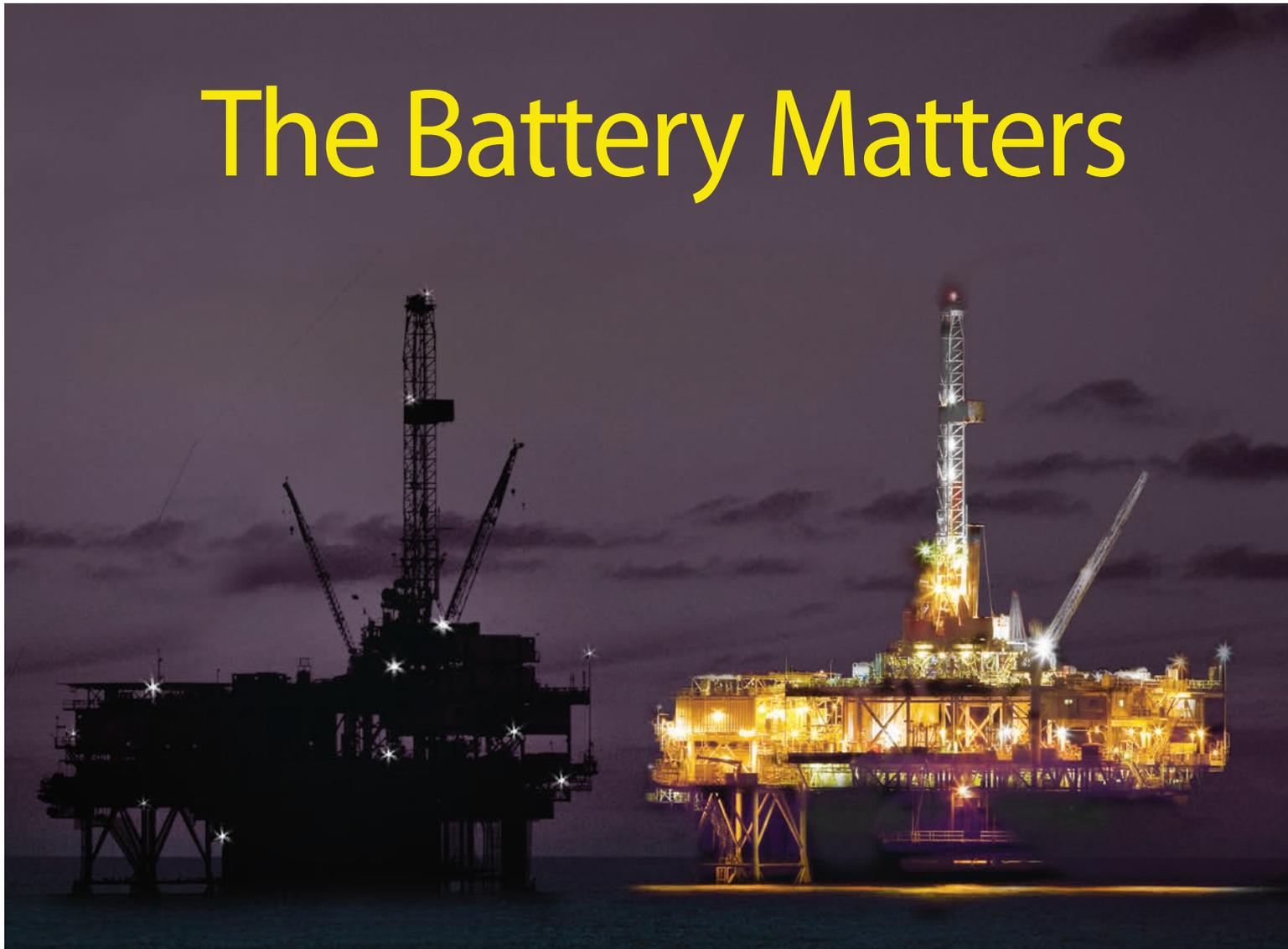
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Real Estate Sustainability Benchmark (GRESB) scores, designed to evaluate and improve sustainability practices in the global real estate sector. With BIPV as part of an overall sustainable design, developers can embark on projects with a clear vision of how to keep costs down while improving the sustainability performance of their real estate portfolios. Even more beneficial is the availability of a holistic set of solutions offering BIPV along with traditional solar rooftop applications for a truly integrated solar strategy.

The demand for clean energy solutions is driven by developers looking to scale NZE across portfolios for high-performing and intelligent buildings. The future of buildings and energy efficiency relies on trusted technologies which help cities, states, and governments reach energy goals. Technology companies have a responsibility to create solutions that incentivize building owners to transition to sustainable business practices. In the BIPV sector, there are a number of ways to introduce power production to transform building facades. Aside from traditional BIPV, there are solar spandrel products, which offer opaque solutions for spandrel applications, bifacial solar solutions, which activate both sides of the module, and solar frit applications, which turn ceramic printing on glass into active frits solutions. Looking forward, we will see more smart BIPV solutions that support smart consumption, lighting, shading, and HVAC controls through smart building skins. These will then interact with smart devices to enable intelligent, connected building skins. It is important for building owners to have customized options to see a clear payback in the successful deployment of sustainable solutions.

This is the tipping point of the transformation of commercial buildings in urban centers from passive to power producing assets. From COP21, 2030 Challenge, SB350, and the recently extended tax package for green building, we're finally getting somewhere. In addition, San Francisco recently passed a new mandate starting in 2017 which requires solar

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Bringing Down Solar Hard Costs with 3D Printing

by Fernando de la Vega, Ph.D.



Solar energy has certainly hit the mainstream market. It is no longer a pipe dream but rather a big player that is becoming a true contender for market domination. For many, a drive to work in the morning means spotting a least a solar panel array or two along the route. But now that solar energy has proven itself in the market, how does growth continue?

In order to further achieve mainstream adoption of solar energy, costs still need to come down. The cost of solar energy has already decreased so much (today's solar panels cost about 100 times less than their 1977 counterparts) that the opportunities for further hard cost reductions are becoming scarce and harder to achieve – for example, lowering cell production costs or less expensive hardware when installing the panels. The conversations these days have centered around soft costs such as customer acquisition, permitting, and labor. However, new innovations prove there is further room for the reduction of these hard costs.

Solar panels are made up of many solar cells, which are usually made of silicon, the most expensive part of the cell. Serving as the semiconductor, silicon is responsible for up to 75 percent of the overall cost of a cell. Improvements in technology for silicon cell production could further drive down solar hardware costs.

When manufacturing solar cells, solar cell metallization plays a major role in the cost of manufacturing. Metallization is the use of conductive inks to print grids on the surfaces of solar cells which draw the current off to an external electrical circuit. Today, the most popular form of printing for solar cells is traditional screen printing technologies in which the screen comes in contact with the cell in order to print. This screen print metallization often results in a high level of breakage (up to 5 percent), a waste of valuable silicon due to the mechanical forces involved in screen printing. Since breakage is already all too common with the current thickness of the wafers, any reductions to their thickness simply is not feasible. However, a transition from traditional screen printing to non-contact digital conductive ink printing could change all of this. Digital printing technologies never come in contact with the cell, and therefore, significantly decrease breakage. Such an advancement enables a reduction

to the wafer thickness, saving valuable silicon, and reducing costs.

The use of conductive inks in digital inkjet printing also saves money by increasing efficiency. With increased solar cell efficiency, fewer cells are needed to harvest the same amount of energy, allowing less product to be used to achieve the same results. The digital printing technology enabled by single-crystal nanometric conductive inks allows for narrower conductive patterns – covering less of the cell's surface with ink – which not only utilizes less of the costly silver for the ink but it also allows for better sunlight penetration.

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Innovative Solar, Inc. | www.innovativesolarinc.com

Until now, inkjet printing technologies had not been able to achieve widespread adoption due to the lack of conductive inks properly suited for the task. Single-crystal nanometric conductive inks are designed to cut solar cell energy costs by 10 to 20 percent. These inks include copper nanometric conductive ink, which delivers the outstanding properties of silver ink with even greater cost efficiency because of the lower cost of copper.

Despite making up only 0.4 percent of the nation's energy supply in 2014, the solar market is growing rapidly. If solar energy becomes cost-competitive with electricity provided from the grid, it stands to make up a significant part of the nation's energy supply. Reducing soft costs is a reliable route to bringing down the cost of solar, but we cannot discount the ability to continue cost reductions in process and materials.

The implementation of innovative technologies can spark cost reductions and increased efficiencies. A combination of both soft and hard cost reductions are required to bring costs down enough to allow solar energy to be a feasible source of energy for anyone in any economic status.



Fernando de la Vega is CEO and founder of PV Nano Cell, producer of Sicrys single-crystal nanometric conductive digital inks.

He holds a PhD in applied chemistry and has a strong technical and management background with more than 20 years experience in the industry.

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BIPV Alternatives for Residential Solar

by Oliver Koehler

TODAY THERE ARE EXCITING NEW CHOICES FOR HOMEOWNERS

contemplating a residential solar investment. Anyone who has been in residential solar for some time knows there are some homeowners who just refuse to put standard solar panels on their roofs, and that many homeowners would like more options on how to integrate solar into their homes. The latest BIPV solutions in the form of solar shingles and solar tiles are now a viable alternative to rack-mounted solar, and can offer a new look, additional savings, and reliability advantages.

Solar shingle and solar tile fundamentals

Solar shingles and solar tiles generate clean electricity from the sun and also function as a roofing material. As such, they are considered a type of Building Integrated Photovoltaics (BIPV), an industry term for solar products which provide a secondary function as a building material. This term is often used in contrast to Building Applied Photovoltaics (BAPV), which describes the conventional rack-mounted approach to solar, where the solar does not provide a secondary function.

Solar shingles and solar tiles are able to provide both solar and building material functions because of their unique design and method of installation. Solar shingles and solar tiles are designed to attach directly to the roof deck in an overlapping fashion, just like a roofing material. This “direct to deck” method enables many smaller attachment points, avoiding the need to attach footings and rails to rafters. The resulting low-profile system enables integration with the surrounding roofing materials. In the case of solar shingles, the integration with the asphalt shingle roofing materials is obtained through an intermediary metal flashing around the perimeter of the solar array.

The basic energy generating solar technology used by solar shingle or solar tile products is essentially the same as that used by standard solar panels. It includes both crystalline solar cells as well as thin film technologies, depending on manufacturer. The real differences compared to standard solar panels are in the design of the framing system and how individual units are connected together both mechanically and electrically.

Homeowner perspective

Homeowners who choose to go with a solar shingle or solar tile system are typically concerned with the aesthetics of what the solar will look like and prefer the low profile appearance of these solutions which blend in better with the design of their home. These products are often more acceptable to concerned neighbors, and could be more likely to support a strong future resale value of the home. In areas of high solar penetration, doing something different than what homeowners see on their neighbor’s roofs is also sometimes a draw.

Other benefits attracting homeowners to these solutions are the savings from not having to put roofing under the solar as well as some unique reliability advantages. For a homeowner who installs a solar shingle system with a reroof of their asphalt shingle roof, the roofing material and labor savings are typically \$1,000 to \$2,000 dollars. For homeowners or homebuilders constructing a new home with a solar tile solution, the savings can be even more. The unique reliability advantages stem from the low-profile

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nature of these systems. Because the cables are protected behind the solar shingle or solar tile, nuisance issues caused by pests such as rodents chewing on cables or pigeons nesting under systems can be avoided. In addition, because solar shingles and solar tiles are attached directly to the deck and are low profile, they can support high wind and snow loads without the need for added footings or rafter reinforcements as is often the case for conventional rack-mounted systems.

Dealer perspective

Solar shingles and solar tiles are typically sold through established solar dealers or roofing companies, many of which have set up a separate solar business unit. The motivations for these companies to carry a solar shingle or solar tile product usually stem from a desire to differentiate their business and convert more leads into sales. In the increasingly competitive solar market, a solar shingle or solar tile offer can help a dealer stand out compared to other competitor offers the homeowner receives and can increase the odds that the dealer gets the homeowner’s business – even if they may go with a conventional system in the end. For roofing companies who are doing solar, solar shingles and solar tiles provide the added benefit that they can be offered as an up-sell to their existing roofing customers. Because solar shingles and solar tiles install in a similar fashion to roofing materials, it is easy for roofers to train and use their existing crews to install the systems.

Value proposition

Although there have been some solar tile and solar shingle products on the market since 2005, today’s products have come a long way in improving performance, efficiency, reliability, and cost. Solar shingles and solar tiles have become more cost-effective, selling for premiums as low as 10%-20% over the fully-installed price for a conventional rack-mounted system. In the future, as volumes grow and relative pricing continues to converge, solar shingles and solar tiles will be able to offer the same or better return on investment because they offer additional roofing material and labor savings.



Solar shingles and solar tiles will continue to evolve and advance, but they have become a viable option, offering residential customers the opportunity to reduce their carbon footprint and achieve long-term savings with solar energy, while maintaining the architectural integrity and value of their homes. Whatever the future holds, one thing is sure, homeowners will have more choices to consider when they go solar.



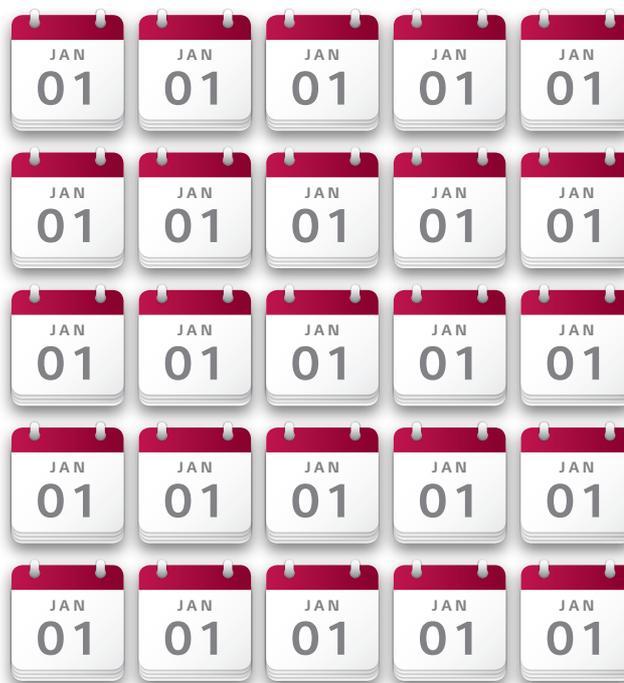
Oliver Koehler is CEO and Founder of Integrated Solar Technology, LLC, dba SunTegra. He has over 15 years of experience in the solar industry and has worked for several solar manufacturers.

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From Cell Phone to Solar Cell

Five practical patenting lessons from the Apple-Samsung patent war

by Jeff Totten

With the negotiation of the Paris Agreement on Climate Change, the passage of new U.S. tax credits for renewables, and growing customer acceptance, renewable and clean-energy businesses are poised for growth. As in other industries that have recently undergone rapid expansion, renewable energy companies may try to use patents and other intellectual property (IP) rights to increase their share of this expanding market.

Patent filings in the renewable energy sector have grown rapidly in recent years. A 2014 study by the World Intellectual Property Organization (WIPO) reported since 2006, patenting activity has increased across the renewable technology sector. Solar photovoltaic, solar thermal, and wind energy all had annual patent growth rates above 20% from 2006-2011, compared to a 6% growth rate for global patent filings. Data from the U.S. Patent and Trademark Office show more than three times as many patents issued for thermoelectric and photoelectric energy generation in 2015 than in 2011.

As illustrated by more than five years of IP litigation between Apple and Samsung over smart-phone technology since 2011, other industries that have undergone rapid growth have experienced periods of patent filings, followed by IP litigation. The Apple-Samsung litigation provides valuable lessons for those expecting growth, and IP disputes, in the renewable energy space. Five of those lessons are worth exploring.

Build a diversified IP portfolio

In its 2011 lawsuit, Apple alleged infringement of utility patents, design patents, and trade dress. These three forms of IP each protect different product aspects. Utility patents—the IP rights most think of upon hearing the word “patent”—protect the technical design of a product or the way of using a product. Design patents protect the ornamental aspects of a utilitarian product, such as the rounded corners of the iPhone and the look-and-feel of its graphical user interface (GUI). Trade dress, a form of trademark protection, can protect aspects of a product’s shape or packaging that consumers have come to associate with the product’s source. Other forms of IP protection, such as trade secrets (secret information providing a competitive advantage), trademarks (the name and logo associated with a manufacturer or product), and copyrights (artistic expression, such as photographs, songs, or even user manuals) can also have a place in a company’s IP quiver. Asserting a variety of IP rights may increase the IP owner’s odds of recovery.

A manufacturer of photovoltaic cells, for example, may want to seek utility patents on the chemical compositions in its cells, use design patents to cover the shape of its roof-top mounting brackets, adopt distinctive trade dress for its packaging and users manuals, and to maintain aspects of its manufacturing process as trade secrets.

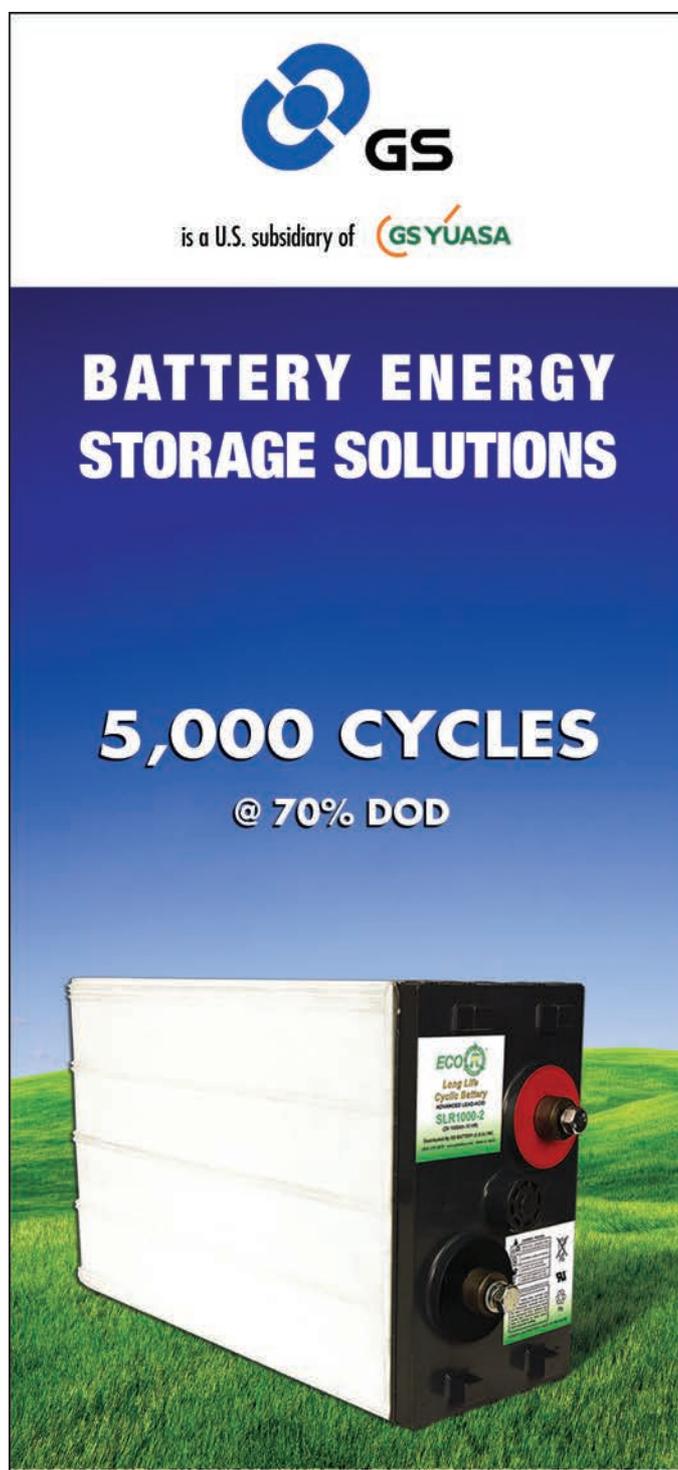
Protecting a range of IP assets also positions a business for future collaboration, sale, or licensing. Patents are regularly licensed or sold. Licenses to trade secrets and know-how may extend beyond the expiration of related patents. Further, trademarks and trade dress associated with a business may have unique value to potential purchasers or collaborators.

Use design patents to protect the product

Apple’s design patents were aimed at the iPhone’s shape, as well as graphical elements that users interfaced with when using their phones. Jurors could easily assess infringement of these features, as they related to the day-to-day interaction consumers have with the product.

Pursuing design patents typically costs a fraction of the costs of preparing and filing utility patent applications. Using design patents to cover, for example, graphical user interfaces, the look and feel of metering and control software, the aesthetic aspects of physical products, and the shape of common replacement parts allows manufacturers to economically protect customer-facing features.

Design patents were responsible for nearly \$400 million dollars in damages that Apple recovered through its suit against Samsung—unlike utility patents, the owner of a design patent may recover an infringing party’s total profit. Samsung has appealed this aspect of the decision to the U.S. Supreme Court, meaning the method of calculating damages for design patents may change. But even if the appeal limits the recovery of an infringer’s profits, design patents will remain a relatively inexpensive way to protect aspects of the product design and user interfaces.



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Defend against attacks from competitors

After being sued by Apple, Samsung retaliated by asserting its own patents against Apple. Samsung counterclaimed in the suit brought by Apple, filed a complaint with the U.S. International Trade Commission, and took the fight to courts outside the U.S. Developing and maintaining IP assets, even if the business does not intend to assert or license them, can provide defensive cover in future disputes. If a competitor claims infringement of its rights, the business can use its own IP to reach an acceptable cross-licensing solution or, if necessary, assert its own IP against the competitor. Further, the business should consider where disputes are likely to arise and seek protection for at least select IP assets in those markets. A handful of U.S. patents may not be enough to protect a company engaged in sales activity around the world, especially where, as in the renewables space, others in an industry are expanding their own patenting activities.

Standards-setting organizations may limit patent rights

Standards setting organizations, such as, IEEE, UL, or ETSI, determine standards used for electronic equipment to operate, connect to utility grids, and communicate. Many of these organizations require members involved in standards-setting activities to license their patents on “fair, reasonable, and non-discriminatory (FRAND)” or “reasonable and non-discriminatory (RAND)” terms. FRAND/RAND obligations may limit a patent owner’s ability to seek injunctive relief (a court order prohibiting a competitor from infringing a patent) or the amount of damages available in litigation. Samsung, for example, was successful in its bid to convince the International Trade Commission (ITC) that Apple infringed Samsung’s patents. But the U.S. Trade Representative, citing Samsung’s obligation to license the patents on FRAND terms, denied injunctive relief.¹ Businesses seeking to license or assert their patents should consider the impact of FRAND/RAND obligations and, where possible, secure IP protecting aspects of their products not subject to those obligations.

Prepare for a long haul

Disputes between arch-rivals can lead, as they did during the “cell phone wars,” to drawn-out, high-stakes IP litigation. When an industry is poised for rapid growth, some companies see litigation as a path to increased market penetration. Their competitors should prepare to meet that challenge with their own IP portfolios.



Jeff Totten is a patent attorney who assists clients in the renewable energy sector, as well as other industries, with intellectual property (IP) litigation, patent validity challenges, patent prosecution, and strategic counseling. He is a partner at Finnegan, Henderson, Farabow, Garrett, & Dunner LLP, one of the world’s largest law firms focused on IP.

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¹ Monetary damages are not available before the ITC, leaving Samsung with no remedy against Apple in this ITC investigation.



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The Growth of Distributed Renewable Energy

Demanding more intelligent grid sensors and analytics

by Michael Bauer

AS THE TECHNOLOGY AND ECONOMICS OF DISTRIBUTED PV SOLAR CONTINUE TO IMPROVE, strong growth in U.S. capacity is expected to continue. It is projected by the year 2020, between four and five million homes will have rooftop PV solar with combined power capacity that exceeds the Three Gorges Dam in China, the world's largest power plant. The growth will not be limited to the areas of the country with the most sustained sunshine, like California. Instead, this phenomenon will be nationwide, as payback for rooftop PV is now estimated to be around 10 years or less in the majority of American states.

A demand for more advanced sensor and analytics technology

As the U.S. grid undergoes this metamorphosis into a distributed model with a two-way power flow, the information required from the grid will expand from traditional safety and reliability data to include economic and technical data for siting feasibility and future innovation. This will not only require a proliferation of new sensors to record grid activity and events, it will demand a new generation of intelligent sensors equipped with high-resolution oscillography technology and waveform analytics in the sensor unit itself, as well as advanced analytics software on the head end for more detailed analysis.

The large scale deployment of intelligent sensors represents a significant paradigm shift in the way utilities exploit information from the distribution grid. Over the past 120 years, the utility industry has never placed major emphasis on distribution grid analytics. Relatively few sensors have been deployed here, and even today, many utilities do not collect and analyze a great deal of information from this part of the grid. As always, the number one objective of gathering information on power delivery will remain public safety. Next on the list is reliability, as ever more of our lives and commerce depend on uninterrupted electrical service.

Defining the top power delivery objectives

Whether or not the grid is one directional or two, safety will still remain the number one priority. Furthermore, as solar continues to become more attractive, utilities will be challenged to provide data on where this additional generation should be located. This is particularly important as more C&I customers adopt distributed energy resources (DER) with the potential to become major generators. Solar demand will put pressure on utilities to provide new innovation, not only in the technology to safely operate the infrastructure, but also innovation in the packaging and pricing of this distributed power generation. The quickest and most efficient way to meet these objectives is through better grid analytics.

Improved safety and reliability

Grid analytics are becoming a vital component of the Utility Industry's public safety initiatives. They can help detect, pinpoint, and expedite the removal of hazards such as energized power lines on the ground. Although utilities have managed to continually improve restoration speeds, they've made less progress on understanding and predicting the underlying causes of events causing outages. Grid analytics have the capability to help utilities fix the causes of outages, not just the symptoms, which leads to significantly improved reliability.

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Power Delivery Objectives	Grid Analytics Impact
<ul style="list-style-type: none"> ✦ Public Safety ✦ Reliability ✦ Lifecycle Management ✦ O&M cost reduction ✦ Customer satisfaction 	<ul style="list-style-type: none"> ✦ Detect, remove hazards fast ✦ ID, fix cause - not symptom ✦ Monitor asset condition ✦ Planned Maintenance ✦ Fix momentaries, power quality
<ul style="list-style-type: none"> ✦ Safety enable two-way grid ✦ DG siting data ✦ Continued Innovation 	<ul style="list-style-type: none"> ✦ Current direction, DG harmonics ✦ Track flow by feeder/lateral/span ✦ ID opportunities, monitor impact

Grid analytics has potential to transform power delivery operations

Siting new generation

In order to safely operate a two-way grid, analytics are needed to determine the direction of the current, presence of harmonics, and other power quality issues. Without a grid analytics system, it is hard to track where power is actually flowing. This makes it very difficult to determine the best places to site additional distributed generation. If the flow of power isn't tracked by feeder and by lateral, or perhaps even by span, then there is no data to provide solar project developers wanting to build more generation in a given location, because utilities don't know what the real flows are, and whether or not additional generation actually creates additional value. If a feeder has no distributed generation whatsoever, and significant power is injected into that feeder, most of the time the utility will be able to pay the provider of that power a fair amount of money. On the other hand, if a feeder that is already producing more power than the feeder itself needs, then it becomes more of a headache to the utility, as it now needs to put in new protective equipment to manage additional power that may have no additional value.

