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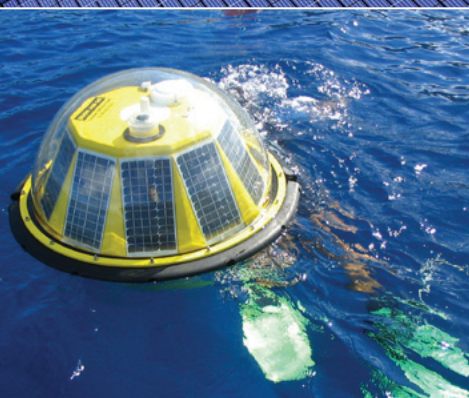
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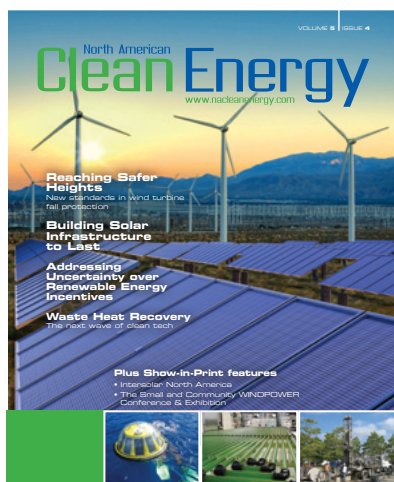
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