Lastly, without good data from analytics, it is hard to determine what innovation will have the most impact. For example, if a new type of battery is put on a feeder, good monitoring of power flows and good resolution on that feeder is required, or else the battery's effects cannot be measured.

Requirements for a grid analytics system

Utilities still have serious bottlenecks to resolve as distributed management systems (DMS) aren't ready for complex data, distribution analytics are immature, and the communications networks are really built for other purposes. A grid analytics system, first and foremost, must provide analytic capabilities matching the data types and structures that are generated from the distribution grid. The analytics capabilities need to be applicable not just for simple data, but also for complex data. Given the network limitations, these analytics capabilities need to be deployed locally out in the field, as well as centrally at the distribution control center. Secondly, the analytics system needs to enable data access over the network being utilized, as building a separate network for analytics purposes is generally too expensive.

Lastly, the grid system needs to interface with all devices collecting grid data, and have the ability to import all the data sets being collected in their entirety, rather than being limited to the subset of data used by SCADA and DMS for control purposes.

Grid analytics system maturity today

Intelligent grid analytics is no longer a theoretical concept. Intelligent sensors with local analytics are currently available, and have been deployed by the thousands at leading utilities, such as FPL. They have been proven to perform as designed with high reliability. Their event detection capabilities continue to mature, and the analytics capabilities are developing at a steady pace.



Michael Bauer is the president and founder of Sentient Energy, Inc.

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Solar Customer Acquisition

All about smart data

by Steve Pockross



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When banks issued their first general-purpose credit cards in the late 1950s and early 1960s, there wasn't much science behind their marketing. In fact, they sent the cards out in mass mailings to tens of thousands of customers and provided credit to anyone who responded. The results were chaotic and financially disastrous.

In the next few decades, technology would come along to reduce fraud and connect networks of merchants. By the late 1980s and early 1990s, a real breakthrough happened, creditors figured out how to analyze the data they had collected for many years about their customers.

Data analytics changed everything. Banks could see which customers were most likely to pay off their monthly balances (and therefore weren't profitable), which customers were likely to default (and definitely were not profitable), and which customers would routinely carry high balances but were not likely to default (and were, therefore, lucrative). Banks could use credit scores, derived in part from customers' repayment habits, and other financial data to personalize their pricing and marketing strategies. They could also offer pricing in advance for customers, which avoided a lengthy review process. The profits followed.

Why the brief history of the evolution of the financial services industry? Because solar has several key parallels.

The solar customer acquisition problem

Until recently, rooftop solar companies have had to do little marketing. Early adopters and innovators eagerly purchased panels and installed them on their roofs. But that customer segment is nearly saturated, and it's time to market PV to the masses. Solar providers face a quandary; send out blanket, blind offers like banks first did and risk low conversion rates and heavy financial losses, or use the kind of data analytics that helped the financial services industry thrive, by targeting personalized offers to the most qualified people.

It's actually not much of a choice. Taking current customer acquisition costs into consideration, it's clear that solar companies need a fine-tuned approach to marketing. It costs solar providers on average about \$3,000, and often up to \$8,000, per potential new customer to complete the sales cycle. Two of the main barriers to cost-effective marketing include a lack of ability to prioritize customers to target, and poor quality leads requiring greater effort and cost to close sales. To spend marketing dollars most efficiently, solar companies need to know who the likely buyers are; people with suitable roofs and credit worthiness. Once they've established those criteria, solar companies should determine who among those potential customers are most likely to purchase.

The data analytics solution

Determining qualified leads and purchase propensities can seem daunting. But solar providers can invest in data analytics technology which performs both tasks automatically. A strong data technology solution will execute four key functions: provide energy data, provide solar generation estimates, evaluate and score potential leads, and generate qualified leads. Step one, providing energy data, is the catalyst for all of the other steps. Comprehensive energy data analytics will aggregate customers' consumption habits and demographics, along with physical characteristics of their homes (size, construction materials, HVAC configuration, etc.). It's the combination of this data that allows for thorough analysis and accurate qualification of appropriate leads.

With these capabilities at hand, solar providers decrease acquisition costs and enable their sales teams to spend more time focused on high quality leads. Using data-driven solar consumption, generation, and return-on-investment estimates, teams can personalize all of their communication with potential customers, thereby forming stronger relationships that convert to sales more frequently. Based on these estimates, providers also see which leads do not meet minimum propensity thresholds. They can qualify and market to these leads through less expensive channels.

Successful marketing from the start

As solar providers ramp up their marketing efforts to the general population, it makes sense to power their outreach with data from the outset. Why risk the losses and frustration that befell the banks before they incorporated data and targeted marketing? The consumption profiles data technology can generate for solar



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providers work like credit reports do for banks: they give important insight into how customers live and use resources, and how the businesses marketing to those customers can expect them to behave. Just as banks have profited from their more personalized, tailored credit offers, so too can solar providers profit from individualized, informed marketing practices.

Solar customers will benefit too. Marketing solar panels to households well suited to support them, physically and financially, helps residents lower their energy expenses down the line as solar providers well know. Just how beneficial the panels will be for individual homes is something the data analytics can estimate, and it's something solar providers can share as they move to acquire customers. With this data-driven marketing, solar providers set more people up to contribute to a greener, more stable, more affordable energy future.



Steve Pockross is a vice president at Tendril, Inc. where he leads the development of new business solutions for the solar industry, leveraging the company's unique big data, software, and analytics capabilities.

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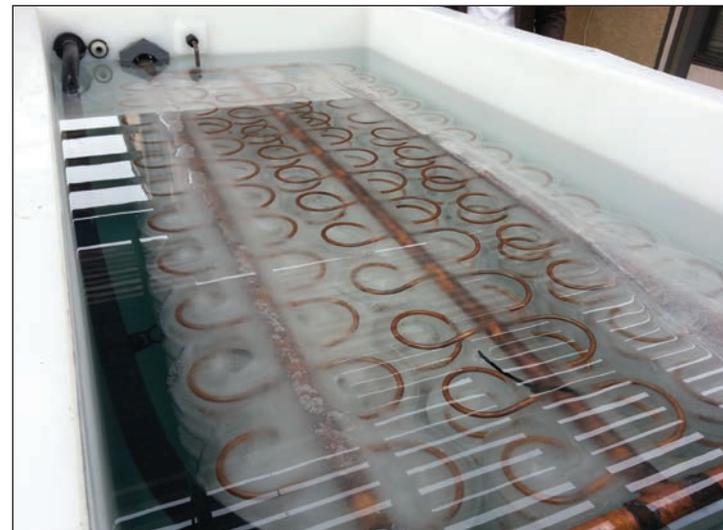
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Marketing in the New Energy Ecosystem

5 things to do now to improve the bottom line

by Tracy Olmstead Williams



THE MARKETPLACE FOR CLEANTECH COMPANIES HAS CHANGED SIGNIFICANTLY OVER

the last five years. Consumers want green and they want to know how much it will cost them. Government has spoken too, and the story has shifted from “if” to “when” new technologies like solar panels, electric vehicles, and smart thermostats will achieve scale. For cleantech companies, marketing strategies need to adapt and address new stakeholders: energy providers.

It’s now less about influencing public opinion or changing consumer behavior and more about strategic relationship building to make connections that move the needle for technology. What’s required is a focused strategy to establish credibility and gain the trust of potential investors, partners, affiliates, and installers throughout target markets.

Following are five marketing pillars to help own the future, stand out during this critical window, and deliver measurable results to the bottom line.

Engage the community

Start with announcements to tout all accomplishments and milestones of the technology to show it is ready for prime time. Put out a press release, post on the company website and social media channels, and blast an eNewsletter to all contacts. Without this awareness of the significance of the technology, valuable contracts, partners, and investors will stay out of reach. Make connections with targeted media and influential municipal and industry groups covering the issues the product or service addresses, from carbon emissions regulations to water conservation targets. Show up at appropriate meetings, create short informative videos for online and YouTube channels to show the technology in action, join the conversation online by adding comments to relevant articles and share news/commentary via all social media channels, website, eNewsletters, blogs, LinkedIn, and Twitter.

Awards and lists matter

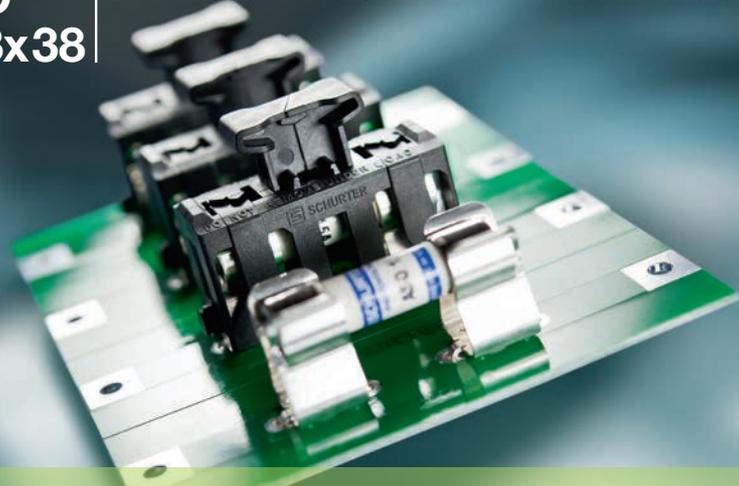
Seek opportunities to spotlight and gain third party endorsement for both the company’s technology and intellectual capital. From high-profile national opportunities like the Inc. 5000 and Edison Awards, to more targeted industry awards, and from local business journals’ annual top public and private company lists to the various age-based and other specialized list opportunities honoring the “20 Under 20,” “40 Under 40,” top women, and minority business owners, a spot is waiting to be claimed. To get started, request editorial calendars from the advertising departments at target publications. Build a master list of opportunities throughout the year and contact each media outlet for consideration several months in advance of their deadlines. There is a lot of block and tackling involved; however, the main cost is time.

Hone messaging

To have maximum impact on the conversation, take time to prepare key messaging about the technology. Be strategic and consistent throughout the year-long marketing effort with clear takeaways on the value the technology brings to stakeholders. Speaking is a great way to hone thinking and messages. Check for presentation and panel opportunities at industry events. While many opportunities are free, some of the larger conferences are pay-to-play. Evaluate each opportunity through a cost-benefit analysis. Alumni groups host webinars and so do trade groups. Brainstorm where to be to make the right connections.

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Writing is a big time commitment, but getting published adds credibility and trustworthiness to a brand. Industry expertise is established through bylines, guest articles, Op-Ed pieces, and quotes in respected news, trade, and business publications. Commit to writing about something that's in the news and fresh. Don't talk about the company's technology but about issues. Follow guidelines and don't go beyond the word count. Don't sell. Give readers information they don't know and knowledge they can't buy. Have an opinion. No matter how limited the initial circulation, post the work on the company website and social media channels to broaden its reach and effectiveness. Frame the finished articles and hang them in the office. Buy digital reprint permissions and include links in eNewsletters. Source sheets are also a valuable tool to get in front of reporters who are seeking informed sources for background and commentary on issues for future articles. Separate from promoting the technology, source sheets help establish relationships that can have direct impact on the bottom line, not to mention provide confident, clear responses to questions about the technology.

Network at trade shows and beyond

There's no substitute for the value of meeting people face-to-face. Take advantage of existing opportunities at trade shows where the company has purchased booth space to stand out. Apply the same strategic thinking and campaign messaging to the booth; know the goals going in to the event and keep both designs and talking points simple and clear about the unique value of the technology. Even without a booth, there's still value in attending and working the event floor. Create opportunities for educating stakeholders on the technology, confirm meetings in advance, keep them, and always follow up. The goal is conversations and relationships based on more than business and sales goals. It may come as a surprise when referrals and strategic partner opportunities come in from unexpected sources. Create a calendar of events and conferences and events associated with the lists now featuring the company. Show up to meet other honorees. Don't set limits. Key investors who can take the business to the next level might be behind that door. The author E.M. Forster famously stated the secret of all success: "Only connect."

Commit time and resources to each of these categories this year to capitalize on the new green economy and create opportunities for maximizing the potential of your technology.



Tracy Olmstead Williams is CEO and president of Olmstead Williams Communications, a business-to-business public relations, crisis communications and social media agency with offices in Los Angeles and Seattle. Williams is tech-focused and has represented leaders in cleantech, cyber security, fintech, drones and aerospace technology, as well as medical device and diagnostic companies. She advises tech startups and professional service companies on strategies to attract capital and grow revenues.

Olmstead Williams Communications | www.olmsteadwilliams.com

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www.crownbattery.com
sales@crownbattery.com



Ballasted ground-mount

Powers Solar Frames is introducing its newly designed, 2nd generation Ballast Ground Mount system that will accommodate all environmental parameters. The system incorporates a wider ballast box that can be ordered in multiple lengths and can be the solution needed for any Ballast Ground Mount application. The Ballast Ground Mount incorporates the Solar Powers Frames' patented Super Purlin which reduces conventional purlin usage by as much as 42%, speeds installation, and reduces labor costs.

Powers Solar Frames

www.powersolarframes.com



Solar cell printing technology

ASM Alternative Energy (ASM AE) announced that it has commercialized its new solar cell printing technology, XtremePrint. XtremePrint self-adjusts print force to compensate for variations in cell topography. Both single and dual print metallization processes can achieve high throughput rates, as full stencil to wafer gasketing at constant high speeds is possible, regardless of substrate surface variances. XtremePrint technology delivers self-regulating capability that adjusts for height variations at high speed. XtremePrint enables wafer-to-wafer repeatability with low standard deviation on printed line widths and heights; improved cell efficiency through reduced shadowing losses because of the ability to print narrower lines with fewer defects; low maintenance and ease-of-use based on reductions in required manual operations and a frictionless pressure mechanism; and higher aspect ratio printed lines as a result of controlled print pressure.

ASM Alternative Energy | www.asm-ae.com



Solar powered thermal mass flow meters

Fluid Components International's (FCI) ST75V Flow Meter is compatible with solar power systems providing 24Vdc power without any special modifications. A typical solar power system supporting up to 28 meters in an oil/gas production field requires two 50W solar panels to provide 24-hour power, even during cloudy, rainy, or snowy days. The ST75V Flow Meter, with its NEMA 4X/IP67 rated enclosure, is ideal for dirty oil and gas production field installations. It features an inline-style flow body providing accuracy to $\pm 1\%$ of reading with flow ranges from 0.04 to 560 SCFM (0.07 to 950 NCMH), depending on pipe size, and repeatability of ± 0.5 percent of reading. It is suitable for line sizes from 0.25 to 2 inches (6 to 51 mm) diameters. The ST75V Flow Meter's flow element is constructed with a 316L stainless steel body and Hastelloy C-22 thermowell sensors to resist corrosion. The instrument is approved for use in hazardous/explosive oil/gas production environments and carries global approvals that include: FM/CSA, Class 1, Div 1, Groups B, C, D; Class 1, Div II, Groups A-D, ATEX/IECEx Zone 1, II 2 G Ex d IIC T6 ...T3, II 2 D Ex tD A21 IP67 T90°C...T300°C. The ST75V meter's transmitter outputs include dual 4-20mA analog outputs, which are user assignable to flow rate and/or temperature, a 0-500 Hz pulse output for totalized flow and a serial RS-232C I/O port. The optional digital display/readout is a two-line LCD displaying flow rate and totalized flow or flow rate and temperature. In applications with difficult access or display readability, the ST75V's transmitter is also available to be remote mounted up to 50 feet (15m) away from the flow element inserted in the pipe.

Fluid Components International | www.fluidcomponents.com

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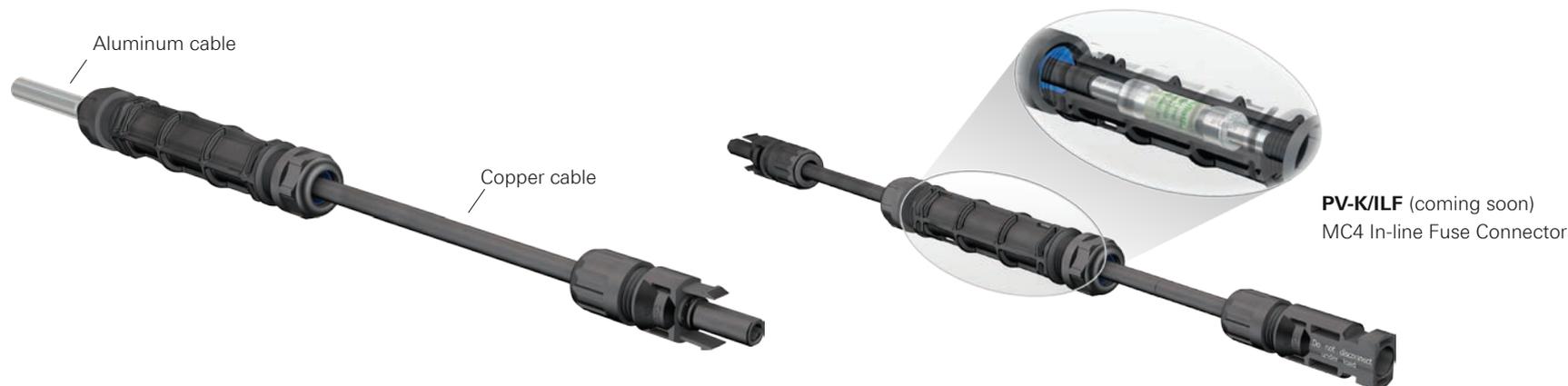
Arca 2424 shown with optional IPW Instrument Protection Window



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Multi-Contact's MC4 photovoltaic connectors are the global industry standard and can be found on more PV modules than any other connector system in the world. The MC4 is now rated up to 1500 V UL, 1500 V TÜV safety class 0 and is available for 14 through 8AWG cable configurations. Additionally, we are offering the in-line fuse **PV-K/ILF** for very low energy loss and heat generation as well as the Aluminum to Copper transition joint **MC-K...ALCU**. Both are IP68 rated and feature robust enclosures. Over one billion MC4 connectors have already been installed worldwide accounting for over 120 GW of installed capacity. Rely on the original!



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Polywater | www.polywater.com



Plug and play solar lighting and energy kit

Phocos North America announces the release of the new LS Series Plug and Play Solar Home System providing reliable lighting and mobile device charging to homes, cabins, outbuildings, recreational vehicles, and campers which are not connected to a power grid. The LS Series Plug and Play Solar Home System is a compact, portable kit designed for easy installation by homeowners without the need to hire an electrician. It offers a long-lasting lithium battery and LED lights for years of reliable operation and a high-efficiency charger for optimal charging, even during cloudy or cold weather. Features contributing to the kit's reliability and convenience are the battery pack with a built-in solar charger using maximum power point tracking (MPPT) technology, LED lights and modular design for expansion. The lithium iron phosphate (LiFePO4) battery is rated to 1500-2000 full cycles (5-8 years) before replacement. The MPPT solar charger optimizes power conversion from the solar panel to the battery, which is effective on cloudy days and in cold weather, when the battery charge is typically very low. The LED lamps are rated for 50,000 hours and infinite switching cycles. The system is designed to easily connect multiple units and the wide range of plug and play accessories make the LS Series Plug and Play Solar Home System very adaptable. The LS Series solar kits are available in 4 amp-hour and 7 amp-hour models.

Phocos North America | www.phocos.com



Converting excess current into thermal energy

The RESOL FlowSol E has been designed for using excess current produced by a photovoltaic system. The station contains all the vital hydraulic components, is particularly easy to install and can be retrofitted into all heating and DHW systems. The measuring device detects excess current and the integrated controller redirects it to a steplessly variable electric heater for heating a water store. Thus, excess power can be stored as regenerative heat, internal consumption can be increased while decreasing conventional heating costs. All the while, household power has absolute priority and grid compliance is maintained. The intelligent control ensures an optimum store stratification so that even small amounts of excess power can be reliably converted into heat and power fluctuations can be balanced out. The RESOL FlowSol E becomes the missing link between the photovoltaic system and the heat generator, for more independence, decreased heating costs, and less CO2 emissions.

RESOL | www.resol.com



Instant sealing

3M Extreme Sealing Tape provides instant sealing that rolls on fast and looks good while increasing productivity throughput with no drying time. Easy to use, the Extreme Sealing Tape sticks on contact to many metals and plastics without dripping, oozing, or clean up, and conforms over contours, edges, rivets, and screw heads for a water tight "seal", holding securely through sun, rain, snow, temperature, and humidity extremes. Applicable to a variety of applications, Extreme Sealing Tape has resistance to many common industrial solvents, stays flexible to compensate for vibration and thermal expansion / contraction, doesn't crack or crumble, and provides resistance to abrasion and high pressure washing. Options include two thicknesses offering regular or low profile, as well as three color options to match most applications.

Mudge Fasteners | www.mudgefasteners.com

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Compact high-performance UMT-H fuse

SCHURTER expands its UMT-H series, adding new current ratings 20 A, 25 A, and 30 A. The compact SMD fuse, UMT-H has a high breaking capacity of 1500 A. It is UL approved up to 6.3 A at 277 VAC and up to 30 A at 250 VAC, with rated breaking capacity from 1500 A to 100 A depending on rated voltage. It also has VDE approval up to 16 A @ 250 VAC. PCBs become replaceable, as maintenance costs rise and board circuitry becomes smaller, more dense, and inexpensive. The UMT-H fuse ratings compare to traditional cylindrical shaped fuses, but in a smaller compact SMD design. With its square design, the UMT-H is well suited for more cost-effective, automated assembly.

SCHURTER Inc. | www.schurterinc.com



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High power PFC capacitors

TDK Corporation presents EPCOS PhaseCap Energy – two new series of high power capacitors for power factor correction. These components are available with gas or resin-filled housings. Designed for voltages of 230 VAC to 690 VAC, they offer a reactive power of between 5 kvar and 33 kvar. The life expectancy of the B25674* series of gas-impregnated capacitors has been possible to extend by nearly 40% from 130,000 to 180,000 hours. The maximum permissible inrush current was also increased by 25% to 500 x IR. The new capacitors can be switched more frequently: the maximum number of switching cycles per year has been doubled from 7500 to 15,000. The maximum permissible operating temperature as per IEC 60831-1 has also been raised by 5 K to 60°C. The B25675* series of resin-filled capacitors features a long life expectancy of 200,000 hours and is likewise designed for a maximum operating temperature of 60°C and a maximum permissible inrush current of 500 x IR. Both series have increased energy density: For the 28 kvar / 440 V types, for example, this has been raised by more than 20% from 9.7 kvar/l to 11.8 kvar/l. This results in compact dimensions: The new PhaseCap Energy capacitors feature a diameter of between 75 mm and 125 mm, depending on the type, and a height of between 164 mm and 224 mm. PhaseCap Energy is equipped with an overpressure disconnecter that isolates all three phases from the grid in the event of damage.

TDK Corporation | www.tdk.com



Commercial solar PV string inverter

Ideal Power Inc. introduced its new SunDial solar photovoltaic (PV) string inverter which includes an optional bi-directional 3rd port for direct integration of solar with energy storage during initial installation or any time in the future. The SunDial is a compact, efficient, and fully isolated PV string inverter with an integrated PV combiner, disconnects, and a built-in Maximum Power Point Tracker (MPPT). It also features an optional, low cost “plug and play” bi-directional DC port kit. This new “solar first, storage ready” design has a field-upgradable, bi-directional energy storage port, making the system market ready today for the solar + storage market. The initial SunDial product is a 30kW system (Model 30PV+S) based on Ideal Power’s patented Power Packet Switching Architecture with 1000V max PV DC input and 480V, 3-phase output. An important feature of the SunDial system is a newly designed AC link providing true galvanic isolation from the AC to the DC ports, enabling PV installations to be either grounded or true floating. The SunDial inverter is comparable in size and cost to today’s widely used transformerless PV string inverters, but is fully isolated and offers the additional value of an optional, upgradable, fully isolated bi-directional port for direct storage integration. The SunDial can be applied to both new PV installations and PV system retrofits where there is a desire to add energy storage to an existing array.

Ideal Power Inc. | www.idealpower.com



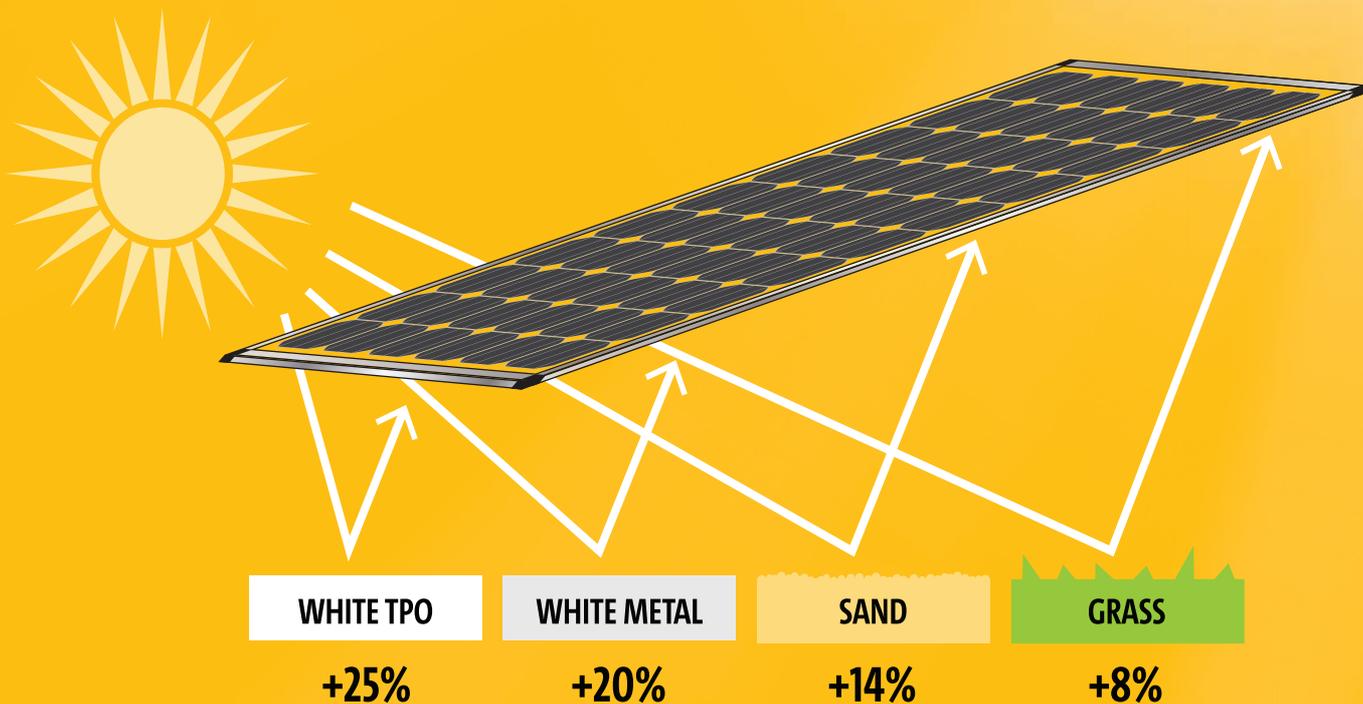
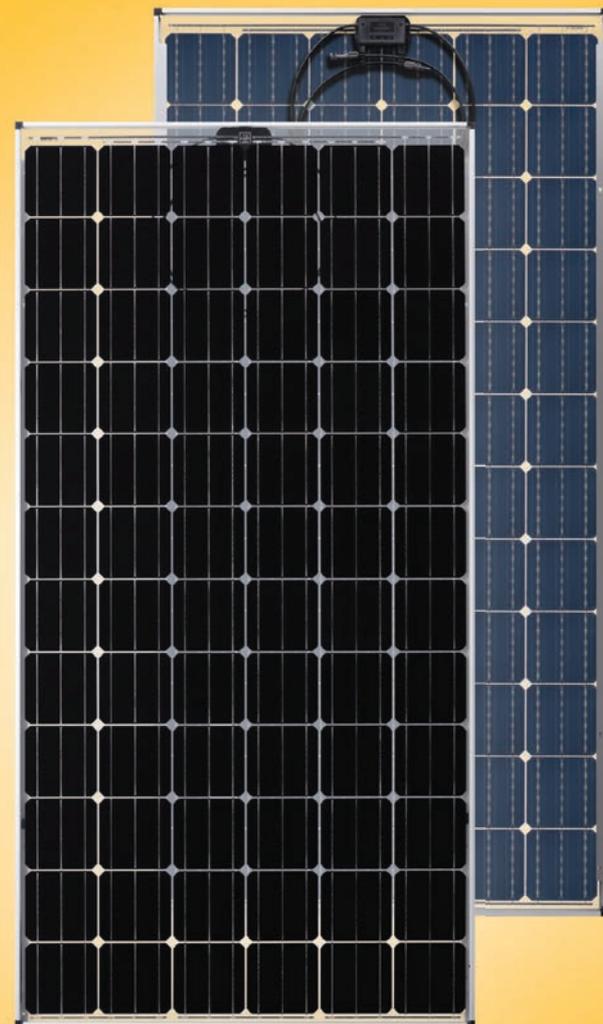
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*Energy boost values are estimates and are not a guarantee of performance. Actual boost performance will vary for your specific installation based on the actual albedo, selected racking system, system design parameters and soiling over time.



Measuring wheel accessories

POSITAL has introduced a series of measuring wheel accessories for its IXARC family of rotary encoders. When one of these wheels is mounted on the shaft of an encoder, the result is an accurate and reliable instrument for measuring linear motion and position. The new measuring wheels are available in circumferences of 200 mm and 500 mm. When fitted to multi-turn IXARC absolute encoders, this translates into a linear measurement range of up to 500 kilometers. Three rim treatments are available; knurled aluminum, smooth polyurethane, and textured (knobby) polyurethane to ensure good traction between the wheel and a variety of surfaces. IXARC programmable encoders can be calibrated at the job site using POSITAL's UBIFAST programming tool.

POSITAL FRABA, Inc. | www.posital.com



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Commercial inverter racking solution

SMA has released the second generation of its ReadyRack all-in-one inverter, rack, and disconnect solution for commercial rooftop PV. Specifically designed for the three-phase inverter, the Sunny Tripower TL-US, the new ReadyRack allows for simpler, faster system installation while offering durability and code compliance right out of the box. The ReadyRack is a fully integrated, preassembled, and prewired roof-mount rack that includes all balance-of-system components for reduced wiring time and labor onsite, saving an average of two hours of assembly time per inverter. This turnkey solution includes a Sunny Tripower TL-US inverter; SMA Connection Unit (an eight-string combiner with disconnect); AC disconnect switch; and complete ground bonding of all components. Also included are pre-installed EPDM foot pads for direct placement on the roof with no additional piers or blocks needed, further speeding installation. The ReadyRack's main structure is made in the U.S.A. of corrosion-resistant aluminum and features stainless-steel mounting hardware. Designed for mounting within 10 feet of the PV array, the ReadyRack complies with the 2014 NEC 690.12 rapid shutdown requirements while the integrated DC AFCI within the Sunny Tripower ensures optimal safety with fewer false-positive trips.

SMA America | www.sma-america.com

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Mobile solar installer tool

APsystems unveiled an all-new version of ArrayApp, its powerful installer mobile application. ArrayApp is designed to streamline APsystems microinverter installations, letting installers complete the entire customer registration and microinverter array mapping process during or after the project installation. New features include an intuitive graphical user interface, gateway connection, and other enhancements. The mobile app is available for both Apple iOS and Android devices.

APsystems | www.apsystems.com



Advanced capacitor-busbars

Rogers Corporation's Power Electronics Solutions (PES) has introduced the latest additions to its ROLINX busbar family: the ROLINX CapEasy and ROLINX CapPerformance capacitor-busbar assemblies. Both products enhance the performance of Rogers ROLINX laminated busbars with Power Ring Film Capacitor technology, which features a circular shape with very low equivalent series resistance (ESR) and equivalent series inductance (ESL). The result is high reliability, low total system cost, and increased power density due to lower overshoot voltages and less $\mu\text{F}/\text{kW}$ of required total capacitance. The ROLINX CapEasy and ROLINX CapPerformance busbar assemblies help minimize weight and volume without compromising system power-handling capabilities. They feature typical voltage ranges from 450 to 1500 VDC and typical capacitance ranges from 75 to 1600 μF , with capacitance tolerance held within $\pm 10\%$. Both busbar assemblies can handle in excess of 1 MW power.

Rogers Corporation

www.rogerscorp.com

Mini ballasted ground-mount

Small, but mighty, the PvMini offers a compact, durable design. This concrete, ballasted ground mount solution is the smaller sibling to Schletter's PvMax and is now available in a 1V configuration on PV Powersite. With this mini version, new levels of system efficiency can be reached with its lightweight and low-profile design. The PvMini is a solution for residential areas where a low-profile design is desired or landfill sites or areas with rocky terrain. It is a cost-effective ballasted solution for single-row-vertical with maximized system efficiency using the proprietary ProfiPlus XT rails. Schletter's PvMini is made of aluminum and partially pre-assembled so it can be easily installed without the need for any heavy machinery. The system is 100% IBC 2006, 2009, and 2012 code compliant.

Schletter | www.pvpowersite.com

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Aerocompact | www.aerocompact.com



PV rooftop solution for east/west orientation

Applied Energy Technologies (AET), announced the expansion of its ECO line of products with its Rayport-B ECO East-West System. AET's Rayport-B ECO East-West System provides an east/west orientation to maximize PV production and increase array density on the rooftop. East to west orientation provides advantages for PV power production with a dynamic grid. With greater array density, the system provides dual exposure during peak PV production times. AET's engineers design each product to be functional, lightweight, durable and cost-effective. The Rayport-B ECO East-West System, like its family of ECO products, is constructed from galvanized steel. It has one common bolt for all joints and has panel clamps with integrated grounding. The Rayport-B ECO System is wind tunnel tested, UL 2703 listed and comes with a 25-year limited warranty.

Applied Energy Technologies (AET)
www.aetenergy.com

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High performance, low cost PV modules

Solaria introduced its PowerXT 330Wp and 400Wp modules optimized for residential and commercial rooftops respectively. Solaria's high output modules are built on the company's proprietary technology – which utilizes an advanced cell interconnect and module production processes. Solaria modules boost power generation while eliminating reliability challenges that can reduce conventional PV modules' long-term performance.

Solaria Corporation | www.solaria.com

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Solar system design software

Valentin Software has adapted and revised its design and simulation software PV*SOL, to take the latest technical developments into account. With the new versions, designers and operators can now design their solar systems even faster, simulate precise yield calculations, and also perform detailed profitability calculations, allowing for government subsidies. PV*SOL premium 2016 offers the possibility of importing floor plans, cadastral maps, and screenshots from web-based satellite maps directly into the 3D visualization and include them in users' projects to scale. The dimensions, orientation, and the mutual distances of 3D objects can be determined without an on-site appointment. By tracing a floor plan, the program automatically detects and creates the standard 3D objects. It then adjusts the dimensions, orientation, and position of the object in the plan.

Valentin Software | www.valentin-software.com



Wind tunnel tested mounting system

TerraGen Solar introduces their TGR flat roof ballasted mounting system. This wind tunnel tested system offers an affordable solution while maintaining module warranties, improving installation efficiencies, increasing onsite flexibility, and reducing ballast requirements. The TGR system is able to accommodate both 60 and 72 cell modules in either landscape or portrait orientations and TerraGen will collaborate with the module manufacturer to ensure their warranties are not being compromised.

TerraGen Solar | www.terragensolar.ca



High-grade polycarbonate enclosure

Fibox's ARCA IEC is sized up to 31x 24 x 12 and offers performance and security in most demanding environments. This UL listed, NEMA 4X enclosure is a viable and cost effective alternative to sheet steel cabinets being installed in harsh and demanding environments. Fibox polycarbonates are UV and impact resistant will not break down like fiberglass or rust, blister, and bubble like steel.

Fibox | www.fibox.com

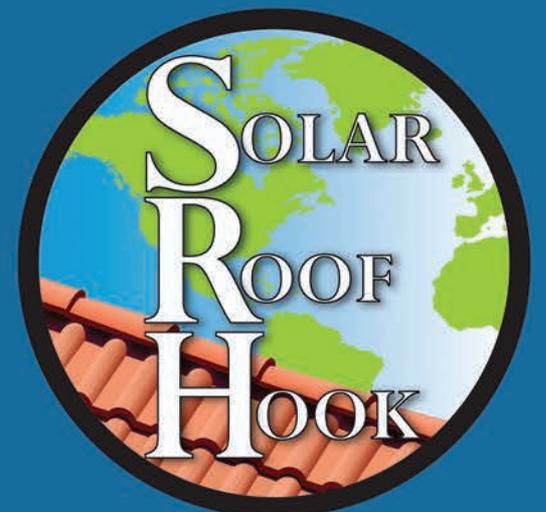
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Full capacity string inverters

Ingeteam has launched its new PV string inverter models, delivering output powers of up to 40 kW in a single inverter. In addition to the 40 kW model, a further three models have also been presented: 24 kW, 28 kW and 33 kW. The UL-1741 compliant version of these models, specifically designed for the North American market, has also been extended to offer output powers of up to 40 kW. These string inverters are suitable for immediate rooftop placement and they perform at full capacity no matter the inclination of the structure they are attached to. This is the INGECON SUN 3Play TLM Series of inverters, noted for their dual MPPT (Maximum Power Point Tracking) as well as their maximum efficiency levels (98.5%) and high performance.

Ingeteam | www.ingeteam.com



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www.lufft.com



Multi-function measurement terminal

With the new EL3751 EtherCAT Terminal, Beckhoff presents a new generation of I/Os for measurement applications. At 10,000 samples per second, a measurement accuracy of $\pm 0.01\%$ and 24 bit resolution, the EL3751 with eXtreme Fast Control technology (XFC) provides measurement technology as part of the standard I/O system. Added to this is long-term stability, flexible filter configurations, and parameterization options for the analog input, which supports the measurement functions U, I, R, DMS (strain gauge) and RTD. Reliable and precision acquisition of measurement data offers potential to optimize machine efficiency and production quality. The EL3751 1-channel EtherCAT Terminal for analog measurement technology combines measurement accuracy: $\pm 0.01\%$ of the full scale value for most interfaces, at $25^{\circ}\text{C} (\pm 5^{\circ}\text{C})$, with a sampling rate of up to 10,000 samples per second and 24 bit resolution (incl. sign). Other factors include long-term hardware stability through pre-aging, as well as configuration options for the nominal measuring range of the input channel. The integrated distributed clocks ensure synchronized sampling across the EtherCAT system. The "Extended Range" feature in the EL3751 enables effective measurement beyond the nominal measuring range, with possible extension up to 107%. To suppress aliasing effects, the input channel features two configurable numeric software filters up to 39th order FIR / 6th order IIR. The filters can be preselected or freely defined, so a band stop or a band pass can be implemented.

Beckhoff Automation | www.beckhoff.com



A highly secure safety system



Greeneye Smart PV Switch

- Failsafe safety system
- Individual shutdown feature per PV module
- Protection for firefighters or PV installers and electricians

ep.mersen.com



Ferraz Shawmut is Mersen



Weatherproof safety canopy

GenTent Safety Canopies are weatherproof self-attaching covers for running portable and inverter generators safely in nearly any wet weather. Independently tested, GenTent is proven to withstand up to 70mph winds, rains up to 12 inches a day, and 18 inch snow loads. GenTent enables portable generators to be run well away from structures safely in rain and wet weather. With an easy to install 3-step process, GenTents self-attach to keep portable generators portable, with easy access for refueling and electrical outlet shielding from the elements to keep them dry. GenTent's patented weatherproofing approach allows generators to cool naturally, while exhaust fumes and heat are expelled safely. GenTents fit 98% of the portable generators and inverters in the market.

GenTent | www.gentent.com



Tile replacement mount

Quick Mount PV introduced the Tile Replacement Mount for rooftop solar installations, which provides a fast and easy way to install solar on tile roofs while protecting against water intrusion. The Tile Replacement Mount eliminates messy and time-consuming tile grinding and cutting to significantly reduce installation time and labor costs. The new mount works with all standard curved and flat tile roofs, as well as all standard rail-based racking systems. The Tile Replacement Mount is fully engineered to meet code requirements and industry best practices, and features Quick Mount's patented Elevated Water Seal technology for superior waterproofing. The Tile Replacement Mount features a universal base mount, which works with all three flashing profiles: Flat tile, S-shaped, and W-shaped curved tiles. The Tile Replacement Mount is 100% IBC compliant and comes with a 20-year warranty.

Quick Mount PV | www.quickmountpv.com

Adhesives for stringing and shingling solar modules

Engineered Material Systems, Inc.'s (EMS) new 561-400 series Low-Cost Snap Cure Conductive Adhesives is designed for stringing and shingling crystalline silicon and heterojunction solar modules. The EMS 561-400 series is designed to be used in modified ribbon stringers. The material will snap cure and fixture ribbons in seconds at 150°C with enough strength to withstand module manufacturing processes until the adhesive cure is completed during the encapsulant lamination process. EMS 561-400 series conductive adhesives can be dispensed by time-pressure, auger or jetting. The adhesive is more stress absorbing than solder to withstand the rigors of thermal cycling and processes at lower temperatures than solder. EMS 561-400 series conductive adhesives are 60% less expensive than pure silver-filled conductive adhesives.

Engineered Material Systems, Inc. | www.emsadhives.com



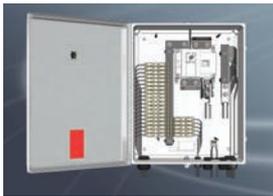
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1500VDC configurable disconnecting combiner boxes

AMtec Solar Products, a unit of AMtec Industries announced its new Prominence Series configurable disconnecting combiner boxes, featuring disconnect ratings of up to 400 Amps at 1500 VDC. The boxes are ETL Listed to UL1741 at 1500VDC and CAN/CSA C22.2 listed at 1500VDC. The new high power capacity combiner boxes are fully customizable with 275A, 325A, or 400A disconnects, and up to 36 strings. Enclosures are available in NEMA 4 steel, NEMA 4X fiberglass or stainless, or 3R. AMtec offers a wide range of additional configuration options including single or dual-hole output lugs, pre-configured pigtailed, voltage monitoring, surge protection, string-level current monitoring, cable connectors, fuse ratings, and more.

AMtec Solar Products | www.amtec1.com



Simulation and monitoring of LID

LayTec is proud to announce the market launch of LID Scope - a system for simulation and monitoring of LID. LID Scope is a table-top system which helps quantify the expected performance loss of any solar cell directly at the line or in the lab. The tool performs accelerated or real-life degradation tests automatically. It delivers reproducible results and a permanent monitoring of Voc changes by integrated metrology. These features make the tool an inevitable part of quality control and production optimization in PV industry. LID Scope degrades cells in a well-controlled procedure with electrical current and high temperatures by applying novel physical models developed by Fraunhofer Center for Silicon Photovoltaics (CSP) in Germany (patent pending). For the first time, cells can be degraded in a repeatable way, which means that LID Scope offers identical LID performance control from line to line and from lab to lab.

LayTec | www.laytec.de



AC high current sensors

TDK Corporation has expanded its CCT series of clamp AC current sensors with a new 600 A type. The lineup of TDK current sensors is now positioned to meet the high-current sensing needs of energy management systems (EMS) for buildings, factories, stores, and communities. The new CCT406393-600-36 current sensor has a clamp inner diameter of 36 mm and external dimensions of 56 mm x 67 mm x 96 mm. With a current transformation ratio of 3000:1, the output current is 200 mA. The new clamp AC current sensor achieves its high current rating thanks to its optimized sensor shape and high-performance ferrite material developed especially for current sensors. Moreover, the CCT series is manufactured with automated winding and soldering processes to ensure high quality. With the addition of this new component to a current sensor lineup that already includes a 300-A (24 mm inner diameter), 100-A (16 mm) and 30-A (6 mm) types, TDK offers a comprehensive portfolio of clamp AC current sensors for a wide range of currents.

TDK Corporation | www.tdk.com



Something very new under the sun.





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All-in-one solar monitoring system

Kipp & Zonen announces RaZON+. RaZON+ is an all-in-one system that accurately measures direct normal irradiance (DNI) and diffuse horizontal irradiance (DHI), enabling it to calculate reliable values of global horizontal solar irradiance (GHI), sunshine duration and total energy. This affordable system has a built-in data logger, a complete web interface, and can easily be extended with the connection of a compact weather station or other Modbus sensors. RaZON+ has a new and unique design of integrated Smart pyrhelimeter and a shaded Smart pyranometer with quartz diffuser. Both meet ISO 9060 requirements and the features of the pyrhelimeter minimize the effects of soiling in unattended remote locations, without compromising the accuracy of the measurement. User friendliness was a key target in the development, not just for installation, but also for the collection of accurate solar irradiance data.

Kipp & Zonen | www.kippzonen.com



Hermitically sealed contactor for safe reliable switching

GIGAVAC announces the latest addition to their line of patented switching devices, the HX460. This new hermitically sealed, HVDC contactor brings massive power switching capabilities in a compact package. Designed and manufactured in the USA, the GIGAVAC HX460 has a package size of approximately 6x6 inches (154x154 mm), and power connection busbars which allow continuous application circuit currents of 600A and beyond. The SPDT, single pole double throw, auxiliary contacts are mechanically linked to provide a reliable indication of the main contacts in the closed position. The sealed internal chambers for both the contacts and coil assures clean switching in any environment making the HX460 suitable for operation in hazardous classified locations. Safe make and break power switching can be achieved for high power applications at powers up to 600kW. With bi-directional switching capability and continuous current carry to 600A, this GIGAVAC sealed contactor is a solution for many solar applications including inverters, and DC combiner boxes along with a variety of industrial drive systems including rail and traction applications requiring a high voltage dielectric rating.

GIGAVAC | www.gigavac.com

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Utility-Scale, Commercial & Residential Inverters

An integral part of any solar energy system, inverters convert the power generated from the sun into functional energy for grid and even off-grid use. With technology offering ever-more efficient and reliable power generation, herein we highlight the latest in utility-scale, commercial, and residential solar inverters...

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Chilicon Power

Product: CP-250E

Application: Residential, commercial

Continuous Output Power (kW): 0.285

Weighted CEC Efficiency: 96%

Peak Efficiency Range: 96.7%

DC Voltage Operating Range: 22V-47V

Operating Temperature Range: -40°F to 149°F (-40°C to 65°C)

Dimensions: 12" x 8" x 1.8" (305mm x 203mm x 46mm)

Certifications/Approvals: UL1741, IEEE std 1547, IEEE std C62.41.2, CSA C22.2 NO. 107.1, CISPR 22 Class B

Warranty: 25-year warranty

Key Features:

- 60 and 72 cell compatibility;
- 285W AC output;
- Industry's most robust and fully featured monitoring equipment, see CP-100 gateway;
- Fully modular trunk cabling solution;
- Made in USA.

www.chiliconpower.com

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AIMS Power

Product: 250 Watt Micro Grid Tie Inverter - 6 pack

Application: Residential

Continuous Output Power (kW): 1.5kW

Weighted CEC Efficiency: 96.0%

Peak Efficiency Range: 96.5%

DC Voltage Operating Range: 27V-48V

Operating Temperature Range: -40°F to 185°F (-40°C to 85°C)

Dimensions: 6.5" x 7.2" x .86" (165mm x 183mm x 28mm)

Certifications/Approvals: UL1741, CSA C22.2, FCC

Warranty: 10-year warranty

Key Features:

- 6 pack includes trunk cable for install;
- Can parallel unlimited sets of 24 inverter strings.

www.aimscorp.net



Enphase Energy

Product: M250

Application: Residential, Commercial

Continuous Output Power (kW): 240kW

Weighted CEC Efficiency: 96.5%

Peak Efficiency Range: 96.5%

DC Voltage Operating Range: 16V-48V

Operating Temperature Range: -40°F to 149°F (-40°C to 65°C)

Dimensions: 6.73" x 6.81" x 1.18" (171mm x 173mm x 30mm)

Certifications/Approvals: CSA Listed per UL 1741/IEEE1547

Warranty: 25-year warranty

www.enphase.com



APsystems

Product: YC500i microinverter with PowerMax

Application: Residential, commercial (120Y208V)

Continuous Output Power: 548W

Weighted CEC Efficiency: 95%

Peak Efficiency Range: 95.5%

DC Voltage Operating Range: 16V-52V

Operating Temperature Range: -40°F to 149°F (-40°C to 65°C)

Dimensions: 8.7" x 6.6" x 1.1" (221mm x 168mm x 28mm)

Certifications/Approvals: UL1741, CSA C22.2 no. 107.01

Warranty: 10- and 25-year warranty

www.apsystems.com



OutBack Power

Product: FLEXpower Radian inverter system

Application: Residential, commercial

Continuous Output Power: 8kW

Weighted CEC Efficiency: 92.5%

Peak Efficiency Range: 95%

DC Voltage Operating Range: 40V-64V

Operating Temperature Range: -40°F to 140°F (-40°C to 60°C)

Dimensions: 47" x 33.5" x 9.84" (119mm x 85.1mm x 24.9mm)

Certifications/Approvals: UL1741, CE, CSA C22.2 No. 107.1, IEC 62109-1, RoHS compliant

Warranty: 5-year standard warranty with optional 10-year extended warranty

www.outbackpower.com



Magnum Energy

(a product brand of **Sensata Technologies**)

Product: MicroGT-500

Application: Residential, small commercial

Continuous Output Power (kW): 500W (dual MPPT micro inverter)

Weighted CEC Efficiency: 95%

Peak Efficiency Range: 95.5%

DC Voltage Operating Range: MPPT voltage range 22V-45V (max 55V)

Operating Temperature Range: 40°F to 149°F (-40°C to 65°C)

Dimensions: 8.75" x 6.5" x 1.1" (221mm x 167mm x 29mm)

Certifications/Approvals: UL1741, CSA C22.2, No. 107.1-01, NEC2014 690.12

Warranty: 25-year warranty

www.sensatapower.com

1500 Volt Central Inverter

Power Electronics leads the world in 1500 Volt inverter technology. Through Q3 of 2016 Power Electronics has already shipped over 200MW of their new UL 1500V HEC-US Inverter with over 900MW of commitments for 2017.

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- Anti-Corrosive C4 Paint
- Double Gasketed Doors
- UL Listed
- NEMA-4 Electronics Compartment
- Wide Selection of Power Ranges Available
- True Master Slave Topology



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Solar energy experts

PV power plant projects often require customer specific solutions. For this reason our clients also have our Engineering and Consulting department at their disposal, which comprise a wide number of highly skilled and experienced engineers that are available to modify our standard product to suit customer demands and ensure our clients get the product they need.

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Fronius USA

Product: Fronius Primo

Application: Residential

Continuous Output Power (kW): 3.8kW to 15kW

Weighted CEC Efficiency: 96.5%

Peak Efficiency Range: 96.9%

DC Voltage Operating Range: 80V-600V

Operating Temperature Range: -40°F to 140°F (-40°C to 60°C)

Dimensions: 16.9" x 24.7" x 8.1" (429mm x 627mm x 205mm)

Certifications/Approvals: UL / CSA, or: UL 1741-2010, UL1998 (for functions: AFCI, RCMU and isolation monitoring), IEEE 1547-2003, IEEE 1547.1-2003, ANSI/IEEE C62.41, FCC Part 15 A & B, NEC Article 690, C22. 2 No. 107.1-01 (September 2001), UL1699B Issue 2 -2013, CSA TIL M-07 Issue 1 -2013

Warranty: 10-year standard warranty, with extended warranty options up to 20 years

Key Features:

- Field serviceable and lightweight;
- Free lifetime monitoring;
- Dual MPPT and transformerless topology;
- Advanced grid features;
- Innovative SnapInverter hinged mounting system.

www.fronius-usa.com

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COTEK Electronic Industrial Co. Ltd.

Product: SD3500-xxx

Application: Commercial/industrial

Continuous Output Power (kW): 3.5kW

Weighted CEC Efficiency: 90%

Peak Efficiency Range: 91%

DC Voltage Operating Range: 20V-32V for 24V model

Operating Temperature Range: -4°F to 140°F (-20°C to 60°C)

Dimensions: 11.14" x 5.04" x 19.53" (283mm x 128mm x 496mm)

Certifications/Approvals: UL458 / EN60950-1

Warranty: 2-year warranty

Key Features:

- Parallel N+1 redundancy design for power expansion;
- Built-in ATS & AC circuit breaker;
- RS232 communication;
- Fully isolated input & output;
- Multiple industrial for single & 3-phase applications.

www.cotek.com



ABB

Product: UNO-7.6/8.6-TL

Application: Residential

Continuous Output Power (kW): 7.6kW / 8.6kW

Weighted CEC Efficiency: 97%

Peak Efficiency Range: 97.8%

DC Voltage Operating Range: 90V-580V

Operating Temperature Range: -13°F to 140°F (-25°C to 60°C)

Dimensions: 29.3" x 22.9" x 8.8" (744mm x 581mm x 223mm)

Certifications/Approvals: UL1741, IEEE 1547, IEEE 1547.1, CSA C22.2N 107.1-01, UL1998, UL1699B, FCC Part 15 Class B

Warranty: 5-year warranty

www.new.abb.com



SMA America

Product: Sunny Boy 5.0-US/6.0-US

Application: Residential

Continuous Output Power (kW): 5kW (5.0-US), 5.2kW @208V / 6kW @240V (6.0-US)

Weighted CEC Efficiency: 96.5% (208V), 97% (240V)

Peak Efficiency Range: 97.2% to 97.6%

DC Voltage Operating Range: 100V-550V

Operating Temperature Range: -13°F to 140°F (-25°C to 60°C)

Dimensions: 21.1" x 28.5" x 7.8" (535mm x 730mm x 198mm)

Certifications/Approvals: UL1741, UL1998, UL 1699B, IEEE1547, FCC Part 15 (Class A & B), CAN.CSA V22.2 107.1-1

Warranty: 10-year standard warranty, with up to 20-years available

www.sma-america.com



Growatt USA Inc.

Product: Growatt 33-40k TL3-US

Application: Commercial and industrial PV systems

Continuous Output Power (kW): 40kW

Weighted CEC Efficiency: 98.2%

Peak Efficiency Range: 98.6%

DC Voltage Operating Range: 200V-1000V

Operating Temperature Range: -13°F to 140°F (-25°C to 60°C)

Dimensions: 17.1" x 31.1" x 10.4" (434mm x 787mm x 264mm)

Certifications/Approvals: UL1741, UL1699B, IEEE1547

Warranty: 10-year standard, with optional extended warranty to 25-years

www.growatt-america.com



Ideal Power

Product: The SunDial 30kW Commercial PV String Inverter

Application: Commercial with energy storage option

Continuous Output Power (kW): 30kW

Weighted CEC Efficiency: >97% (est.)

Peak Efficiency Range: >97.5%

DC Voltage Operating Range: 100V-1000V

Operating Temperature Range: -13°F to 122°F (-25°C to 50°C)

Dimensions: 20.5" x 52" x 16" (520mm x 1321mm x 406mm)

Certifications/Approvals: UL1741, IEEE 1547A, IEC 62109-1,2

Warranty: 10-year limited standard warranty

www.idealpower.com

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Rhombus Energy Solutions

Product: Rhombus Battery Energy Storage Inverter (RBES 125)
Application: Commercial
Continuous Output Power: 125kW
Peak Efficiency Range: >97%
DC Voltage Operating Range: 450V-600V

Operating Temperature Range: -4°F to 122°F (-20°C to 40°C)
Dimensions: 50" x 60" x 80" (1270mm x 1524mm x 2032mm)
Certifications/Approvals: Certified UL1741- 2015, IEEE 1547
Warranty: 2-year standard warranty with optional extended warranty to 10 years

Key Features:

- Patented power management technology produces quality grid power with low common mode noise (THD);
- UL Listed with +/-0.5 Power Factor range;
- Bi-directional operation links seamlessly to the grid;
- Scalable for multiple unit paralleling capability for higher power.

www.rhombusenergy.com



Darfon America, Corp.

Product: G320
Application: Commercial, Residential
Continuous Output Power (kW): .300kW
Weighted CEC Efficiency: 96%
Peak Efficiency Range: 96.5%
DC Voltage Operating Range: 22V-60V

Operating Temperature Range: -40°F to 149°F (-40°C to 65°C)
Dimensions: 7.7" x 10.6" x 1.3" (195mm x 268mm x 34mm)
Certifications/Approvals: UL1741, CEC, FCC Part15 Class B, IEEE 1547
Warranty: 25-year warranty
www.darfonsolar.com



Delta Products Corporation

Product: Three Phase Transformerless String Inverter
Application: Commercial, industrial, utility-scale
Continuous Output Power (kW): 80kW
Weighted CEC Efficiency: 98.5%
Peak Efficiency Range: 98.8%
DC Voltage Operating Range: 200V-1000V

Operating Temperature Range: -13°F to 140°F (-25°C to 60°C)
Dimensions: 24.2" x 35.4" x 10.8" (614mm x 899mm x 274mm)
Certifications/Approvals: UL1741
Warranty: 10-year warranty
www.delta-americas.com



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SEE AD ON PAGE 6



CyboEnergy, Inc.

Product: On/Off-Grid CyboInverter

Application: Commercial and Residential

Continuous Output Power: 1.2kW

Peak Efficiency: 96%

DC Voltage Operating Range: 15V-48V

Operating Temperature Range: -40°F to 149°F (-40°C to 65°C)

Dimensions: 12.5" x 9.5" x 2.3" (317.5mm x 241mm x 58mm)

Certifications/Approvals: UL1741, IEEE1547, CSA 107.1, FCC, NEMA6 (IP67)

Warranty: 10-year warranty with extended available

Key Features:

- On-grid or off-grid mode, switching automatically based on grid condition;
- For on-grid systems with backup power when grid is down;
- Four DC input channels with MPPT for each solar panel;
- Solar, battery, or wind power for each input channel;
- Seamless integration of different DC sources with grid flexibility.

www.cyboenergy.com

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Canadian Energy

Product: Schneider Conext XW+

Application: Commercial, residential

Continuous Output Power (kW): 6.8 kW

Weighted CEC Efficiency: 92.5%

Peak Efficiency Range: 95.7%

DC Voltage Operating Range: 40V-64V

Operating Temperature Range: -13°F to 150°F (-25°C to 70°C)

Dimensions: 22.8" x 16.1" x 9" (580mm x 410mm x 230mm)

Certifications/Approvals: UL1741, CSA 107.1

Warranty: 5-year warranty

Key Features:

- Advanced features to take advantage of next generation lithium batteries;
- Advanced peak shaving capability to reduce time of use charges;
- Ability to stack multiple inverters together to form a 3 phase commercial grade system;
- High surge power capability allows for starting difficult motor loads;
- Accessories including automated generator start, solar charge controllers, battery monitors, and remote connectivity using Conext Combox.

www.sesolar.com



SolarEdge

Product: DC optimized inverters

Application: Commercial

Continuous Output Power (kW): Scaleable ratings from 9kW to 33.3kW

Weighted CEC Efficiency: 96.5% to 98.5% (depending on model)

DC Voltage Operating Range: Fixed DC voltage

Operating Temperature Range: -40°F to 140°F (-40°C to 60°C)

Dimensions: 30.5" x 12.5" x 10.5" (775mm x 315mm x 260mm)

Certifications/Approvals: UL1741, UL1699B, UL1998, CSA22.2, IEEE1547, FCC Part 15 Class B

Warranty: 12-year standard warranty, extendable to 20- or 25-years

www.solaredge.us



Yaskawa - Solectria Solar

Product: PVI 50/60TL

Application: Commercial, Utility-scale

Continuous Output Power (kW): 50/60kW

Weighted CEC Efficiency: 98%

Peak Efficiency Range: 99%

DC Voltage Operating Range: 300V-950V

Operating Temperature Range: -22°F to 140°F (-30°C to 60°C)

Dimensions: 39.4" x 23.6" x 10.24" (1000mm x 600mm x 260mm)

Certifications/Approvals: UL 1741:2010, UL 1699B, CSA-C22.2 NO.107..1-01, IEEE1547; FCC Part 15

Warranty: 10-year standard warranty with 15- and 20-year options

www.solectria.com

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sales@aimscorp.net



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Huawei Technologies Co., Ltd.

Product: SUN2000-25KTL-US / SUN2000-30KTL-US

Application: Utility-scale, commercial

Continuous Output Power (kW): 25kW / 30kW

Weighted CEC Efficiency: 98.0%

Peak Efficiency Range: 98.6%

DC Voltage Operating Range: 200V-950V

Operating Temperature Range: -13°F to 140°F (-25°C to 60°C)

Dimensions: 21.7" x 30.3" x 10.6" (550mm x 770mm x 270mm)

Certifications/Approvals: UL1741, UL1699B, UL1998, CSA C22.2 #107.1-01, FCC Part 15, IEEE 1547, IEEE 1547.1

Warranty: 10-year standard with optional extended warranty of 15-, 20-, 25-years

Key Features:

- High yields;
- Smart O&M;
- Safe and reliable.

www.huawei.com/en/all-products/solar



KACO new energy

Product: blueplanet 2200 TL3 US

Application: Utility-scale

Continuous Output Power (kW): 2200kW

Weighted CEC Efficiency: 98%

Peak Efficiency Range: 98.8%

DC Voltage Operating Range: 550V-1000V

Operating Temperature Range: -4°F to 122°F (-20°C to 50°C)

Dimensions: 84.6" x 134" x 55" (2150mm x 3400mm x 1400mm)

Certifications/Approvals: UL1741 -2010, IEEE1547, IEEE1547.1, CSA C22.2 No. 107.1

Warranty: 5-years standard warranty with extendable options

www.kaco-newenergy.com



Eaton

Product: Power Xpert Solar Grid Tie Inverters

Application: Utility-scale

Continuous Output Power (kW): 1666 kW

Weighted CEC Efficiency: 98.5%

Peak Efficiency Range: 98.7%

DC Voltage Operating Range: 550V-1000V

Operating Temperature Range: -4°F to 122°F (-20°C to 50°C)

Dimensions: 92.3" x 130.8" x 61.1" (2344mm x 3322mm x 1552mm)

Certifications/Approvals: UL1741, CSA C22.2 107.1

Warranty: 5-year warranty

www.eaton.com



Tabuchi Electric Company of America, Ltd.

Product: EMVAS - Mega Value System

Application: Commercial

Continuous Output Power: 25kW

Weighted CEC Efficiency: 97.5%

Peak Efficiency Range: 98.5%

DC Voltage Operating Range: 140V-880V

Operating Temperature Range: -4°F to 122°F (-20°C to 50°C)

Dimensions: 53" x 21.5" x 11.8" (1350mm x 545mm x 300mm)

Certifications/Approvals: ETL (UL1741/1699B, CSA C22.2, No 107-01, IEEE 1547A, CEC), FCC class A

Warranty: 10-year warranty

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SP-1000

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SEE AD ON PAGE 39



Power Electronics

Product: HEC-US 1500 volt
Application: Central inverter utility-scale
Continuous Output Power (kW): 1MW to 3MW @ 50°C
Weighted CEC Efficiency: 98.0%
Peak Efficiency Range: 98.5%
DC Voltage Operating Range: 800V-1500V

Operating Temperature Range: -41°F to 122°F (-35°C to 50°C)
Dimensions: 231" x 37" x 86" (5867mm x 940mm x 2184mm)
Certifications/Approvals: UL 1741, 16109.1, CSA 22.2, IEEE 1547
Warranty: 5-year standard warranty with extensions available to 25 years

Key Features:

- Stainless steel enclosure;
- Anti-corrosive C4 paint;
- Double gasketed doors;
- True master slave topology;
- NEC 2014 compliant.

www.power-electronics.com



Ingeteam, Inc.

Product: Ingecon PowerMax TL U B
Application: Utility-scale
Continuous Output Power (kW): up to 1640kW
Weighted CEC Efficiency: 98.5%
Peak Efficiency Range: 98.9%
DC Voltage Operating Range: 660V-1300V
Operating Temperature Range: -4°F to 131°F (-20°C to 55°C)
Dimensions: 111" x 35" x 89" (2819mm x 889mm x 2260mm)
Certifications/Approvals: UL1741
Warranty: 5-year warranty, with extended warranty options up to 20-years
www.ingetteam.com



TMEIC Corporation

Product: Solar Ware Samurai 1500V
Application: Utility-scale
Continuous Output Power: 2700kW
Weighted CEC Efficiency: 98.5%
Peak Efficiency Range: 98.8%
DC Voltage Operating Range: 875V-1300V
Operating Temperature Range: -4°F to 131°F (-20°C to 55°C)
Dimensions: 92" x 197" x 46" (2286mm x 5000mm x 1150mm)
Certifications/Approvals: UL1741/CSA; 107.1/IEEE1547; NEC standard
Warranty: 5-year standard warranty, with up to 20-years extended available
www.tmeic.com



Alencon, LLC

Product: GrIP Modules
Application: Utility-Scale
Continuous Output Power (kW): 2.5MW per module
Weighted CEC Efficiency: 99% (estimated)
Peak Efficiency Range: 2500V (specification dependent)
DC Voltage Operating Range: 2500V (specification dependent)
Operating Temperature Range: -4°F to 140°F (-20°C to 60°C)
Dimensions: 6.23' x 3.93' x 4.59' (1.9m x 1.2m x 1.4m)
Certifications/Approvals: UL 1741, IEEE1547; 2016
Warranty: 5-year standard warranty, optional 25-year extended available
www.alenconsystems.com



SIC USA

Product: Equinox 1MW UL
Application: Utility-scale
Continuous Output Power (kW): 1000kW
Weighted CEC Efficiency: 98.5%
Peak Efficiency Range: 30% to 75% Power Level (%kW)
DC Voltage Operating Range: 615V-850V
Operating Temperature Range: -22°F to 140°F (-30°C to 60°C)
Dimensions: 82.8" x 180.5" x 37.2" (2103mm x 4585mm x 945mm)
Certifications/Approvals: UL1741, CSA C22.2 No 107.1-01, IEEE1547, IEEE1547.1, IEEE C62.41.2, IEEE C62.45, IEEE C37.90.1, IEEE C37.90.2
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Product: 890GT-B Outdoor rated PCS
Application: Utility and large commercial energy storage
Continuous Output Power (kW): 2000kW
Weighted CEC Efficiency: 97.83% - 98.34%
Peak Efficiency Range: 98.7%
DC Voltage Operating Range: 750V-1150V
Operating Temperature Range: -4°F to 131°F (-20°C to 55°C), -40° option available

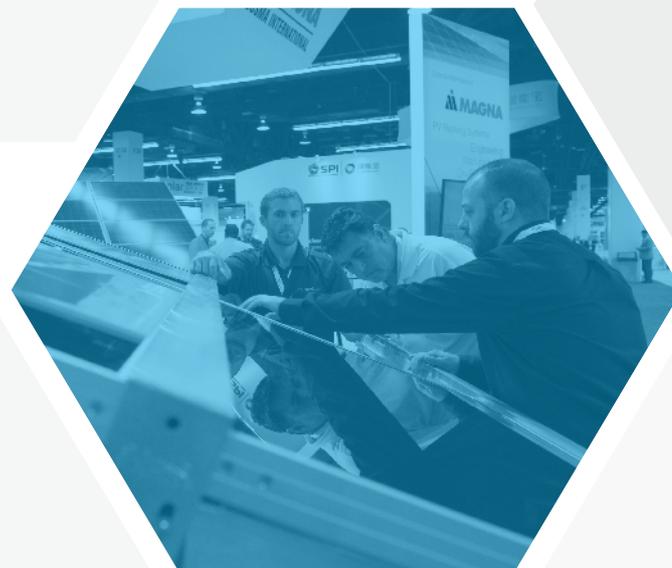
Dimensions: 133.7" x 67.3" x 104.3" (3395mm x 1710mm x 2648mm)
Certifications/Approvals: UL 1741 Second Edition, 2010, NFPA70, IEEE1547 (2003), IEEE1547.1 (2005), IEEE1547a-2014 amendment to IEEE1547 (2003), IEEE 519, CE: LVD, EMC, G5/4, G59/1
Warranty: 3-year standard warranty
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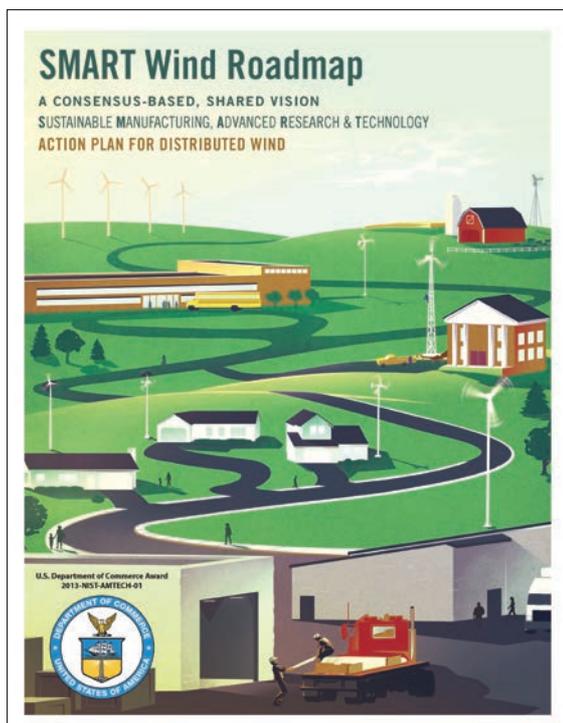
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U.S. Wind Turbine Manufacturers Work Together

Driving down costs, expanding exports, and increasing domestic sales

by Heather Rhoads-Weaver and Britton Rife

Both exports and domestic sales by U.S. distributed wind turbine manufacturers doubled last year over 2014 to nearly 26 MW and installed costs have decreased 20 percent since 2013, according to new market statistics compiled by the Pacific Northwest National Laboratory.

To continue pushing forward both trends, a team of U.S. manufacturers have partnered together with academic researchers and other industry stakeholders to pursue innovative approaches for reducing lifecycle costs and scaling up production volumes – while maintaining high quality – by recognizing the most urgently needed joint actions in a recently released Sustainable Manufacturing, Advanced Research & Technology (SMART) Wind Roadmap.

More than two dozen distributed wind energy equipment manufacturers, 50 other vendors and industry supply chain members, researchers from 4 federal laboratories, 30 academic stakeholders, and nearly 20 nonprofit organizations, government representatives and other stakeholders convened over a two-year period to develop a shared vision on common distributed wind research and manufacturing gaps and barriers, and prioritized solutions to those gaps for today and for future scalability.

The U.S. distributed wind industry stands poised to provide cost-effective solutions and claim its share of the multi-trillion dollar global microgrid boom. The Roadmap's vision is to connect and inspire vital industry-academic R&D investments to advance innovative manufacturing techniques and aid rapid distributed wind growth.

Convincing competitors to collaborate and cooperatively invest in critical actions is key for helping U.S. manufacturers remain global leaders in expanding distributed wind deployment worldwide. The landmark consensus-based Roadmap charts a clear industry-wide path forward to increase American jobs, competitiveness and market share in the growing distributed generation sector.

Key actions recommended

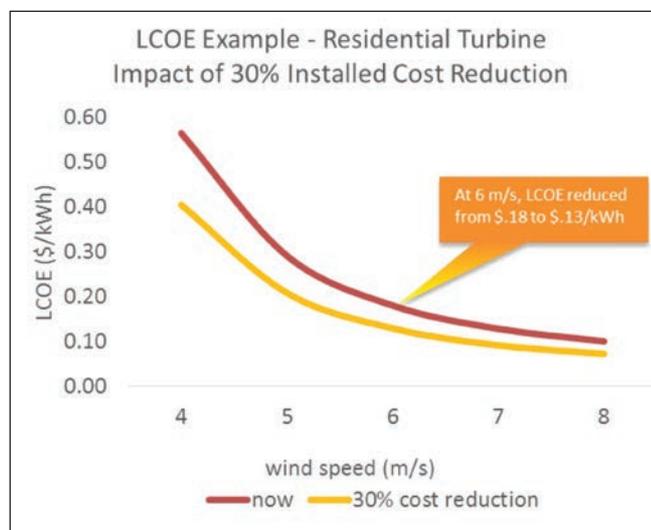
With grant funding from the U.S. Department of Commerce's National Institute of Standards and Technology (NIST) Advanced Manufacturing Technology Consortia program, the Distributed Wind Energy Association (DWEA) launched the targeted SMART Wind Consortium to facilitate a rapid transfer of innovation into American-manufactured wind turbines. Implementing the Roadmap will open up new market opportunities and expand the number of distributed wind applications, maintaining U.S. global competitiveness and leadership. Top priority action steps include:

1. Optimizing and harmonizing wind turbine designs to improve levelized cost of energy (LCOE) and achieve parity with U.S. retail electricity rates in more markets, including developing a common core modular inverter, utilizing wide bandgap materials (advanced semiconductors) in power electronics, and creating new standard support structure designs
2. Improving manufacturing processes and materials including incorporating lean manufacturing practices, new approaches to hot-dip galvanization, efficient fixturing and tooling, and non-destructive testing methods
3. Optimizing standards and certification processes to enable technology evolution and maintain quality, including conducting a gap analysis for certification requirements for various global markets
4. Streamlining installation and maintenance of wind turbine systems; develop low-cost prognostic condition monitoring to provide a feedback loop on field performance to equipment manufacturers
5. Sustaining SMART Wind Consortium activities and partnerships to allow for further refinement of costs and benefits of top actions, creation of a supplier directory and industry-wide reliability and materials databases, and funding for R&D and workforce training

These prioritized action steps will help reach DWEA's "30 GW by 2030" vision, aiding distributed wind industry growth and advancing innovative manufacturing techniques by increasing production volumes and reducing lifecycle costs while maintaining high quality.

Top cost reduction opportunities

Aggregated breakdowns of eight leading U.S. wind turbine manufacturers' top-level bills of materials (BOMs) revealed the main overall component cost contributors of total system costs for both micro/residential and commercial/mid-size sectors. Towers are the single highest cost element, and



foundations also represent significant cost.

For mechanical subsystems, the gearbox and bedplate are the most expensive, particularly for larger turbines. Blades are the dominant focus for composites. Under electrical subsystems, inverters (for the micro/residential sector), the control panel (for the commercial sector), and generator/alternators are the top cost contributors. Installation costs are not included in the BOMs, but it and other items such as turbine assembly, site development and preparation, zoning and permitting, transportation and logistics, and other non-hardware costs can contribute substantially to the overall system cost.

SMART Wind Consortium meetings investigated lean manufacturing and innovation engineering and other manufacturing improvement philosophies that can be deployed to increase the competitiveness of distributed wind equipment manufacturers. The strategy for the U.S. distributed wind industry's continued growth is to increase manufacturing process improvements incrementally while addressing shifting production levels, taking individual steps that will reduce manufacturing costs but not become an undue financial burden.

Applying the action steps identified by the SMART Wind Consortium will result in more competitive systems and greater market share for U.S. manufacturers. This will accelerate deployment of U.S. technology, helping to generate clean, renewable energy, increase employment in the sector, and bolster the capabilities of this U.S.-led industry.

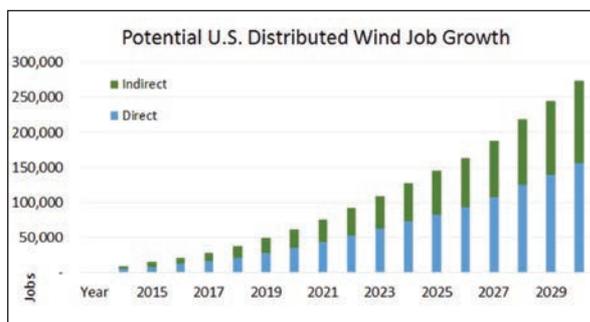
Heather Rhoads-Weaver is founder and principal consultant of eFormative Options, LLC, specializing in advancing sustainable energy solutions, creating funding and resource plans, and strengthening relationships with stakeholders, drawing on substantial experience and lessons learned with managing complex data and successful consensus-building efforts.

Britton Rife is communications manager for the Distributed Wind Energy Association, a collaborative group of manufacturers, distributors, project developers, dealers, installers, and advocates, whose primary mission is to promote and foster all aspects of the American distributed wind energy industry.

eFormative Options, LLC
www.eformativeoptions.com

The Distributed Wind Energy Association
www.distributedwind.org

A 90-minute virtual briefing by SMART Wind Consortium leaders highlighting top-priority action steps to address key distributed wind industry barriers and opportunities is can be viewed free-of-charge at: <http://distributedwind.org/event/smart-wind-roadmapwindexchange-webinar/>



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Real Time Monitoring

Providing performance opportunities

by Robbie Gibson

RENEWABLE ENERGY ASSETS ACCOUNT FOR 130GW OF CLEAN ENERGY GENERATION GLOBALLY,

with North America providing around 25% (30GW). 2015 saw a record number of clean energy investments totalling \$329 billion internationally, with the US ranking second in the top 10 clean energy investment markets.

With continually growing investment in clean energy, more mature understanding of technology and natural resources, combined with a global push towards combatting the effects of climate change, new solutions, such as real time monitoring, are emerging to maximize energy asset efficiency.

Simple vs complex - power plant monitoring

For years, coal and gas plants dominated the energy mix, and featured several large plants generating huge volumes of power for wide areas. This common structure meant generation was dealt with at a national level. Monitoring and control of these large-scale power plants was operated on-site and, with only a few plants, this was a feasible and natural option.

Traditional energy generation from coal or gas is considered non-complex as both the fuel and the technology are reasonably simple and well-understood. As a result, the monitoring and control of these plants is also relatively straight forward. The fuel used in a nuclear power station can be considered relatively simple, while the technology used to convert it is considerably complex, leading to a far more challenging plant monitoring and control system.

Renewables requirements

Renewable energy assets are made up of wind farms, solar plants, and wave and tidal projects in their thousands. Each type of clean energy generation holds its own challenges and can be considered complex, both in terms of the fuel type and the behavior of the resource. Following the rule for traditional energy generation, the more complex the technology, the greater the need for complex monitoring and control systems in order to maximize production.

Looking at wind energy, while the method of capturing the wind and subsequently generating power is relatively well understood, the complexities of the wind resource, and our understanding of them, cause the process to be considered complex. As a result, wind energy assets require significant control and management. Recent advancements in real time monitoring are transforming the ability to optimize wind energy generation.

The demand for monitoring

Wind farms are generally developed in remote locations, designed to operate autonomously, without a site presence and be visited periodically for planned maintenance. Unlike traditional energy models, there is no need to routinely feed the burner with coal; the wind is a free and natural resource, and despite variations, it will keep turbines spinning whenever present.

The role of technological advancements

Historically, as long as wind turbines were generating energy, asset owners weren't concerned with their greater possible achievements. The increase in understanding of the complex nature of the wind resource has made owners and operators aware of optimization and the potential increase in return when it's applied to operating projects.

Advancement in measurement technology is a huge contributor to wind farm optimization and combined with improvements in monitoring, sites are now able to uncover an accurate, well-rounded picture of real conditions. The complex nature of the wind has been studied by academics for many years, but only in the last few has the industry been able to accurately measure and characterize the wind in real time, using technologies such as lidar.

Before the availability of highly accurate lidar measurements, analysts predicted wind flow by modeling it across complex terrain, with point in space measurements. Now, real time accurate measurements can be applied to operational wind farms which are known to be underperforming.

What real time monitoring has to offer

Wind energy assets can be monitored via the Original Equipment Manufacturer (OEM) Supervisory Control and Data Acquisition (SCADA) system, or on a separate Open Platform Communication (OPC) connection to the wind farm. However, it is third party, independent performance monitoring systems which appear to be offering true value in terms of optimization capabilities.

Independent 'control centers' and performance tools monitor all sites on the same online platform regardless of asset make or model, meaning operators don't need to draw down and analyze SCADA data separately for each OEM.

These systems allow operators to monitor assets quickly on a turbine-by-turbine basis or as a full 'birds eye view' of their portfolio where key data signatures and trends can be viewed and analyzed.

Visualization of both current and historical data can be accessed on these platforms, including; power curves, energy against wind resource, availability, capacity factors, production ratios, and event energy yield deficit.

Being able to access this kind of detailed information 24/7 gives real insight into performance, delivering the opportunity for significant operational improvements which were previously unavailable.



Taking control

Other technology advances allow us to improve the control of wind turbines, enhancing performance as well as better manage component loadings. The application of real time monitoring facilitates the selective control of an individual turbine's power output to reduce potential damage and maximize energy capture. Devices including sensors and controller add-ons can be fitted to a wind turbine to monitor surrounding conditions and control it in a more efficient manner. These devices combine condition monitoring, data processing, and control.

Advanced control solutions effectively maximize energy capture and extend turbine lifetime while providing exceptional levels of safety and operational flexibility. Wind farms which have been operating for a number of years can benefit from a controller upgrade to improve the operation and efficiency of the asset. Used alongside real time monitoring solutions, a complete picture is drawn of the potential performance enhancement that can be realized for aging assets.

The ability to control a wind farm as effectively as a power station, as a single unit integrated to the grid, is something made possible through the ability to react to conditions as they change. Many wind farms are simply an aggregation of wind turbines which are controlled and optimized individually, rather than operating as one well-optimized, efficient grid asset. Monitored and managed properly, wind farms can be controlled in real time, providing support to the grid under conditions such as system faults, and dips in voltage or frequency. Advanced wind farm control can also manage constraining factors more optimally, such as turbines being shut down due to noise limits or shadow flicker effects.

So what's next for real time monitoring?

It has now become commonplace to use lidar technology to accurately characterize the resource of wind farms in the feasibility and development phase. Lidar is supporting the theory that knowledge is power. As monitoring practices of operational wind farms evolve, it is likely lidar will play an increasingly integral part in the real-time monitoring and control of operational wind farms.

Advancements in lidar, monitoring, and control technology are all important, and the aim is for the industry to reach an acceptable price point to facilitate deployment of these technologies on all current assets and to further develop improved methodologies used to monitor the wind and control the turbine. Asset owners should always be questioning the current operational performance of their assets and looking to improve with the help of the ever-evolving tools and solutions

available. They no longer have to accept the performance of aging assets and can instigate effective optimizing solutions through real time monitoring to radically improve their return on investment.



Robbie Gibson has over ten years of experience in the renewable energy industry and leads the measurement and active asset management groups within SgurrEnergy as an associate director. Robbie's expertise lies in the fields of wind and power performance monitoring and he is hands-on as project director, providing support and direction for key projects.

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Spiraling O&M Costs are Holding Back Wind Power Output and Profits in the U.S.

Faulty electronics systems are mostly to blame

by John Greulich

The potential: 35% by 2050

Alternative energy skeptics are keen to point out wind energy only made up 5% of total electricity generation in the United States in 2015; a mere “drop in the bucket.” While it’s true the power generated by wind energy and other sustainable sources is dwarfed by that of fossil fuels, it’s also a mistake to overlook the boom the wind energy industry has experienced in the past decade.

Demand for sustainable wind energy in the U.S. has grown an average of 22% per year since 2007. 50,000 wind turbines currently generate 75,000 MW of energy across the country, powering over 20 million American homes a year. Consider that a very large “drop in the bucket”.

Granted, this industry is young compared to coal, natural gas, and nuclear but large-scale investment in wind energy didn’t begin in earnest in the U.S. until 2000, and off-shore wind farms have yet to get established.

The problem: wind turbine reliability

Despite this striking growth potential, wind turbine reliability is a serious cause for concern. Commercial wind turbines (WTs) are supposed to last 20 to 25 years, but this is typically a grandiose projection. The heavy toll from wind, temperature, humidity, precipitation, and other environmental factors stresses WTs to the hilt, and their availability and output declines sharply with exposure.

With operations and maintenance (O&M) costs increasing as turbines installed between 2000 and 2007 get older, improving the reliability and performance of WTs is a paramount challenge for the growth of the industry.

The economic forces behind this statement are clear: WTs are expensive—typically \$3-\$4 million per unit once installed—and unplanned downtime resulting in lost electricity sales is costly. This downtime cuts into slim profit margins and makes investing in wind energy less appealing to stakeholders and policymakers.

It’s estimated that every WT languishes for 3% or more during the first 10 years of its lifespan, not including natural standstill. What’s more, this estimate doubles to 6% after 10 years, as O&M costs associated with replacing worn out components and upgrading obsolete technology stack up. The worst case scenario yet is the premature decommissioning of WTs prior to 20 years in service.

Data is somewhat shallow on this topic because of the youth of the industry in the U.S., but it’s widely acknowledged even though turbine manufacturing is becoming cheaper, O&M costs will continue to soar as WTs reach their mid-teens. (Figure 1)

Beyond the high cost of new equipment and replacement parts from a turbine’s OEM, field service labor costs also aren’t cheap, not to mention the inherent danger and liability associated with having a technician lug a 50 lb. replacement part up a 300+ foot turbine.

Suffice to say the #1 goal for wind farm managers is to establish preventative maintenance strategies reducing O&M costs and increasing profitability by improving mean time between failures (MTBF) and extending the average lifespan of their fleet.

The culprit: faulty electronics

It’s a common misconception that gearbox failures and/or structural problems account for the vast majority of WT failures.

According to widely-accepted Reliawind report data, electrical systems and electrical control systems cause at least 50% of all wind turbine failures. Approximately 38% of these electrical failures are caused by defective components within a turbine’s power module and the other 12% in its electrical control system. As the chart of Reliawind data illustrates, the

main power converter is the electrical component that most often fails. (Figure 2)

Because converters are responsible for 18% of all turbine failures, their faults are worth dissecting individually. According to available data, the electronic components within WT converters most prone to failure are:

1. Capacitors (30% of converter failures)
2. Printed Circuit Boards (26%)
3. Power Semiconductors (i.e. IGBT-modules) (21%)

Temperature, vibration, and humidity are the three most common sources of failure for these electrical components, with temperature being the dominant stressor.

The solution: preventative maintenance and long-term engineering

Electronic assemblies within turbines may be some of the least expensive components initially, but they have a bad habit of creating O&M headaches and cutting into profits when downtime and labor costs start piling up.

While all WT electronic components inevitably fail, O&M managers can substantially reduce long-term costs by better anticipating (through effective condition monitoring) and addressing the root cause of these failures before high-cost unplanned or emergency field service is required. This “Intelligent Maintenance” approach will reduce long-term O&M costs and the number of WT failures. (Figure 3)

The only way to improve WT reliability and ultimately wind industry profitability is to bridge the gap between the wind farm and the OEM when warranties have expired and turbines begin to show signs of wear.

To do so, it’s essential to partner with an Independent Service Provider (ISP) with experience servicing WT components including PCBs, pitch drive systems, IGBTs, PLCs, controls, encoders, transducers, and more.

Beyond repairs, the ISP should be equipped to accurately diagnose performance issues and offer cost-saving solutions by recommending and taking preventive repair actions. These actions include: removing and replacing stressed parts; improving legacy design with newer, more reliable technology; remanufacturing unsalvageable or obsolete components; and manufacturing custom-designed products.

The U.S. Department of Energy expects by 2030 wind energy will power 20% of U.S. electricity, and 35% by 2050. WT availability and performance – and especially the reliability of the electrical components within them – will need to come a long way for those exciting benchmarks to be realized.

John Greulich is the sales director at PSI Repair Services.

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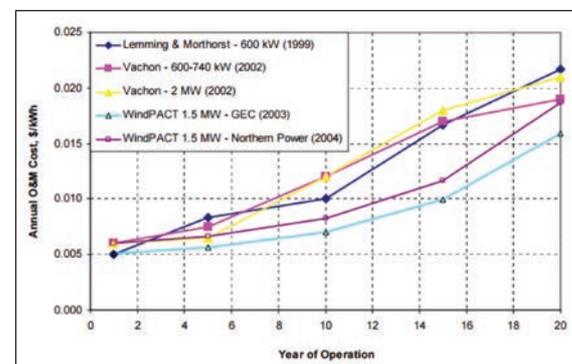


Figure 1. Total O&M costs increase with age due to wear-out related failures

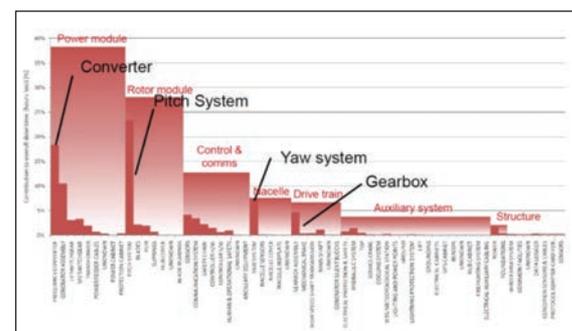


Figure 2. Normalized failure rate of subsystems and assemblies for variable-speed wind turbines of multiple manufacturers

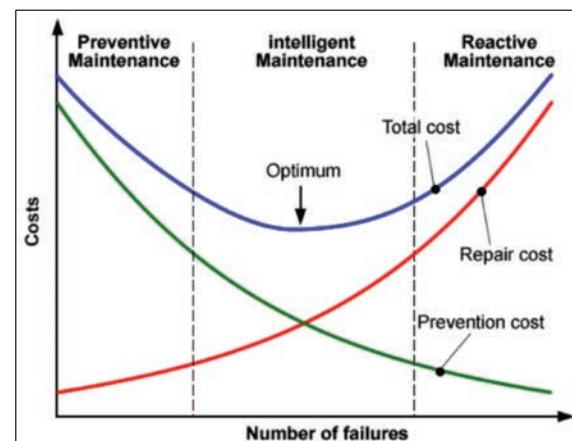


Figure 3.



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Enabling Life Extension

Computational modeling catches failures before sensors

by Dr. Elon Terrell

WIND TURBINES OFTEN OPERATE IN HARSH, volatile environments due to the unsteady nature of wind. Temperature extremes, humidity, and/or dusty air all amount to unpredictable and strenuous conditions that must be endured by the wind turbine gearbox. For this reason, key turbine components like the bearings and gears in the gearbox are prone to premature failure. Unplanned repairs to these failed components drive up operations and maintenance costs and the levelized cost of wind energy. Finding ways to mitigate those failures is therefore crucial to the sustainability of wind as an energy source.

A wind turbine gearbox is typically designed to last 20 years, but in practice usually needs to be replaced every 6-8 years. This can cost between \$200,000 and \$350,000 for 1.5MW gearboxes and double to triple that amount for 2.5MW machines, not including the cost of the crane and revenue loss due to prolonged asset downtime. Many operators have turned to “big data” to “predict” when maintenance should be scheduled in an effort to mitigate unplanned outages. Scheduling maintenance based on presumptions made from large datasets often causes unnecessary expense in replacing components too early, or on the contrary, results in missed failures that lead to catastrophic damage and prolonged asset downtime. Investments made in condition-based monitoring systems and sensors are also often used to alert the operator when failures occur. While useful tools, they only alert operators to end of life failures. Once a vibration is detected, the technician is in corrective maintenance mode, making it too late to do preventative maintenance.

A new monitoring approach, which combines small data with material science, has recently entered the market. The process uses fundamental physics combined with the standard SCADA data feed from each turbine to accurately predict the life of the gearbox and key components from 0-30 years without the use of extra sensors and big data. The computational testing software builds digital models of the gearbox and key components based on the material DNA and the components’ microgeometries and operating conditions to determine the impacts on component life. High performance computers simulate the models’ operational performance under representative operating conditions and applies a large volume of hypothetical scenarios to detect the earliest point in time that cracks initiate at the microstructural level.

Having accurate information on how a component will fail, and even better, when it will fail, months and years in advance affords operators the ability to

schedule up-tower component replacements and other maintenance operations in a proactive manner as opposed to a reactive manner, which is the case when using big data and sensors. Knowing the failure rates of the gearbox components, main bearings, pitch bearings, and soon to be blades by using computational testing allows for accurate predictive data to be available on high value systems. This enables operators to build multi-year budgets, forecast maintenance and replacements, and simulate how a de-rate or uprate impacts the life extension of unique assets. Eventually, a digital model of the entire wind turbine will be available accounting for both long and short term failure predictions to optimize both operations and asset management.

Computational testing using material science-based prognostics can help an operator prevent failures by knowing the component has early crack initiation long before a sensor can detect it. The software continually monitors the asset’s gearbox and key components and simulates each site location’s operating conditions to provide a “watch list” ranking from worst to best, updating the operator of any changes in life.

With the amount of lead time given, operators can now source from suppliers based on component life rather than purchasing parts solely because of cost or that it was on the OEM’s “supplier-approved” list. The operator now has the ability to see side by side life comparisons offered from different supplier products and simulate how those components would operate at the site under its unique loading conditions.

Computational testing provides insight into how choosing a part or service with a longer life prediction could help achieve gearbox life extension. On the other hand, it could also help an operator choose a part with a lower life prediction in instances where a core part of the gearbox is expected to fail within a short timeframe. The operator would choose a component with a shorter life and for less cost to keep the asset operational until the gearbox needed to be fully replaced.

Suppliers are also starting to use the software to forecast where and when uptower component replacements will be needed in the field. The dashboard provides visibility into how their products are performing and displays an anonymized forecast into where the sales opportunities are located within the operator network and when the parts and services will be needed.



Dr. Elon Terrell is a computational tribologist at Sentient Science.

Sentient Science | www.sentientscience.com

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Addressing the Challenge

Determining wind conditions in forests dominated by coniferous trees

by Peter Enevoldsen



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SIBA FUSES is proud to introduce a new range of SSK-type fuses in the switch-fuse combination. Our fuses can replace expensive circuit breakers and can be used on transformers rated up to 3,150KVA. SIBA's special SSK-type fuse maintains the minimum breaking current at lower dissipation than the existing products, and is specially designed for Wind Energy Applications. One of the major challenges taken on by SIBA is the heating of fuses. Empirical work based on long-term test series involving the heating of the fuses ensures that we are able to cope with this challenge, and continue to further develop the SSK production series in order to meet the demands for regenerative energies in the future as well. For further information, please visit our website.



IN NORTH AMERICA, THE INSTALLATION OF WIND TURBINES IN RURAL AREAS HAS INCREASED DRAMATICALLY IN RECENT YEARS, especially in Canada, where the installed wind energy capacity has increased by an average of 23 percent annually over the past five years. Canada is covered by 42 percent forest, and more than 50 percent of those trees are of the coniferous type, so the challenge of determining wind conditions in forests becomes an important task for the wind industry. In other parts of North America, wind project developers are being pushed to locate wind projects in rural and forested areas, as a response to lack of space, and rising land prices for favorable locations. The ever increasing wind turbine hub height has rendered it possible to deploy wind turbines in forests. Besides acquiring the needed land at lower prices, wind projects in forests are expected to be installed further from larger residential areas, which reduce the risk of social opposition, due to less exposure of the negative aspects of wind turbines such as noise emissions and flicker effects. A range of scholars have thus revealed the great potential of deploying wind turbines in forests.

The risks involved with wind project development in forested areas

Notwithstanding the promising developments, several researchers have examined the risks of estimating the wind resources in forested areas. This trend in risk studies has been proven to follow the development of installed capacity in a country, suggesting that more wind projects overall equals more wind projects in forests.¹ The majority of risk studies focus on fatigue loads, turbulence intensities, and loss in energy production, all caused by the change in wind conditions above forests. In general wind literature, several researches have investigated the estimations of roughness lengths and displacement heights of different tree types, which has been suggested as one of the approaches to control the risk of unpredictable wind conditions above forests. This article presents the key results from a study focusing on finding a uniform approach for determining the roughness lengths and displacement height for forests dominated by coniferous trees. The equation below displays the function of the displacement height and the roughness length when estimating wind resources.

$$(1) U_{\text{mean}}(z) = U_* \cdot \frac{1}{\kappa} \text{LN} \left[\frac{z-d}{z_0} \right]$$

Where U_{mean} is the mean wind speed at a certain height, z , u^* is the friction velocity, κ is the von Kármán constant (0.40), Z the height above ground level, d is the displacement height, and Z_0 is the roughness length. Being aware of the average mean wind speed at different heights makes it possible to simulate the relationship between roughness length and displacement height, when having access to the full wind profile at a given location.

Testing approaches to reduce the risk of poor estimations of wind conditions above forests

In this study the wind profiles were based on 12 meteorological measurement masts located in the middle of forests dominated by coniferous, with tree heights varying from 3 meters at one site to 28 meters at another. This variety in tree heights made it possible to verify the final output for usage in different locations with different tree heights. Tables 1 and 2, above right, introduce some of the most known approaches for roughness length and displacement height for forests dominated by coniferous trees, which were tested in this study.

Table 1: Division of roughness length approaches

Letter	Author	Tree Type	Roughness Length
A	Hick et al. (1975)	Coniferous	0.3* (Tree height-displacement height)
B	Freris (1990)	Coniferous	tree height /30
C	Garratt (1992)	Coniferous	0.1* tree height
D	Jarvis et al. (1976)	Coniferous	0.075* tree height

Table 2: Division of displacement height approaches

Number	Author	Tree Type	Displacement Height
1	Raupach and Thom (1975)	Coniferous	0.65* tree height
2	Dolman (1986)	Coniferous	0.75* tree height
3	Garratt (1994)	Coniferous	2* tree height /3
4	Stanhill (1969)	Coniferous	0.64* tree height
5	Jarvis et al. (1976)	Coniferous	0.78* tree height
7	Hicks et al (1975)	Coniferous	0.8* tree height

A total of 24 configurations combining approaches for roughness length and displacement height were tested. A regression analysis was then used to reveal the configuration matching the actual conditions measured at the 12 meteorological masts. The combination of A+3 provided the best fit when testing the relationship between the wind profiles estimated with this approach, and the ones measured at the 12 measurement masts, with a median delta average on 5.5% for the wind speed at 100 meters above ground level.

It can therefore be concluded that the combination of a roughness length of 0.3*(tree height-displacement height) combined with a displacement height of 2* tree height /3 is considered the best approach for determining wind speeds above forests dominated by coniferous trees following (1).

Peter Enevoldsen is an Industrial PhD fellow at Siemens Wind Power A/S

Siemens Wind Power | www.siemens.com

(1) Enevoldsen, 2016

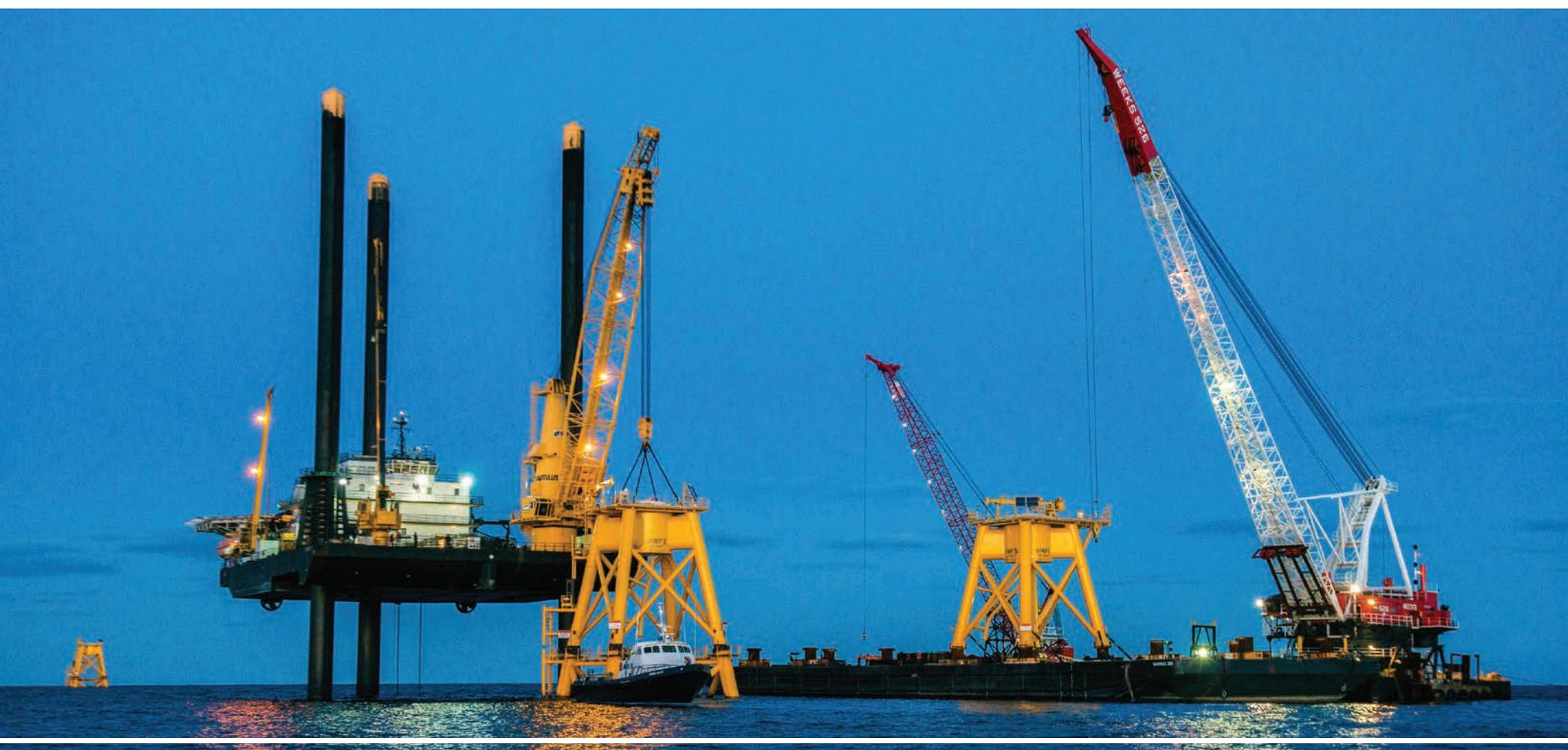
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www.offshorewindexpo.org



Double-sided, multi-edge milling concept

Offering high productivity and a low cost per edge, the CoroMill 745 has a double-sided, multi-edge design that is ideal for large batch productions. With its tilted insert positioning system and sharp cutting edges, this milling cutter offers a light cutting action at low power consumption. With a total of 14 cutting edges per insert, the CoroMill 745 is a cost-efficient choice for face milling. The assortment includes three pitch versions. The differential pitch design of the MD pitch is best when vibration is a factor and is radially compensated to ensure equal chip thickness for every insert. The M pitch is best for general applications and the H pitch has a higher number of teeth making it the best choice for higher productivity. The M and MD pitch both have the same number of teeth. Designed to make insert indexing quick and easy, the insert positioning system in the tip seat and heptagonal insert design keep the inserts securely in the pocket when mounting. The inserts are tilted in the tip seat to create a positive cutting action. Inserts geometries and grades are available for steel and cast iron materials. For roughing to semi-finishing applications, the strong and light cutting inserts provide reliable face milling in all types of milling machines.

Sandvik Cormorant | www.sandvik.coromant.com



Intel IoT gateways

Advantech launches its full range of IoT gateways to fulfill a wide array of application environments. These gateways, powered by Intel IoT Gateway Technology, comprise of fanless box PCs, embedded automation computers, video surveillance, fleet management, and in-vehicle series. These gateways provide a foundation for connecting devices seamlessly and securely, delivering trusted data to the cloud, and adding value through analytics. They enable Machine-to-Machine (M2M) communication, Integrated Services Router (ISR), and cellular connectivity for areas such as industry, smart buildings, retail, and transportation. The Intel IoT Gateway Technology solution is designed on the Wind River Intelligent Device Platform XT to speed innovation and maintain interoperability with legacy systems. Developers can quickly develop, prototype, and deploy intelligent gateways that meet emerging IoT market requirements, while maintaining interoperability with legacy systems including sensors and datacenter servers. The solution is completely preconfigured and pre-validated with hardware, software, and security capabilities.

Advantech Corporation, Industrial Automation Group

www.advantech.com/ea



Gearbox computational models predict life

Sentient Science's DigitalClone software is accessible to operators through an online portal, and utilizes materials science-based computational models of the gearbox to predict life and provide life extension solutions. DigitalClone Live for Suppliers network aggregates the demand for parts and services needed by operators. The amount that operators are willing to pay for products and services is directly tied to operating performance that can be gained through life extension. Sentient's new product allows suppliers to see where Sentient has recommended uptower replacements, which can be ordered and prioritized. The dashboard describes overall opportunities, their urgency, and uses material science prognostics to predict how much life is gained by the repair. By employing the DigitalClone, operators and suppliers can see optimal timing windows for repairs so the supply chain can better support the key performance metrics of the operators. The operator chooses when and whether or not to share their information with the supplier. At very least, suppliers receive overall network and long term vision into regional demand for O&M products. Most will receive a detailed and immediately actionable demand report and the ability to communicate directly with their prospective and current customers.

Sentient Science | www.sentientscience.com



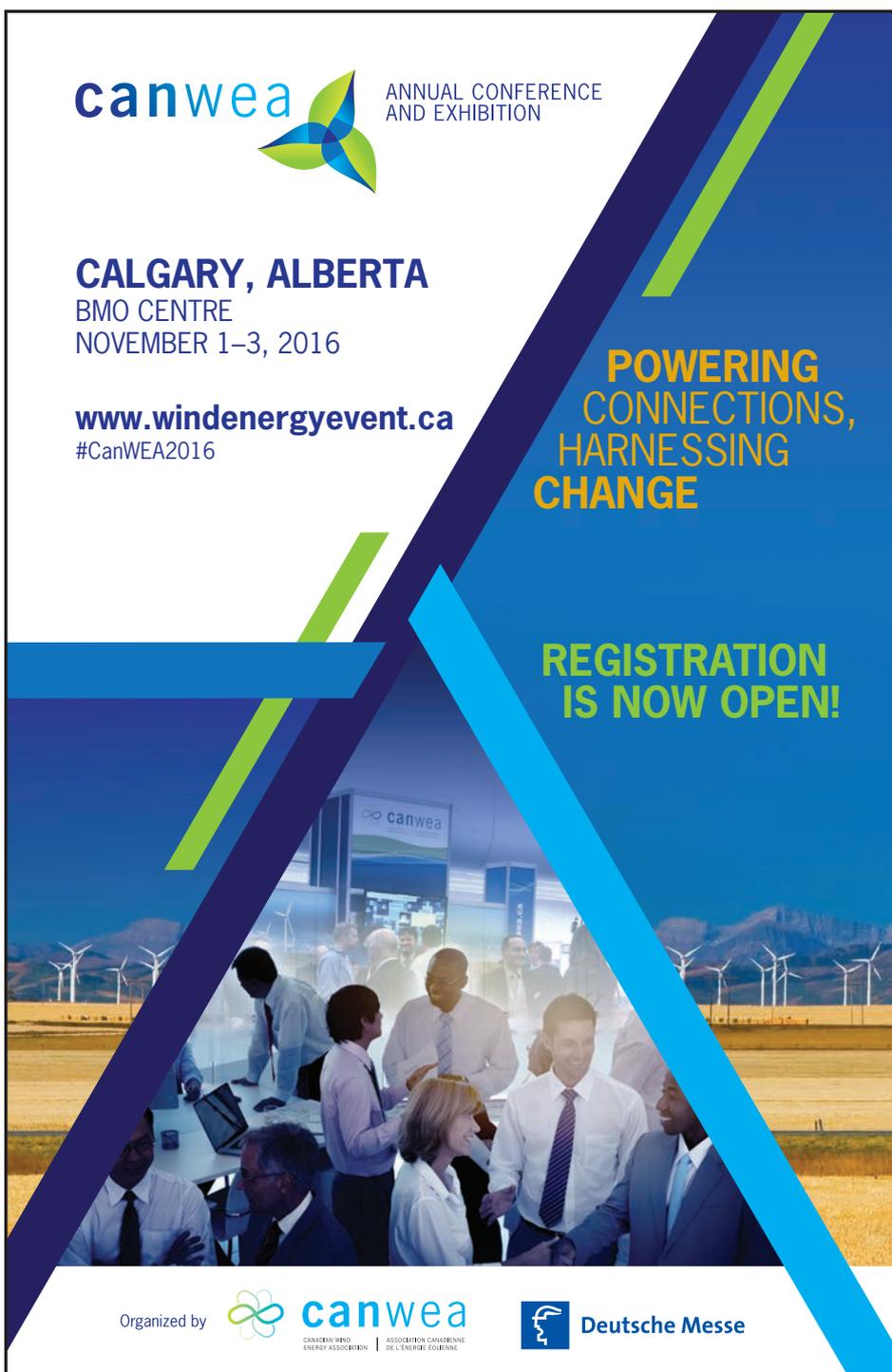
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Large capacity, rough terrain telehandler

Las Vegas-based, Xtreme Manufacturing presents their Xtreme XR7038, North America's largest capacity rough terrain telehandler. Designed to lift up to 70,000 lbs, the XR7038 is suited to heavy-duty applications, such as loading and unloading turbine hubs. Weighing in at 115,000 lbs, and equipped with 6 ft tall foam filled tires, the all-steel XR7038 is powered by a 300hp Tier IV Final engine and a 150-gallon steel fuel tank. Featuring a fork positioning carriage as standard, the XR7038 has a lift height of up to 38 ft and a forward reach of up to 22 ft. All Xtreme telehandlers are backed by a 10yr-5yr-2yr warranty, and are built in the USA.

Xtreme Manufacturing | www.xmfg.com



High yield onshore turbine

Senvion is launching its highest onshore yield turbine for the North American market. The Senvion 3.4M140 is equipped with a high-efficient and sound-optimized blade profile, managed by a new pitch control system to reduce turbine load. The Senvion 3.4M140 will be available from 2018 in hub heights of 110 and 130 metres. The longer 68-metre blades at these tower heights alone permit high yields at low-wind locations such as forested and mountainous areas. The Senvion 3.4M140 is a turbine for all regions with low wind speeds and potential sound restrictions. The blade profile with integrated serrations also reduces the sound power level of wind turbines.

Senvion | www.senvion.com



Industrial wire feeder

Lincoln Electric's latest addition to its industrial wire feeder line, the Flex Feed 84, boasts a rugged, reliable design to deliver consistent feeding over long conduit runs with large-diameter wires up to 3/32 inches (2.4 mm) or cored wires up to .120 inches (3.2 mm). This new feeder offers a flexible, modular design, including single-bench, dual-bench, and boom-mount configurations that can be converted as workspace requirements change. It's ideal for use in heavy and general fabrication, construction, structural, and heavy equipment applications and includes a built-in interface for hard automation. Featuring digital meters with preset voltage and wire-feed speed, the Flex Feed 84 displays actual voltage and current during welding and also offers four user memories to save repeated procedures. The system also allows the welding engineer to set passcode-secured limits and lockouts to control welding procedures. Its patented advanced MaxTrac wire drive has a rugged, cast-aluminum feed plate that protects the wire and ensures consistent wire feeding. Patented, tool-less drive rolls allow operators to easily change wire size or type, while tool-less, split wire guides ensure uninterrupted feeding and prevent "birdnesting." Brass gun adapters provide superior electrical connections, reducing voltage drops and simplifying connections. A user-selectable, wire-retract function pulls the hot wire back into the nozzle after welding to prevent operator injury. Dual models can be equipped with an optional Power Path contactor that electrically isolates the non-active wire drive and gun.

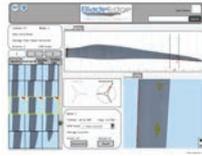
Lincoln Electric | www.lincolnelectric.com



Lineman hammer

Hi-Line Utility Supply presents the new dual-head Lineman Hammer. This 35-ounce fiberglass hammer was designed exclusively for Electric Utility Linemen. It is available in Milled or Smooth Face, each with two heads - one large head for driving Lag Screws, "J" Hooks, and Hard Heads and a small staple starter. The nonconductive, long-handle design allows for 2-handed driving.

Hi-Line Utility Supply Co.
www.hilineco.com



Automated analytical software portal

EdgeData, LLC, a Grand Forks, North Dakota-based software firm, announced the launch of BladeEdge, an innovative software analytics portal, customized for the wind energy industry. BladeEdge software transforms raw data from aerial inspection into actionable intelligence for wind turbine manufacturers, inspection, and repair providers and operations and maintenance companies. BladeEdge offers the ability to manage inspection and maintenance records in a single portal with a streamlined interface providing access to the data intelligence in an effort to better manage wind farm assets. Data is captured using Unmanned Aircraft Systems (UAS or drones) and uploaded into a software portal which includes tools, such as revenue loss calculators, that can be leveraged to help make more informed business decisions regarding maintenance and repair.

EdgeData | www.edgedata.net



Life extending upgrade

Gearbox specialist Moventas announces Extra Life for Siemens 2.3. It is a suite of after sales services designed to address the failures of Winergy gearboxes in the Siemens 2.3 fleet in both Europe and North America, encompassing upgrades, replacements, up-tower service, and spares. Moventas has recently re-engineered the Winergy 4456 and developed a life extending upgrade, up-tower repair capabilities, replacements, and spare parts for this model. Moventas is now able to repair and manufacture or source any component for this gearbox. The Extra Life is about harnessing Moventas' 35-years of wind gearbox experience for popular fleets coming to service age. The methods Moventas has developed remove known premature failure modes to extend gearbox lifetime, providing carefree extra years for older fleets.

Moventas | www.moventas.com

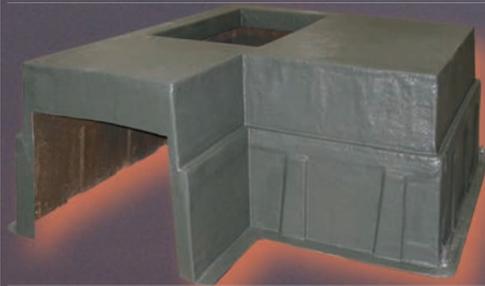


AC powered torque multiplier

Norbar Torque Tools introduces the EvoTorque2, a new generation of AC-powered, torque multipliers, with accuracy, versatility, and ease of operation. This tool is factory calibrated and certified to an accuracy of ±3%, regardless of fluctuating voltages. Operating ranges are available from 100lb-ft to 4500lb-ft (135-6000N•m). The wrench measures in torque, torque and angle, and torque audit mode for pre-tightened bolts. The tool is offered in 110VAC or 230VAC versions. It is lightweight, at only 23lbs.(10.4kg). Communication is via USB and Bluetooth 4.0 data transfer (also called Bluetooth Smart). Up to 3,000 readings can be stored in internal memory, with time and date stamping. 'EvoLog' PC software manages data and tool configuration.

Norbar Torque Tools, Inc. | www.norbar.us

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Lubricants and Greases

An important part of the planned maintenance of a wind turbine, proper lubrication will help the machinery work well for years. Keeping a wind turbine's gearbox properly lubricated is essential to extending the life of the turbine. Herein we highlight some of the solutions available on the market today...

SEE AD ON PAGE 59



Royal Purple Industrial

Product: Synfilm GT Wind Gear 320

Application: Royal Purple's Synfilm GT Wind Gear 320 is a synthetic gear oil specifically formulated to meet the challenging requirements of modern wind turbine gearboxes.

cSt @ 40°C: 320 cSt

cSt @ 100°C: 28.8 cSt

Viscosity Index: 122

Pour Point: -40°F (-40°C)

Flash Point: 445°F (230°C)

Key Features:

- Oil life remains consistent for over 30,000 hours;
- Average increase of only 12 ppm of iron over 30,000 hours;
- Increase in operating efficiency of up to 2.6%;
- Equipment performance shows no sign of gear pitting or unusual bearing wear or corrosion.

www.royalpurpleindustrial.com

SEE AD ON PAGE 51



Contemporary Lubricants for Equipment Reliability

American Chemical Technologies, Inc.

Product: EcoGear 270XP

Application: Wind turbine gearboxes

cSt @ 40°C: 270 cSt

cSt @ 100°C: 39.5 cSt

Viscosity Index: 215

Pour Point: 13.9°F (-25.5°C)

Flash Point: 426°F (219°C)

Key Features:

- Chemically engineered load-carrying capacity;
- Superior wear characteristics;
- Hydrolytically stable / water forgiving;
- Excellent low temperature start-ups.

www.americanchemtech.com



Petro-Canada Lubricants Inc.

Product: HARNEX 320 Wind Turbine Gear Oil

Application: HARNEX 320 Wind Turbine Gear Oil is specially formulated for lubricating wind turbine gearboxes for reduced downtime and less maintenance. HARNEX 320 has GE service fill approval for 1.x and 2.x platforms with Winergy gearboxes. In addition, HARNEX 320 meets the technical requirements of Shanghai Electric, and is approved for use in any gearbox on a Shanghai Electric wind turbine.

cSt @ 40°C: 323 cSt

cSt @ 100°C: 34.9 cSt

Viscosity Index: 153

Pour Point: -44°F (-42°C)

Flash Point: 459°F (237°C)

www.lubricants.petro-canada.com



Castrol

Product: Optigear Synthetic CT 320

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

cSt @ 40°C: 320 cSt

cSt @ 100°C: 40.4 cSt

Viscosity Index: 180

Pour Point: -49°F (-45°C)

Flash Point: 482°F (250°C)

www.castrol.com/windenergy



Fuchs Lubricants, Co.

Product: Renolin Unisyn CLP 320

Application: Main gearbox oil for wind turbines

cSt @ 40°C: 320 cSt

cSt @ 100°C: 35 cSt

Viscosity Index: 155

Pour Point: -44°F (-42°C)

Flash Point: 500°F (260°C)

www.fuchsus.com



Klüber Lubrication NA LP

Product: Klübersynth GEM 4-320 N

Application: Gear drives

cSt @ 40°C: 320 cSt

cSt @ 100°C: 36 cSt

Viscosity Index: > 155

Pour Point : < 95°F (< 35°C)

Flash Point: > 392°F (> 200°C)

www.klueber.com



AMSOIL, Inc.

Product: PTN, Synthetic Power Transmission EP Gear Lubricants

Application: Main gearbox

cSt @ 40°C: 326.7 cSt

cSt @ 100°C: 34.8 cSt

Viscosity Index: 151

Pour Point: -36°F (-38°C)

Flash Point: 473°F (245°C)

www.amsoilwind.com



Shell Lubricants

Product: Shell Rhodina BBZ Grease

Application: Shell Rhodina BBZ is designed for lubrication of specific bearings in wind turbines (e.g. blade bearings) and other similar applications. Protection against fretting corrosion and false brinelling is provided. Rhodina BBZ can also be used in bearings operating at very low temperatures e.g., under arctic conditions

cSt @ 40°C: 13.0 cSt

cSt @ 100°C: 3.0 cSt

Dropping Point (IP 396): 293°F (145°C)

Operating Temperature Range: -67°F to 212°F (-55°C to 100°C)

www.lube-education.com

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www.intersolar.us

show in print

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



Modular mounting system

Sollega, Inc.'s FastRack FR510 is a patented, one-piece injection molded solar racking system designed for both commercial low-pitch roofs and ground-mount installations. It is made from BASF Ultramid Glass-filled Nylon for strength and durability (25-year warranty) in a lightweight part. The glass-reinforced nylon with built-in UV inhibitor allows for each mount to hold over 200 times its own weight and retain its strength despite intense weathering over the lifetime of the product. FR510 is quick to ship, stage, and install.

Sollega, Inc. | www.sollega.com

Booth 9252



Off-grid water pumping

Franklin Electric's new Photon SolarPAK system utilizes Franklin's solar technology with the Photon solar drive which features a smaller modular design, providing flexibility and simple maintenance for the installer. The new Photon solar drive features a robust IP66, NEMA 4 enclosure that protects against wildlife, insects, dust, and weather. The system is available in a variety of flow rates from 2.5 to 90 gpm and power ratings of 0.75 and 1.5 hp. Franklin Electric has a network of water systems professionals available, for solar installers looking to partner with a driller.

Franklin Electric | www.franklinwater.com

Booth 7356



Watertight solar roof mounts

EcoFasten Solar designs, engineers, and manufactures patented, watertight solar roof mounts for all roof types. Their product line includes GreenFasten, the rail-free Rock-It System, SimpleGrip for low-slope applications, Tile Flashing Systems, CorruSlide for metal roofing, QuikFoot for slate or comp shingle, conduit mounts, a SIPs solution, and more, including solar snow management options. The company provides quality mounting solutions that are easy to install, cost-effective, and rugged in fabrication. EcoFasten Solar products are precision-designed with the installer in mind.

EcoFasten Solar

www.ecofastensolar.com

Booth 9733



Rapid shutdown for rooftop PV systems

Phoenix Contact has developed an NEC 690.12-compliant solution for the safe, rapid shutdown of rooftop PV systems. SOLARCHECK RSD (Rapid Shutdown) is based on the intelligent analysis of electrical conditions within solar strings. In the event of an emergency, a fault condition within a string, or a manual shutdown for maintenance work, the system automatically switches the PV system into a safe state, with no need for additional communications cables or wireless networks. SOLARCHECK RSD modules are integrated directly onto the panels via a smart cabling system. When the system can be safely restarted, SOLARCHECK RSD switches on automatically, triggered by the startup of the inverter, or optionally, via an enable input.

Phoenix Contact

www.phoenixcontact.com/rsd

Booth 8632



Reliable, maintenance-free energy storage

Rolls Battery maintenance-free GEL line includes 2 volt and 12 volt models, ranging in capacity from 120 Amp-hour to 3220 Amp-hour. Using a strong grid design and gel electrolyte, Rolls GEL models are durable and dependable, providing high recover after deep discharge. Well-suited for backup applications, as well as regular cycling, GEL models perform well at extreme temperature ranges. Rolls Battery GEL line is backed by a 5-year manufacture warranty (3 year full / 2 year pro-rated).

Rolls Battery Engineering

www.rollsbattery.com

Booth 8047

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www.huawei.com/solar





Bifacial PV module

Sunmodule Bisun XL provides up to 25% more energy yield using bifacial cell technology. Active on both sides, the new Sunmodule Bisun bifacial solar modules from SolarWorld deliver high energy yields by converting light from all directions into power.

SolarWorld | solarworld.com/boost
Booth 7411



Unified battery management system

MK Battery now distributes the Deka Solar Fahrenheit advanced AGM battery HT200ET, specifically designed for energy storage in grid-tied backup systems in high heat applications. Engineered for power, their IPF Technology enhances energy capacity, cell consistency, and long-term reliability. The Deka Fahrenheit battery case is constructed of THT Plastic, specifically designed to resist heat and optimize compression, and the TempX Alloy helps inhibit corrosion under high temperature extremes. Epoxy-sealed posts eliminate leaks while the case and cover are heat sealed and 100% tested to prevent overall leakage. To further mitigate thermal buildup and cell dry-out, the Microcat Catalyst is utilized to lower float current and maximize the efficiency in high-heat applications. The Deka Fahrenheit's front access design allows for easy installation and maintenance. All batteries meet or exceed IEEE recommended practices and UL recognition requirements.

MK Battery | www.mkbattery.com
Booth 8053



Smart energy management

The sonnenBatterie eco is an all-in-one intelligent energy storage solution that integrates with new and existing solar systems to provide smart energy management for residential customers. The full integrated sonnenBatterie eco system ranges in size from 4kWh up to 16kWh in a single enclosure. Each system includes lithium-ion batteries, the battery inverter, 200A internal automatic transfer switch, and other hardware components along with sonnen's intelligent energy management software, which monitors and controls household energy generation and consumption throughout the day. The sonnenBatterie eco has several basic modes of operation – solar self-consumption, backup power, time-of-use rate arbitrage, and both grid-tied and off-grid modes. The sonnenBatterie eco systems use components meeting UL1741, UL1973, UL 1998, and developed to meet UL9540 standards.

sonnen, Inc. | www.sonnen-batterie.com
Booth 8011

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- Top quality solid silicone diaphragms
- Premium PTFE-coated release sheet and transport belt materials.

SMARTTECH

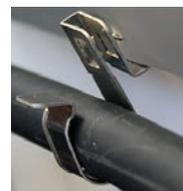
SmartechOnline.com
704 362 1922



Zero maintenance solar tracking

The DuraTrack HZ v3 from Array Technologies, Inc. (ATI) is a single-axis solar tracking system, which provides low LCOE through its reliable, easy to install and maintain design. Articulating joints, telescopic driveline sections, and variable column attachments make an easy install even in difficult conditions. Tolerances inherent in the design permit up to 40° flexibility in the East-West direction and 15% slope in the North-South plane. The DuraTrack HZ v3 is also designed for long-term reliability, with the limited amount of sensitive components per MW. The tracker requires no scheduled maintenance over its 30-year design life, with sealed and lubricated gearboxes and high-reliability motors. DuraTrack HZ v3 features an innovative row-by-row passive wind mitigation design which protects against storm survival risks and eliminates maintenance associated with active stow systems. Array Technologies' engineers will help design a customized project to ensure low LCOE and high ROI.

Array Technologies, Inc.
arraytechinc.com
Booth 9621



Corrosion-resistant wire management

Wiley, a product line of Burndy, offers wire management solutions for all types of solar applications. Their newest addition to the wire management family is the ACC-F1-270. It's made of corrosion resistant 304 stainless steel, which makes it a durable, long lasting, and reliable solution for all environments. The ACC-F1-270 is easy to install and can be slid onto module frames of various thicknesses. The ACC-F1-270 accommodates micro inverter trunk cables, AC module cables, and PV cables. The rolled edges help protect cable insulation from damage. When mounted on the module frame the cable compartment always faces up which allows for the cable to be securely held in place by gravity. The 270 feature permits installation of the clip on the top or side portion of the module flange. Designed for rail-less and ballasted roof systems.

Burndy | www.burndy.com
Booth 9338



Tile replacement mount

Introducing the Tile Replacement Mount from Quick Mount PV which provides a fast and easy way to install solar on tile roofs while protecting against water intrusion. Simply remove the tile and replace it with the Tile Replacement Mount. Works with all standard curved and flat tile roofs, and all standard rail-based racking systems. Flashed at both the deck and top levels, the mount is fully engineered to meet code requirements and industry best practices. The Tile Replacement Mount features Quick Mount PV's patented Elevated Water Seal technology for optimal waterproofing. This universal base mount works with Flat, S, and W shaped tile profile flashings, and all standard rail-based racking systems with no tile grinding or cutting necessary. Flashed at both the deck and tile levels for code compliance, it also features the patented QBlock Elevated Water Seal Technology.

Quick Mount PV | quickmountpv.com
Booth 9421

TRACK & YIELD

- > Higher Yield per Acre
- > Best Land-Use Enabler
- > Self-Powered Tracking and Wireless Communications
- > Low-Cost Installation & Maintenance

SF UTILITY Single Axis Tracker



Making Tracks

Soltec specializes in the manufacturing and supply of single-axis solar trackers and related services, with more than 1 GW in projects worldwide and a workforce of over 500 people. The company has manufacturing facilities and offices in Spain, Brazil, Chile and China; and offices in Denmark, Israel, Italy, Mexico, Peru and United States.



Soltec

Contact us:
3050 Osgood Ct, Fremont, CA
+1 510 440 9200
usa@soltec.com
soltec.com



Residential energy and solar monitoring system

CURB, a real-time home and solar monitoring system, tracks solar energy production and all devices using electricity in the home, which provides insights to make smarter decisions about power consumption. The CURB Pro incorporates 18 current sensors and a software suite that includes mobile apps, a web dashboard, and personalized email reports.

CURB | www.energycurb.com
Booth 8613



Self-securing mounting system

SolarRoofHook has designed a new mounting system for asphalt shingle roofs called the U-Foot Mounting Kit. Composed of three pieces of hardware, this system decreases the amount of time and energy installers need to complete their asphalt shingle roof installations. At an affordable price, users can lower their costs without sacrificing product quality. The U-Foot is designed to be mounted using two 5/16" diameter screws which secure the U-Foot in place, and then flashed with an aluminum sheet that easily slides underneath the shingle. Due to its design, the aluminum flashing is self-secured by the U-Foot, eliminating the need for nails.

SolarRoofHook | www.solarroofhook.com
Booth 9633

SOLAR CLIPS



NFI-1306-V90

90° oriented clip intended to secure two USE-2 wires, up to .20" diameter, to standard module frame.

DCS-1306

Designed to secure two USE-2 wires, up to .20" diameter, to module frame.



DCS-1307

Designed to secure two PV wires, up to .30" diameter, to module frame.



NFI-1461

Designed to secure two Enphase trunk cables to module frame.



NFI-1462

90° oriented clip designed to secure two Enphase trunk cables to module frame.



NFI-1463

NEWLY designed clip to secure a single Enphase trunk cable to module frame.



DCX-2452A

Designed to secure two Enphase trunk cables on to most rail/racking systems.

For FREE product samples, please reach out to Vin Marino vin@ninefasteners.com or 800.539.3939

NINE FASTENERS INC.

233A South Street | Hopkinton, MA 01748 | 800.539.3939
www.ninefasteners.com



Soiling index datalogger

The CRSI2 Soiling Index Datalogger provides solar energy professionals who are responsible for managing the performance of a PV power plant with the information needed to evaluate and manage the impact of soiling. The CRSI2 is a purpose-built Campbell Scientific datalogger that can either act as a complete soiling solution or be integrated into any SCADA network or existing MET station. The CRSI2 supports Modbus and/or DNP3, data encryption, and Internet protocols. No programming is required. Measurements of reference and test modules short-circuit current, back of module temperature, and effective irradiance are stored and available for additional post-processing. Soiling loss indices and soiling rate are calculated under proper power and environmentally stable conditions.

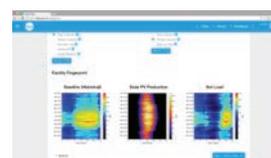
Campbell Scientific
www.campbellsci.com/crsi2
Booth 8835



Watertight racking connection

PowerGrip Plus, from OMG Roofing Products, is watertight, easy-to-install, provides a secure connection directly to the roof deck or structural members, taking the wind load off of the membrane or roof cover and onto the structural deck. Once heat welded in place, properly installed PowerGrip Plus units can help to eliminate rack movement that can damage commercial roofing systems. With 2,000 lbs. of tensile strength and 1,075 lbs. of shear strength, PowerGrip Plus is designed for use with ballasted solar racks on roofs covered with single-ply roofing membranes.

OMG Roofing Products
www.omgroofing.com
Booth 9450



Software tools for energy storage

Geli's software tools enable integrated, cost-effective energy storage to any solar PV project. The Geli EOS can be deployed in behind-the-meter solutions to perform advanced functions such as, demand charge management and demand response. With multiple hardware vendors embedding Geli software products at the factory, it's easy to design and deploy a plug-n-play, scalable solution. The Geli EOS can be deployed in mass-market products, as well as advanced energy storage projects, including sophisticated EV charging applications and large-scale microgrids.

Growing Energy Labs, Inc. | www.geli.net
Booth 8117



Single axis utility tracker

Soltec's SF Utility single-axis independent-row tracker design and project supply is a Land-Use Enabler providing built-in tolerances for irregular land, including its steep-slope tolerance of 17% grade North-South. SF Utility is a Yield Enabler providing configurations and related Land-Use tolerance features to achieve a high yield per acre. SF Utility provides low-cost installation with low piles-per-MW figure, meaning low pile-driving expenses and less environmental impact.

Soltec | www.soltec.com
Booth 9133

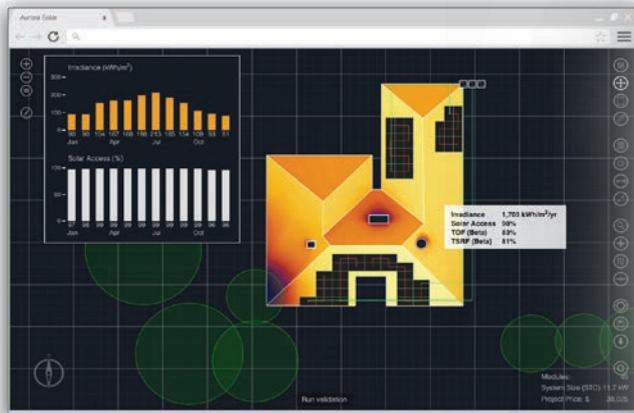


Diaphragms for module laminators

Smartech International will display a variety of Steinbach's silicone diaphragm materials. Steinbach membranes provide quality and consistency, from the EVA-resistant Lamibrans Diaphragm to three types of solid silicone diaphragm materials. Smartech provides an assortment of widths, thicknesses, and surface treatments to help keep module production running smoothly.

Smartech International, LP | www.smartechonline.com
Booth 7627

One-stop solution for the solar architect



Remote Shading Analysis

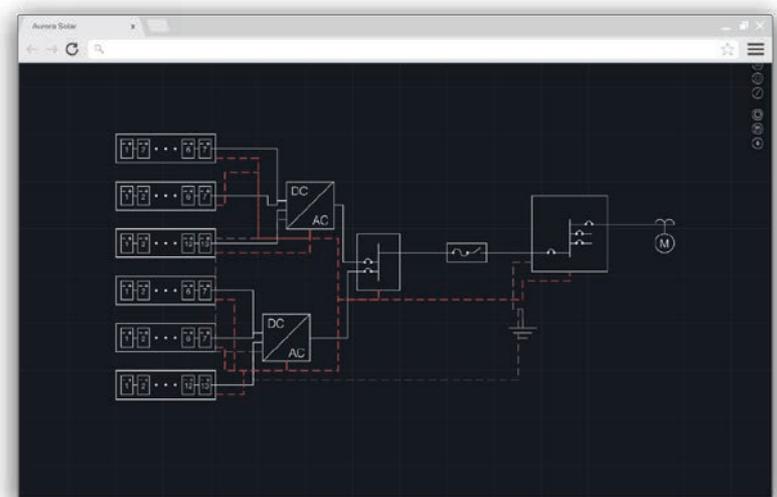
Save time and money

Generate NREL-validated irradiance maps and save truck rolls. Aurora's shade reports are accepted by rebate authorities and financing providers.

Engineering and Design

Always design optimal systems

Automatically generate optimal systems or manually create detailed designs in Aurora's CAD environment. All designs are checked for NEC compliance.



Sales Proposals and Financial Analysis

Impress customers

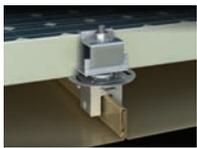
Calculate your project's financial returns and present them with dynamic 3D visualizations and customizable sales proposals.

aurora

Powerful tools for solar sales and design



Sign up for a FREE demo
AURORASOLAR.COM/NACE



Solar module mounting solution

The S-5! PV Kit is one of the first solar module mounting solutions to be listed to the new UL subject 2703, a standard that covers both bonding and mounting, and has gained an ETL listing to UL 1703. This non-penetrating, DirectAttach PV mounting solution for standing seam metal roofs fits the majority of solar panels on the market and can withstand the harshest weather conditions while maintaining electrical conductivity. S-5!'s new EdgeGrab is specifically designed to be used in conjunction with the patented S-5-PV Kit for solar array end conditions. The S-5! PV Kit reduces cost by eliminating the need for inter-module copper wires and lug bonding, and ultimately saves time and materials by providing the entire attachment system.

S-5! | www.s-5.com
Booth 9533



Stainless steel wire management

Nine Fasteners, Inc. designs, manufactures, and distributes stainless steel wire management products to the solar industry. They recently introduced a new addition to their line-up of standard wire management offerings, the NFI-1463. The NFI-1463 is designed to securely fasten a single Enphase Engage trunk cable (or AC cable) to a module frame. The NFI-1463 is produced using 410-grade stainless steel, and is manufactured entirely in the US. Nine Fasteners has continued to use a rolled outer edge on this clip, as is standard across their entire product line. In addition to their standard products, Nine Fasteners offers custom design capabilities for application-specific products in both 300 series and 400 series stainless steel.

Nine Fasteners, Inc.
www.ninefasteners.com
Booth 9011



Solar refrigerator/freezer

Steca PF refrigerators are efficient DC energy-saving refrigerators and can be used as either a refrigerator or a freezer. The Steca PF 166 and Steca PF 240 are fully programmable. The inside temperature and each of the other configuration values can be set by the user. They are suited for all DC applications including the refrigeration of medicines in hospitals. The optimal electronic control and speed regulation of the compressor guarantees efficient use of energy. This leads to significant cost reductions. This product is user-friendly, due to a large digital display with setting options, high standards of quality and reliability, and a long service life. The refrigerator or freezer is easy to clean as it has a sealing plug on the bottom for draining water.

Steca Elektronik GmbH | www.steca.com
Booth 8838



Reliable single axis tracker

Genius Tracker offers fast install and overall value for low O&M costs. It has completed Black & Veatch technical assessment, CPP wind tunnel testing, is rated 150mph, and ETL / UL 2703 tested. Genius Tracker provides 99.3% panel density on rows. It's linear actuator drive system has a 40-year operating life and is IP 66 rated for operation in harsh environmental conditions. Every drive actuator has its own battery backup and wirelessly linked controllers, eliminating all trenching. Tru3D-Gimbal bearings account for pile installation being out of plumb, out of azimuth, and out of vertical and east-west alignment. Self-powered rows eliminates central drive, allowing for uninterrupted grass cutting and panel washing. GameChange Solar provides free installation training and tracker commissioning for their Genius Tracker systems.

GameChange Solar
www.gamechangesolar.com
Booth 9521



Cable management system

CAB Solar's cable management system for use in large-scale PV ground-mount projects is in use in over 1.6 GW of solar power plants. The CAB Solar Cable Management System is simple and easy to use. The system helps save money on labor and material costs, will not suffer from weather or ground-water related delays, offers reduced engineering and more predictable costs across an entire portfolio of projects, benefits the environment by having less soil disruption, and provides for ease of trouble-shooting should problems arise. Assistance in planning the implementation of the CAB System and onsite training is offered as a free service to customers. CAB Solar has over 25 designs and modifications available to meet any cable management need.

CAB Solar | www.cabproducts.com
Booth 9114



Electric power meters

Continental Control Systems features the WattNode Revenue meter and the customizable meter module with ANSI 12 accuracy as well as its full line of high accuracy split-core current transformers and its flexible style, Rogowski Coils for difficult to install loads up to 6000A. CCS specializes in low-cost, high accuracy electric power metering and custom inverter monitoring equipment for OEM applications. The company's meters and current transformers are designed to provide bi-directional, revenue-grade electrical measurements including power (kW) and energy (kWh) through a variety of communication protocols including BACnet, Modbus, and LonWorks or as pulse outputs. Applications for the WattNode meter and Accu-CT current transformers include measurement and verification of energy production, measurement and verification of energy consumption as well as net metering.

Continental Control Systems
www.ccontrols.com
Booth 8716

WE THRIVE IN THE TOUGHEST CONDITIONS

More developers are reducing pre-construction costs, accelerating timelines and eliminating both risk and sub-surface unknowns with TerraSmart's new TF2 turnkey fixed-tilt racking solution.

START SMART. BUILD SMART.



VISIT TERRASmart.COM
 TO START BUILDING SMART



Optimize commercial projects

SolarEdge offers a cost-effective module-level optimization solution for commercial systems that enables harvesting more power from a PV system, simplifying the design process, reducing O&M and installation costs, while also meeting the latest safety requirements for a fastest return on investment (ROI) and a lower levelized cost of electricity (LCOE).

SolarEdge | www.solaredge.com

Booth 8521



Powered enclosure kit

The Powered Enclosure Kit (PEK) is designed for installation of the eGauge in combination with one of several communication protocol devices. The kit comes with components that complement the eGauge main unit, decreasing installation time and reducing complexity. The PEK can be utilized with 3p/4w, 120/208vac and 2p/3w, 120/240vac services.

eGauge Systems, LLC | www.egauge.net

Booth 8829



Solar structures & carports

Baja Construction provides pre-fabricated, pre-engineered, 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.bajacarpports.com

Booth 9727

Self-organized manufacturing

ASYS's PULSE solution provides an always updated task list, available on a smart watch, directly on the wrist of the operator. ASYS also offers advanced features, providing smart production. With electro-luminescence inspection integrated in the tester, it is possible to detect micro cracks and finger interruptions before the cells are installed in the modules. The motor-driven squeegee head adjusts itself automatically and adapts to the wafer continuously during the printing process. And the integrated inspection system makes it possible to position wafers directly in the screen printer for double printing.

ASYS Group Americas, Inc.
www.asys-group.com

Booth 7617



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

Clipping Right Along

Long-lasting, Customizable Wire Management Clips

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

Custom designs are available upon request.

WILEY



Connecting Power to Your World®



www.burndy.com

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Translucent PV modules

The SOL_GT TRANSLUCENT series by solarnova combine individuality with standard modules. Its translucent back sheet offers an aesthetic look and new design options. The variant with 60 monocrystalline cells has 11% translucency. Its performance is equal to that of standard modules with its 284 Wp. The 45-cell module offers 33% translucency and an output of 213 Wp. Both modules are available with black or silver anodized aluminum frames. The modules can be used in roof systems, overhead glazings, and facades, producing power and also providing shade. solarnova can adapt the cell's color to the customer's wishes for even more individuality. The color palette ranges from pink to green, and red to gold.

solarnova | www.solarnova.de/en

Booth 7333-2



Tracking precision and accuracy

Cone Drive's solutions for the solar energy industry help harness the power of the sun, in both an efficient and cost effective manner. For accuracy-critical applications, Cone Drive's solutions are capable of providing tracking precision. With robust construction and maintenance-free operation, Cone Drive's Azimuth Drive is offered in three sizes, with customizable ratios, and is designed to suit any requirements. The Azimuth Drive family has a vast output torque range with a minimum nominal dynamic torque of 150 Nm and a maximum holding survival torque of 15000 Nm.

Cone Drive | www.conedrive.com

Booth 9639



Composite shingle mount

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

Spider-Rax | www.spiderrax.com

Booth 9320



Versatile, rail-less PV mounting system

Roof Tech's compact and versatile rail-less PV mounting system, RT-[E] Mount attaches to rafters or anywhere else on roof decking. Once panels are fastened, the array is electrically bonded. RT-[E] Mount comes complete with watertight and durable RT Butyl flashing. Power electronics mounting is available for the RT-[E] Mount Air, as are PE stamped certification letters; UL 2703 Bonding, ICC ESR-3575, ASTM 2140 and UL 1703 Fire Class A.

Roof Tech, Inc. | www.roof-tech.us

Booth 9334



Commercial and industrial three-phase inverter

Growatt 33-40k TL3-US model is an inverter providing performance and high reliability. Its dual independent MPPT with wide input voltage range ensures energy harvesting. With string monitoring, comprehensive protection, and remote upgrading, Growatt 40k TL3-US series offers a low operating and maintenance cost. Wide MPPT range, max DC/AC ratio of 1.5, and plug & play wiring box makes design and installation flexible.

Growatt USA, Inc.

www.growatt-america.com

Booth 8547-A



Maintenance-free, deep cycle AGM battery

Fullriver DC Series Deep-Cycle AGM batteries are specifically built for cyclic use in demanding solar applications. The thick plate design and AGM construction combine for a robust battery delivering optimal performance in both fair weather and extreme climate conditions, all in a spill-proof, non-hazardous, and maintenance-free package.

Full River Battery

www.fullriverbattery.com

Booth 8227 ees

JUST ADD WATER

Solar Pumping Systems

Your new revenue stream. Harness the power of the sun to provide water wherever your customers want it with Franklin Electric's proven and dependable solar water pumping systems. Need a drilling or pump installation expert? No problem. Contact our Technical Service Hotline at 800.348.2420 to be connected with our expansive network of water systems professionals that you can team with today.

See us at Intersolar North America Booth 7356

franklinwater.com



Franklin Electric



Unified battery management system

Powin Energy's BESS delivers full system control to megawatt+ energy storage, from peak demand management to grid support services, and assures reliability and flexibility for jobs of all sizes. The simplified interconnection and optional chassis-mounting make Powin Energy's BESS a utility and C&I-scale storage system that can be interconnected in less than 15 minutes at a prepped and permitted site. The brain powering Powin Energy's BESS is their patented Battery Management System (BMS). It gives visibility and predictability into every layer of a battery system down to the cell level. The BMS can also scale up to manage as many battery packs as needed at no extra cost, so as operations expand, Powin Energy's BESS yields greater ROI.

Powin Energy | www.powinenergy.com
Booth 8322



NEMA 4X rated inverter

Huawei's 6 strings inverter provides intelligent monitoring and 80% time saving for fault detection. With real-time operation monitoring, it offers adaptive edge MPPT for fast tracking. The maximum efficiency reaches 98.6%, and CEC efficiency of 98.0%. It doesn't require an N-line, providing an AC cable savings up to 20%. The DC is AFCI compliant to UL 1699B, and the DC disconnect is integrated, offering safety and convenience for maintenance and ground fault protection with Category C surge arresters for both DC and AC. This reliable inverter has no need for external fans due to its natural cooling technology and rates an outdoor application of NEMA 4X.

Huawei America | www.huawei.com/solar
Booth 8333



High cycle rechargeable batteries

The ECO R SLR1000-2 is one of the newest additions to the GS Battery "Pyramid of Power" energy storage lineup. These Advanced Lead-Carbon batteries feature a patented nano-carbon enhancement which allows the battery to achieve long cycle life, deliver partial SOC performance and provide fast charging rates. These 2-volt mono-block batteries are rated at 1000ah (10hr) and tested to deliver 5000 cycles at 70% DOD. The SLR1000-2 is a non-spillable, sealed VRLA offering minimal maintenance requirements in an inherently safe and environmentally friendly format.

GS Battery (U.S.A.), Inc.
www.gsbattery.com
Booth 8124



Intelligent all-in-one solar system

smartflower energy technology brings its revolutionary all-in-one solar system - smartflower POP - to the US. The power generation begins as soon as the sun rises. smartflower POP is inspired by the shape of a sunflower: it automatically unfolds its 18 m2 of solar petals to form a perfect circle. With various "smart features" such as smart tracking, smart cleaning, and smart cooling, the solar energy yield as well as the self-utilization degree is maximized. Depending on the region, it delivers between 3,400 and 6,200 kWh a year.

smartflower energy technology
www.smartflower.com
Booth 7445

Sell More Solar With Quick Mount PV

" We use virtually every Quick Mount PV product for mounting rooftop solar systems. It's a no-brainer for us. We tell our customers: You have a 30-year roof, why would you use a mount that lasts only 10 years?

And Quick Mount PV delivers not just the best product, but also the best training, technical support, and sales assistance. We use Quick Mount's website, literature and informative videos to help sell the customer on the value proposition.

No doubt about it – Quick Mount PV helps us sell more solar. "

Quick Mount PV[®]
quickmountpv.com



A. Dean Rafaat
Owner, *Wired into the Future Solar*

Visit us at Intersolar!
See our latest products and live demos at Booth #9421



Reliable PV connector

Multi-Contact's MC4 photovoltaic connector is now rated up to 1500 V UL, 1500 V TÜV safety class 0, and is available for 14 through 8 AWG cable configurations. Over one billion MC4 connectors have already been installed worldwide, accounting for over 120GW of installed capacity.

Multi-Contact | www.mc-pv-portal.com
Booth 8411



Balance on tracker solution

Shoals' Balance on Tracker is a full PV utility-scale solution, which includes all necessary electrical and mechanical components to move panels and transport electricity to the inverter. The SAH tracker, all electrical harnesses, the BLA, and wireless string monitoring have been designed and optimized at the system level.

Shoals Technologies Group
www.shoals.com
Booth 8433



Solar racking channels

RPM Rollformed Metal Products, Ltd. is a supplier of standard and custom rollformed steel profiles and aluminum profiles to the North American solar industry. They work with a professional team of engineers, metallurgists, code writers, and product designers to provide customized solutions in both pre-assembly and complete assembly. RPM also provides braces, hats, post, truss, and rails.

RPM Rollformed Metal Products, Ltd.
www.rpmroll.com
Booth 9136



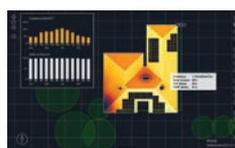
PV manufacturing components

Schunk Carbon Technology is a manufacturer of C/C (carbon fiber reinforced carbon), insulation materials, and graphite, including SiC and PyC coating, for PV manufacturing equipment. Their products are used in c-Si (Cz and DSS) and thin film (CIGS and CdTe) processes, as well as polysilicon production. They manufacture products to their client's specifications, including crucibles, wafer carriers and boats, heating elements, c/c plates and susceptors, insulation cylinders, and boards.

Schunk Carbon Technology
www.schunk-group.com
Booth 7333-4

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Automated PV system design

Aurora is a one-stop application for solar sales and engineering providing powerful tools to streamline the solar workflow, allowing users to generate a full system design, bankable shade reports, sales proposals, and perform financial analysis starting with just an address and utility bill. Aurora is used to create over 6,000 residential and commercial projects a week globally.

Aurora Solar | www.aurorasolar.com
Booth 7351



Stackable ESS

The Adara Energy Storage System is an intelligent, stackable 8.6kWh lithium-ion battery system designed for safe, reliable, long lasting power management. Each system delivers more than 10 years of operation or a minimum of 4,000 cycles of dedicated peak shifting, back-up power, energy efficiency, as well as enables participation in emerging interactive energy exchanges. The Adara Energy Storage System is housed in an indoor/outdoor, floor, or wall-mounted UL-rated enclosure.

Adara Power | www.adarapower.com
Booth 8249



Cost effective ground-mount solution

RBI Solar's next generation ground mount solution features innovations specifically designed to reduce the cost of solar installation for commercial and utility-scale PV projects. This solution includes a wider selection of component parts that use less material without sacrificing strength where strength is needed. After passing a rigorous testing regimen for bonding and grounding, the RBI Solar next generation ground mount achieved ETL Classification from Intertek to UL Standard 2703. With five manufacturing facilities, RBI Solar customers benefit from short lead times and low shipping costs on their solar racking solutions.

RBI Solar | www.rbisolar.com
Booth 9511



Fixed-tilt ground mount solution

TF2 is the fixed-tilt ground mount racking solution offered by the turnkey solar ground mount company, TerraSmart. The TF2 racking system is based on TerraSmart's versatile ground screw foundation, which works with any soil condition. TerraSmart's installation machinery not only provides a precisely installed foundation, their surveying, rock drilling, and installation equipment also removes project risks and increases installation velocity. All of these benefits improve upon TerraSmart's construction efficiency and offers customers an additional 30% reduction of installation man-hours, saving time on every project.

TerraSmart | www.terrasmart.com
Booth 9411

OFFICIAL VENDOR Solar 2016 Visit us at **InterSolar Booth #9252**

Sollega

- 5° or 10° mounting solution
- Simple, modular, one piece design
- Universal design compatible with all framed modules
- Roof friendly with round edges and low point loads
- One size bolt with all top down connections
- Injection molded with Ultramid[®] by BASF
- Engineering and ballast layout services available
- UL 1703 Class "A" Type 1 Module
- UL 467 Integrated grounding
- 100% Recyclable

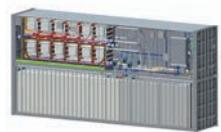
855.725.RACK **info@sollega.com** **www.sollega.com**



Smart home monitoring hub

The Chilicon Power Cortex gateway is a graphical tablet smart home and monitoring hub. The device communicates via powerline with Chilicon Power microinverters, but also controls other devices via zWave wireless networking. The Cortex supports wireless home energy (net meter) monitoring with automated setup for two CT clamps and can be customized for up to 10 CT clamps. The gateway also incorporates a stand-alone home security system which detects wireless door/window sensor trips and sounds an alarm based on programmable rules. All site configuration and setup is done directly on the Cortex device. This includes adding installer and customer email address for access to cloud monitoring. WiFi, Ethernet, zWave, and PLC are included in every gateway.

Chilicon Power | www.chiliconpower.com
Booth 8653



Multi-use flow battery

ViZn's GS200 redox flow battery system is designed for large-scale applications which require both high-power and long-duration capabilities. It utilizes ViZn's non-toxic, non-flammable, and non-explosive proprietary alkaline zinc-iron chemistry which is composed of globally abundant, inexpensive materials. The GS200 can access its full state-of-charge and perform several cycles per day without degrading battery capacity or damaging the system. ViZn's systems have a 20 plus year cycling life and do not require electrolyte or cell stack replacement during that time. Their ability to offer both power and energy services allows end users to incorporate multiple revenue streams. Its multi-use capabilities coupled with low O&M costs over the life of the battery generate accelerated payback periods, improving return on investment.

ViZn Energy | www.viznenergy.com
Booth 8035 ees



Engineering, program management, and technical and field services

Ulteig Engineers, Inc. provides core services in substation and transmission line engineering, project management services, survey, right of way acquisition, and most recently testing and commission and field services, among various other capabilities. They have a progressive approach and work with utilities, renewable developers, and contractors. Ulteig has extensive experience supporting solar project development at various stages, including permitting support, equipment selection and sizing, interconnection studies, cost analysis, SCADA, and modeling. Ulteig can also provide end-to-end integration of solar-plus-energy storage projects.

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Booth 7237



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When it comes to securing solar panels to commercial rooftops, most racking systems are designed to be secured in place with ballast blocks or cement pavers.

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OMG PowerGrip and PowerGrip Plus were designed to help reduce the ballast from these racking systems, and are ideal for use on roofs covered with single-ply roof membranes. OMG PowerGrip products provide a secure connection directly to the roof deck or structural members and once heat welded in place, properly installed PowerGrip products help minimize rack movement and remain watertight.

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Visit us at InterSolar, Booth #9450

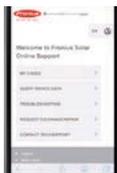


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Diagnostic platform

Fronius USA, will be hosting live demos on the show floor of Fronius SOS, their latest platform for troubleshooting and diagnosing issues in the field. Fronius SOS will allow for installers, via app, PC, or tablet to look up state codes and diagnose without even needing to speak to a representative.

Fronius USA | www.fronius.com/sos
Booth 8811

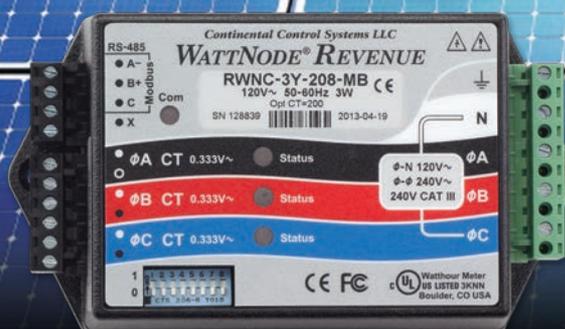


SMA certified energy storage system

The BMZ ESS 7.0 is scalable to a total of six units with an additional combiner box and latest firmware, for a total of 40.44kWh of storage, with additional future testing to be expandable to 12 units totaling 80.88 kWh. Currently being delivered, the new ESS offers high performance in a modern, aesthetically pleasing design intended for residential and small commercial grid-tied or off-grid backup, and peak shaving/time of use configurations. This product is certified by SMA to work with the Sunny Island battery inverters.

BMZ USA | www.bmz-usa.com
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EnSync Energy System's Matrix Energy Management platform brings energy management and energy storage solutions to micro-environments. The Matrix is a behind-the-meter control system participating in C&I, multi-tenant, and utility industries. Matrix utilizes patented "Auto-Sync" DC-Bus controls that enable simple, real-time integration of all AC and DC inputs, and automatically routes electricity in the most efficient and cost-effective manner. Matrix is modular and configurable, designed to meet the building owner's needs today, and a "future proof" solution for electrical applications tomorrow. Facility owners have complete DG asset-to-utility communication for "smart export" and can be clustered in a secure network as a set of assets that enable real-time spot market electricity sales.

EnSync Energy Systems
www.ensync.com
Booth 8147



Energy storage building blocks

Electrovaya has recently launched its LITACORE and LITASTORE modules for energy storage applications based on the LITACELL technology. The LITACORE is a building block easy for system integrators to use, and available in voltage configurations from 3.7V to 25.9V. The system features integrated voltage and temperature sensing that can be connected to any BMS. The LITASTORE is a similar building block, standardized at 48V and features an integrated BMS system. Units can be paralleled to create any size system required by a customer and the system is ready to use as is. The LITASTORE unit is in the process of being UL1973 listed.

Electrovaya | www.electrovaya.com
Booth 8224

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Storage, Risk, and the Winds of Change

by Dr. Davion Hill

THE WIND INDUSTRY IS NO STRANGER TO ENERGY STORAGE. Wind project developers were, in fact, some of the earliest adopters of energy storage, doing their best to prove out the case for renewables firming. Most of these initiatives occurred in 2008-2010 with the available battery chemistries at that time, such as sodium sulfur and advanced lead acid, and project developers were self-financing these experiments or leveraging stimulus dollars to execute them. While Li-ion was appealing, its expense often made it a showstopper, or at least a delayed opener. The utility industry was more highly focused on long duration peak shaving applications and the benchmark for cost effective energy storage was pumped hydro.

Yet, as the wind industry observed the deployment of these battery projects, several things happened. The product tax credit (PTC), a signal of stability to the wind sector, underwent several expiration and extension cycles which reduced investment in the sector. The stimulus dollars after the 2008 market downturn began to slow down. The wind sector focused on the existing project pipeline and braced itself against the shockwaves from the PTC fluctuations. Investors were noticeably wary of a market where the policies behind it were unreliable.

In the meantime, the Li-ion battery discussion began to change. The darling chemistry of Li-ion in 2008 was iron phosphate, promising lower cost, enhanced safety, thermal stability, and high power capability. Yet, a gradual shift occurred where nickel cobalt manganese (NCM) began its slow takeover of the market. Li-ion battery cell costs steadily declined from approximately \$1,000 - \$1,200/kWh in 2008 to somewhere near \$350/kWh in 2016. If compounded over that eight year period, the cost reduction for Li-ion approximates to ~10-15 percent annually. Other battery chemistries were developed and flow batteries saw similar cost declines. These declines resulted from gradually increasing demand, economies of scale, refinement of production, and manufacturing processes, consolidation of supply chains and incremental advancements in energy density.

In addition to these advancements, software controls were developed that have enabled the deployment of energy storage behind the meter in an aggregate form, integrated with distributed energy resources and performing virtual power plant functions for the grid. Distributed energy resources (DER) proliferated to the point where some utilities in California recently canceled distribution upgrades because DER has reduced load and met generation needs. Something else occurred during this time: solar PV costs dropped significantly and successful business models were created around third party financing, tax equity structures, and bundled resources into power purchase agreements. In the last 12-24 months, these solar business models have helped advance storage, which has been successfully financed in project structures; benefiting largely from tax equity strategies supported by the investment tax credit (ITC). Energy storage qualifies under the ITC as long as it can be shown that 75 percent or more of its charging energy comes from renewable sources.

Today, investors enjoy a temporary period of certainty for the PTC and the ITC, which gives the renewable energy sector some time to reflect on the market and consider new business strategies. Battery costs are low; energy storage capability is greatly enhanced with advanced software controls; and financing tools are available that support energy storage investment. The energy storage conversation has shifted away from long duration storage and is focused on “stacking” applications like frequency regulation, demand charge management and shared services with the meter customer and the grid. In fact, software algorithms can stagger the discharge of aggregated storage devices to achieve the long durations that were so desirable eight years ago. Wind developers have new challenges and opportunities in this dynamic environment where a reevaluation of former energy storage business models may produce new insights and there are new approaches to financing.

Investors now have a chance to refresh the perspective on storage and wind. Because tools are available to stack revenue streams for energy storage, it is now possible to look at energy storage to do more than just firm up wind energy production. While firming, storage devices can also help avoid curtailment losses, potentially perform frequency regulation, and perhaps take advantage of peak-peak price differentials. These multiple revenue streams make the project economics more diverse and resilient to project uncertainty. In many cases, all of these functions can be performed simultaneously with the advent of new software.

In the near future, wind project developers are likely to build new teams that will include software and battery energy storage partners. Reevaluation of the tax equity strategy and the integration of storage to qualify for incentives creates new opportunities. Because policy risk is presently reduced and a precedent for financing storage exists from the solar sector, lenders have a new energy market to examine: wind + storage.



Dr. Davion Hill is energy storage leader for DNV GL Americas. He has 10 years of experience testing energy systems and has managed battery R&D programs for NYSERDA and ARPA-e, and has authored or co-authored 30+ publications on the topics of materials testing and energy storage. Dr. Hill is 2016 Chairman of NAATBatt International.

DNV GL Americas | www.dnvgl.com

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Energy Storage

What we need and why we need it

by Alysha D. Singh

Why do we need energy storage? It is a question many of us may not have considered until recently. The brief answer is the world needs more energy, and we need that energy to be clean. The world is changing rapidly and if the energy landscape doesn't change with it, there will be negative consequences. With advances in technology, growing population, and developing infrastructure in both developed and developing countries, there is a real need for energy storage.

Energy storage will play a key role in the growing demand for energy, as it not only provides energy when it is needed, it also stabilizes the energy supply. Energy storage offers firming capabilities for unpredictable renewables, which is necessary for providing wind and solar energy in an uninterrupted state to the end-user when it is required.

Energy storage applications are very relevant to remote communities, which are off the grid but still require reliable power. While there has been an increase in the installation of solar panels for power generation, this energy is inefficient without energy storage. Energy storage can be applied to remote microgrids, which will benefit these communities, as well. With remote microgrids, energy is generated off-site and, as a result, there is an inadequate supply of energy. One way to solve that problem is by storing energy when there is an abundant supply from solar and wind sources and using the stored energy when there is a shortage.

But large cities require energy storage, too. The energy landscape has been developing with new technology at a rapid pace and the electricity grid needs to catch up. The integration of renewables into the grid places stress on grid infrastructure, which energy storage can alleviate by helping the grid to stabilize. Energy storage increases efficiency for the grid and reduces peak electricity demands. With peak electricity demands in mind, energy storage allows for energy arbitrage, which enables users to store energy when it is less expensive and use it during peak periods; thereby reducing the bill to the end user.

As electrical infrastructure develops worldwide to meet the needs of growing populations and increased energy demand, it becomes clear that energy storage is necessary as we continue to transition to a greater use of renewable energy sources.

Advances in technology continually change the way we use energy. It also raises our demand for it. In the coming decades electric vehicles will become mainstream. Energy storage will be key in ensuring the heightened demand for clean energy vehicles is met with seamless integration with the energy infrastructure, thereby safeguarding against a heavy strain on the grid.

Energy storage is also required for telecom backup power. People are increasingly turning away from the use of landlines and are opting to use their cell phones exclusively. A battery offering long duration backup power in the case of natural disasters is vitally important. During emergency situations such as hurricanes, phone lines can be down for several days. With reliable, long duration energy storage, telecom facilities can remain up and running, which will aid rescue services and facilitate communication.

While there is a clear need for energy storage to help balance the grid and improve the grid's efficiency, there is another factor that is greatly influencing the need for energy storage. That factor is climate change. Our longstanding reliance on harmful

fossil fuels has been detrimental to the environment. As a result of climate change, air and water quality has been affected, causing health issues for many. Further impact can be seen in the loss of habitat for animals and plant life, as they struggle to adapt to a changing environment. Because of climate change, we are experiencing the loss of an environment we have come to depend on for generations.

As climate change has become a critical issue, there is an immediate need for clean energy to replace the use of diesel and other energy sources which release greenhouse gases. Energy storage harnessing clean power from solar and wind sources can certainly help achieve this goal; but the ideal energy storage battery will be a clean energy storage battery, one that does not integrate harmful chemicals into its system and does not release harmful gases into the environment. This ideal storage battery will need to have a high efficiency rating, the capacity to recharge many times, and be very cost-effective. A long duration battery that possesses these characteristics is what the world needs right now.

Environmentally sustainable energy storage will be regarded as the next stage in the evolution of energy. There is an undeniable need for energy storage that is safe, reliable, and clean. As energy storage developers strive to meet the goal of bringing the ideal energy storage battery to commercialization, it is evident the will and determination is there, despite the challenges. There is no doubt we will soon see this ideal energy storage system on the market, as the need to support both sustainability and efficiency must be met.



Alysha D. Singh is the marketing communications manager for ZincNyx Energy Solutions, Inc.

ZincNyx Energy Solutions, Inc. | www.zincnyx.com | @ZincNyx





UL certified scalable solar energy storage and usage system

The POWERSTATION 247 is a complete, and fully integrated scalable solar energy storage and usage system with built-in battery storage. The system comes in three sizes, 5 kW, 10 kW, or 15 kW; all have the same battery storage capacity of 17.28 kWh. Its free standing cabinet is easy to install and easy to use. The system integrates up to 3 hybrid inverters, solar MPP-trackers, charge controller and lithium-iron batteries, all necessary field wiring terminals, disconnect switches, and software. It is completely “plug and play”, and can be installed on and off grid. No more piecemeal systems from different manufacturers because all functional units are manufactured by concept by US.

Concept by US | www.concept-us.com



Intelligent EV charging sensor

Circontrol launches eHome BeON, intelligent sensor allowing charging of an electric vehicle at home avoiding blackouts. eHomeBeON synchronizes the electric vehicle charge with the house by a dynamic power adjustment regarding the consumption supported by domestic installation. This solution, unique in the market, consists of an electrical device called BeON that can be easily added to the usual protection panel at home. The eHome BeON will adjust dynamically the electric vehicle’s consumption, taking the consumption supported by the installation as a reference. This device generates and sends a control signal to the eHome that allows it to regulate electric vehicle’s consumption when necessary.

Circontrol | www.circontrol.com



Aesthetically pleasing, high performance, energy storage unit

The new 6.8kWh, ESS 7.0 lithium energy storage unit offers high performance in a modern, aesthetically pleasing design intended for residential and small commercial solar PV installations, although usable in other types of renewable energy as well as on/off-grid. The 48V system with CAN BUS communication has an 80% Depth of Discharge offering 5.44kWh usable storage. This high efficiency unit offers a ten year warranty at 5,000 cycles, with an expected potential life span of up to 20 years. The BMZ ESS Storage System 7.0 is scalable to a total of 6 units with an additional Master Module add-on, for a total of 40.8kWh of storage.

Proinso Solar | www.proinosolar.com



Residential and commercial grid

The POWERGRID is now available to both residential and commercial customers for creating an independent grid that can replace the grid, using solar and its new LiFeMnPO4 battery system in a small 2 s.f. foot print that is safe for indoors, with no fumes or toxic chemicals of any kind. Built to last 20 years, with no maintenance and online monitoring. Clean Energy Storage systems are easy to install and they offer online tools to help customize any system within minutes.

Clean Energy Storage
www.cleanenergystorage.net



Regenerative grid simulator

Chroma has released a new addition to their 61800 series of Regenerative Grid Simulators. The 61830 is a full 4 quadrant, fully regenerative, 30kVA AC power source with advanced features satisfying rigorous regulatory standards testing as well as design and verification testing throughout the product development cycle. Designed to simulate grid characteristics, the 61800 is ideal for testing PV inverter, on-line UPS, Smart Grid, Vehicle to Grid (V2G) and Energy Storage System (ESS) applications as well as common electrical product testing such as home appliances and industrial electronics requiring a programmable input source. It contains Chroma’s standard output voltage of 330V L-N as compared to 300V L-N found in the market (0-300V L-N range does not sufficiently cover a +10% variation for 480V L-L applications); an optional 0-400V L-N / 0-692V L-L opt. that does not require a transformer; maximum power delivered down to 200VAC L-N which provides a wider output power range; and better front panel display with a real time waveform viewer.

Chroma Systems Solutions
www.chromausa.com



Fully integrated energy storage system

The Northern Power ESS (Energy Storage Solution) features the advanced FP2000 FlexPhase power conversion system has a wide range of DC voltage optimization, able to be effective with Flow, Lithium, Lead Acid, or any other chemical battery, as well as mechanical storage options such as flywheels. Northern Power Systems offers integrated Energy Storage Solutions (ESS) configurable for a range of applications. NPS ESS can be packaged into containers, shelters, trailers, or buildings with an output power range of 125 kVA – 2,000 kVA. The duration of rated power can be configured from 15 minutes to 4 hours. Key Applications of this solution include: Utility Grid Support – frequency regulation, VAR support/power quality, peak shaving/load shifting, sub-station resiliency, renewable integration; Behind-the-Meter – demand management, time-of-use, back-up power, critical load support; and Hybrid Microgrids – remote/islanded operation, black start, renewables utilization/reduced fuel consumption.

Northern Power Systems
www.northernpower.com

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ENERGY MANAGEMENT “BEHIND THE METER” IS BEGINNING to be recognized as a major area of opportunity in a variety of sectors including energy retail, facility management, energy management, energy service companies (ESCOs), and maintenance and service companies. As energy costs continue to rise, the level of waste is becoming more and more significant. The cost effective management and reduction of this waste is a good fit with the service mix and vision of these sectors. With the level of energy wasted in buildings and facilities estimated to be as high as 30 percent or more, and the annual value of this wasted energy estimated to exceed \$75 to \$80 billion in the U.S. alone, the size of this untapped market is now attracting the attention of those who are positioning their companies to attain an early leadership position and capture a greater market share.

Historically, it was typical to install utility meters which captured the total electrical consumption for the entire building. Some of the more advanced and aggressive operators would also make limited use of submeters to measure the major pieces of equipment in their HVAC plant. A more comprehensive submetering strategy was employed in high value manufacturing facilities, where the high cost of submetering solutions could be justified due to the substantial value of reliability and the cost of equipment maintenance and replacement.

Recently, major advances in submeter technology have been made, and significantly lower cost, more sophisticated submeters are now available. This technology includes integrated cloud communications and Big Data software analytics. With these submeters, companies can monitor their energy on a per circuit basis, enabling them to more effectively pinpoint problem areas. With high powered, energy analytics software encompassing real time communications, this new technology precisely analyzes energy usage and identifies the location and the timing of wasted energy. Submetering, therefore, now provides value by isolating specific equipment requiring troubleshooting at a reasonable cost and ensures accountability on a divisional or managerial basis with respect to energy use and cost. Additionally, these new submeters identify the exact time of peak demand and relative contribution of each piece of equipment, leading to more cost effective demand management strategies.

The granular reporting generated through circuit level, real time metering, can be used to increase awareness of energy use. This, in turn, can drive down consumption and create synergies within departments through competition to reduce energy or associated reward systems. Recognition programs can increase awareness and interest.

The Rise of Electricity Submetering and Energy Analytics

Why software is the key to energy storage

by Paul Mertes

Energy savings can be expected if facility managers are held accountable for knowing and controlling energy costs. Metering data allows for better transparency in the shared savings process and encourages partnerships between facility managers and the C-suite while providing quantifiable data that can be used as part of the decision-making process for various projects. Monitoring, controlling, and reducing energy consumption is of growing importance to today's facility managers. Submetering at the circuit level yields key data for operational baselines, project development, and savings validation. It also provides ongoing information with respect to the sustainability of specific projects.

Typical electricity smart meters monitor electricity usage every 15 minutes. This usage information can be sent to energy management software for analysis. Using the analytic capability of the software and proprietary energy use models, external consultants, vendors, on-staff personnel, or some combination, can identify energy savings opportunities, which can be as much as 30 percent of current energy consumption levels.

With real time, circuit level submetering, a completely new level of insight into the exact areas of energy waste is generated. Savings can be achieved through simple no-cost, behavior changes such as turning off unneeded equipment and correcting improperly set or programmed control systems. Granular submetering highlights the fact some systems and equipment are running when it is not necessary, and once identified, the software notifies the operator if the condition occurs again. Just as significantly, equipment operating with a low power factor, or with a higher energy consumption than benchmarked, can be identified and flagged for maintenance or replacement. With this level of energy analytics, significant cost savings can be achieved by reducing operating costs, and greatly enhance the potential that comes from traditional upgrades of lighting, motors, chillers, and other systems.

This overall analytical capability is sometimes referred to as “continuous energy audit”. The term captures the concept that advanced submeter technology identifies energy “drift” in real time, and minimizes the degree to which building efficiency declines with time from initial commissioning. These losses in efficiency can be as much as 20 percent over the first two years. Some of the causes of this degradation can include:

- temperature and time overrides by occupants or operators;
- improper control system programming;
- seasonal changes which disrupt mechanical equipment operation;
- failures of temperature sensors, relays, filters, or controls; and
- malfunctioning of complex electrical, mechanical, and HVAC components.

In summary, there is a wide range of benefits for organizations embracing the new, advanced submetering technology and related energy management services. Commercial building portfolio management, the manufacturing sector, and institutions can all benefit by:

- Eliminating the operation of equipment running unnecessarily due to mistakes in control systems and mis-set programs;
- Eliminating the operation of equipment for hours longer than necessary through inattentive employee actions;
- Minimizing the inefficient operation of equipment in need of maintenance or replacement; and
- Implementing improved operational strategies to limit peak demand and the associated charges.

New, advanced submetering technology enables the energy management service industry by helping those who play a major role in determining facility energy usage to identify areas in which they can schedule corrective action. As a data-gathering tool for a facility's energy-using systems, submeters can improve an organization's bottom line by placing greater visibility on its overall energy footprint. By introducing energy profiling down to the individual piece of equipment, organizations can begin to understand the importance of changes in their operational strategies. As more and more companies find energy savings opportunities based on submetering their facilities, interest in submetering technology will continue to grow.

Paul Mertes is president & CEO of Circuit Meter

CircuitMeter | www.circuitmeter.com



Optimized efficiency and standby power performance

Power Integrations announced its InnoSwitch-CE ICs, a new class of its InnoSwitch family of off-line CV/CC flyback switcher ICs. The devices are optimized for consumer electronics applications where government regulations for Total Energy Consumption (TEC) are of utmost importance. InnoSwitch ICs use a magneto-inductive coupling technique called FluxLink, which enables precise switching control of both primary and secondary MOSFETs without unreliable optocouplers. This topology provides efficient synchronous rectification without the risk of shoot-through during transient loads or line surges, enhancing product reliability. The technique also exhibits cross-regulation performance, which often permits the elimination of DC-DC converter stages in multi-output designs, further enhancing power subsystem efficiency and reducing system cost. InnoSwitch-CE ICs target adapters and chargers for smart mobile products as well as open-frame power supplies for set-top boxes, computer monitors, and other consumer audio-visual and entertainment products. InnoSwitch-CE ICs consume less than 10 mW no-load and are also efficient across the entire load range, minimizing the energy wasted in low-power standby or sleep modes. InnoSwitch-CE ICs include an on-chip 650V MOSFET with accurate line OV/UV monitoring, which delivers protection against line surges and swells. Devices support multiple outputs with an accurate external current sense. InnoSwitch-CE devices exceed all international energy-efficiency standards such as ENERGY STAR, California Energy Commission, European Union Code of Conduct (CoC) Version 5, Tier 2, and the US Department of Energy standards (DoE 6). Devices are UL1577 and TUV (EN60950) safety-approved, and EN61000-4-8 (100 A/m) and EN61000-4-9 (1000 A/m) compliant.

Power Integrations, Inc. | www.power.com



LED lighting system for high speed imaging

The new 80W Solarlux Blitz LED lighting system from EYE Lighting Applied Optix is a portable bright white light for high speed/resolution digital imaging systems. These lights are for use in static test labs, or as fill-in lighting in larger test cells during safety testing in the transportation industry. The 80W LED fixture completes the family of Blitz portable LED products, which also includes 200W and 400W versions. The Blitz product line is suited for use with new high speed/resolution digital imaging systems because these systems require the bright white light produced by EYE Applied Optix LEDs to maximize performance. Safety testing entities are also searching for environmentally friendly, low cost of ownership lighting to improve their operational efficiency. The Blitz product line features the latest chip on board (COB), super high intensity, white-light LED engines with 5000K color corrected temperature (CCT). Instant on operation and DC electronic drivers provide continuous operation while eliminating light flicker/strobe during high speed imaging events. This feature eliminates the need for potentially problematic light system synchronization to the imaging system. Blitz products are fully sealed to the environment, use a proprietary thermal convective system for cooling, and produce minimal heat transmission onto test targets. The Blitz LED product family is complimented by the Solarlux On-Board LED designed for in-vehicle and sled applications, and the Solarlux DueLL II high intensity LED designed for overhead array applications.

EYE Lighting International
www.eyelighting.com



Intelligent defrost control system

Century Refrigeration announces the release of the new Centinel Intelligent Defrost Control System. This control system improves refrigeration systems' energy efficiency, eliminates icing and fogging, and reduces operating costs. The Centinel consists of a microprocessor-driven controller, 4 temperature sensors, and a suction transducer. The microprocessor, paired with the advanced, sensitive temperature sensors, controls the system with a precision and accuracy unmatched by mechanical controls. The Centinel reduces the energy used by the system by precisely controlling superheat and fans, reducing compressor run time, and implementing demand defrosts. It uses a unique self-learning algorithm allowing it to automatically adjust to changing system conditions, making it customized to each individual evaporator. This defrost control system was designed for a rapid ROI and long service life. The Centinel can be used with both new and existing applications. As the controller is not refrigerant specific and can be configured for use with mechanical or electronic expansion valves, it is appropriate for use in a wide range of refrigeration applications.

RAE Corporation | www.raecorp.com



Unified application for energy providers and consumers

Tendril announced the availability of Tendril MyHome, the first unified, personalized, mobile-first application for the energy industry. Built on the company's TrueHome Simulation Model, Tendril MyHome is an easy-to-use application that unifies existing utility programs and mobile offerings in a single interface. By integrating with any utility engagement program, regardless of vendor, Tendril MyHome is the single application framework from which energy providers can spur consumer engagement. Tendril MyHome offers utilities the ability to personalize content, deliver push notifications and provide real-time chat functionality across programs.

Tendril | www.tendrilinc.com



LED flat panel troffer

Cree announces Essentia LED Flat Panel Troffer which offers flexibility in application and design, both product lines transform commercial spaces where broad spectrum lighting and soft visual balance are most important. The 2.8" thick flat panel troffer is optically efficient with an edge-lit design making it a solution for restrictive plenums. The track light portfolio includes one and two-circuit track heads with dimming capability and is backwards compatible with other track systems. The Essentia LED Flat Panel Troffer delivers up to 100 lumens per watt (LPW) at 90 CRI in color temperatures of 3500K, 4000K, and 5000K. The troffer's quiet light delivers quality lighting and eliminates the cost of short-lived flickering lighting, while delivering an ROI in less than 3 years compared to fluorescent T8 luminaires. The result is soft, balanced light with minimal glare and visually comfortable spaces that reduce visual fatigue. The Essentia by Cree lighting portfolio is engineered to perform in new construction and renovation applications and comes with a 5-year limited warranty.

Cree, Inc. | www.lighting.cree.com



Energy saving, integrated LEDs

ILEX introduces a new selection of integrated LEDs, keeping design at the forefront, with their sleek and modern aesthetic, while having the added benefits this category provides, such as ADA compliance, fixture longevity, and attractive light temperature. Integrated LEDs continue to make their presence known on the market due to a number of factors. They are virtually maintenance free, with a light designed to last as long as the fixture encompassing it. ILEX's integrated LED lights feature an attractive 3000K color temperature. The ILEX lights available with integrated LED include sconces and flush mounts, so designers can select whatever model best suits their projects, and have flexible mounting options (vertical or horizontal) for additional adaptability. Select lights are also ADA compliant and/or dimmable.

ILEX | www.ilexlight.com



LED track lighting

The Essential LED Track Light portfolio by Cree is available in solid fit and finish and includes integrated track heads with precision reflectors for a beautiful beam spread. The track lighting casts smooth light without fringing, hotspots, or discoloration to transform any showroom, restaurant, or retail environment. The product delivers performance up to 80 lumens per watt (LPW) at 80 CRI in color temperatures of 2700K, 3000K, 3500K, and 4000K. The Essentia by Cree lighting portfolio is engineered to perform in new construction and renovation applications and comes with a 5-year limited warranty.

Cree, Inc. | www.lighting.cree.com

JULY

- 12-14 **SEMICON West**
Moscone Center – San Francisco, CA; www.semiconwest.org
- 12-14 **Intersolar North America 2016**
Moscone Center – San Francisco, CA; www.intersolar.us

AUGUST

- 30-01 **2016 Sandia Wind Turbine Blade Workshop**
Embassy Suites – Albuquerque, NM; www.energy.sandia.gov

SEPTEMBER

- 12-15 **PES ESMO Conference & Expo**
Greater Columbus Convention Center – Columbus, OH; www.esmo.ieeeepesreg.com
- 12-15 **Solar Power International**
Las Vegas Convention Center – Las Vegas, NV; www.solarpowerinternational.com

OCTOBER

- 04-06 **Energy Storage North America 2016**
San Diego Convention Center – San Diego, CA; www.esnaexpo.com
- 05-07 **The COMSOL Conference 2016 Boston**
Boston Marriott Newton – Boston, MA; www.comsol.com/conference
- 05-07 **Solar West**
Edmonton, AB; www.solarwestconference.ca
- 13-14 **Decision 2016: Energy Choices!**
Sheraton Burlington Hotel & Conference Center – Burlington, VT; www.revconference.org
- 16-17 **Building Safety & Design Expo**
Kansas City Convention Center – Kansas City, MO; www.bsdxpo.org
- 17-19 **2016 Adhesive & Sealant Convention**
JW Marriott – Indianapolis, IN; www.ascouncil.site-ym.com
- 18-19 **15th Annual BIO Investor Forum**
Westin St. Francis Hotel – San Francisco, CA; www.bio.org/events
- 23-26 **GRC Annual Meeting & GEA Geothermal Energy Expo**
Sacramento Convention Center – Sacramento, CA; www.geothermal.org/meet-new.html
- 25-26 **AWEA Offshore Windpower**
Crowne Plaza Providence – Warwick, RI; www.offshorewindexpo.org

NOVEMBER

- 01-04 **Cities Alive**
Washington, DC; www.greenroofs.org
- 01 **ACORE Finance West**
Parc 55 Hotel – San Francisco, CA; www.acore.org
- 07-10 **Grid Modernization Summit 2016**
Capital Hilton – Washington, DC; www.sjip.org

MAY 2017

- 22-25 **AWEA Windpower 2017 Conference & Exhibition**
Anaheim Convention Center – Anaheim, CA; www.awea.org

SEPTEMBER 2017

- 19-21 **tcbiomass 2017**
Radisson Blu Aqua – Chicago, IL; www.gastechnology.org/tcbiomass

Send us your clean energy show and event listings.
Email information to the editor at editor@nacleanenergy.com

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42	AIMS Corporation	www.aimscorp.net
51	American Chemical Technologies	www.americanchemtech.com
41	Applied Energy Technologies	www.aetenergy.com
18	Arctracker Inc	www.arctrackerinc.com
7	Array Technologies	arraytechinc.com
65	Aurora Solar	www.aurorasolar.com
55	AWEA	www.offshorewindexpo.org
5	Baja Construction	www.bajacarports.com
IBC	Building Safety and Design Expo	www.bsdxpo.org
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20	Canadian Energy	cdnrg.com
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43	Cotek Electronic Ind. Co. Ltd	www.cotek.ca
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6	CyboEnergy	www.cyboenergy.com
OBC	DCE Solar	www.dcesolar.com
32	DPW SOLAR	www.dpw solar.com
47	Ecology and Environment, Inc.	www.ene.com
36	Eko Instruments (USA) Inc	www.eko-usa.com
37	Everglades University	www.evergladesuniversity.edu
24	FIBOX	www.fibox.com
68	Franklin Electric	franklinwater.com
27	Fronius USA	www.fronius.com
9	Gamechange Solar	www.gamechangesolar.com
16	GS Battery	www.gsbattery.com
36	HT Instruments	www.ht-instruments.com
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26	HuksefluxUSA Inc	www.hukseflux.com
31	IDEEMATEC Deutschland GmbH	www.ideematec.de
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15	LG Electronics	www.lg-solar.com
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32	Magerack Corporation	www.magerack.com
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34	Mersen	www.ep.mersen.com
11	MK Battery	mkbattery.com
25	Multi-Contact	www.mc-pv-portal.com
64	Nine Fasteners	www.ninefasteners.com
57	Nordic Fiberglass	www.nordicfiberglass.com
71	OMG Roofing Products	www.omgroofing.com
19	Phoenix Contact	www.phoenixcontact.com/sunclix
39	Power Electronics	www.power-electronics.com
69	Quick Mount PV	quickmountpv.com
35	RBI Solar	www.rbisolar.com
75	Rhombus Energy Solutions	www.rhombusenergy.com
13	Rolls Battery	rollsbattery.com
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60	S-5	www.s-5.com
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IFC	Shoals	www.shoals.com
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3	SOL Components	www.solcomponents.com
45	Solar Power International	www.solarpowerinternational.com
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70	Sollega	www.sollega.com
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70	Spider Rax	www.spiderrax.com
44	Steca Elektronik	www.stecasolar.com
21	Sun Action Tracker	www.sat-energy.com
12	SunTegra	www.suntegrasolar.com
66	TerraSmart	terrasmart.com
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Exhibit at the new Energy Efficiency Zone at the Building Safety & Design Expo!

Sponsored by:



The **Energy Efficiency Zone**, sponsored by RESNET, is a special opportunity event to bring your company and products face-to-face with code officials and professionals from the built environment including local tradesmen, architects, engineers, and plumbing, mechanical, fuel gas, building and fire safety professionals from around the country. PLUS, highly-focused pre-show promotions will reach ICC's 58,000 members of code officials and other professionals and 190,000 customers that turn to ICC for their building safety and design needs.

Position your brand and your company as an industry leader in Building Safety and Design!

The **Energy Efficiency Zone** is new to the trade show floor this year and will feature manufacturers, suppliers and organizations displaying and discussing the latest energy efficiency technologies and products. The Energy Efficiency Zone will provide industry professionals an area to learn how to save time and money for them, their customers and clients.

Energy Efficiency Zone Exhibitor Benefits include:

- Presence at the final hearings in Kansas City which includes the 2018 IECC
- Exposure to hundreds of code officials and state energy office representatives
- Ability to educate ICC members and industry professionals on benefits of energy efficiency
- Explain your company/organization role in implementation of the IECC

Additional Benefits to Exhibiting:

- Four (4) complimentary exhibitor badges for every 100 square feet of exhibit space*.
- Opportunity to offer your customers and prospects FREE admission to the Expo.
- Complimentary listing on the BSD Expo website. Listing includes company name, booth number, web address, company logo, and 100-word description.
- Complimentary listing in the BSD Expo program and ICC Annual Conference Program. Listing includes company name, booth number, web address and company logo.
- Complimentary listing in the Mobile App. Listing includes company name, booth number, phone number, web address, company logo, and 100-word description.
- Complimentary listing on signage located outside the main expo entrance. Listing includes company name and booth number.
- Use of the BSD Expo logo and marketing materials to help with your exhibit promotions.
- FREE ICC Corporate Membership for Non Members** (\$450 Value).
- Discount on exhibit space for ICC Members (\$400 savings)
- Booth includes back drape and side drape in show colors and Identification sign.

Exhibit Rates

\$2,400 – Standard Fee
 \$2,000 – ICC Corporate Member Fee
 Fees listed above are per 10' x 10' or 100 sq. ft. booth space
 \$1,000 – Adjacent Booth Fee (For each additional 10'x10' booth space)

Terms

A 50% deposit is required at time of application. Payment in full is due by September 2, 2016

High Impact Sponsorship Opportunities also available!
 Contact Brian Campbell at bcampbell@iccsafe.org or by calling 888-422-7233- x5264

HOW DATES AND HOURS	
Sunday, Oct. 16	3:00 pm – 7:00 pm <i>(Open to ICC Annual Conference Attendees Only)</i>
Monday, Oct. 17	10:00 am – 5:00 pm <i>(Open to the Public)</i>
EXHIBITOR MOVE-IN	
Saturday, Oct. 15	1:00 pm – 5:00 pm
Sunday, Oct. 16	8:00 am – 1:00 pm
EXHIBITOR MOVE-OUT	
Monday, Oct. 17	5:00 pm – 10:00 pm

Reserve your Booth Today! www.bsdexpo.org

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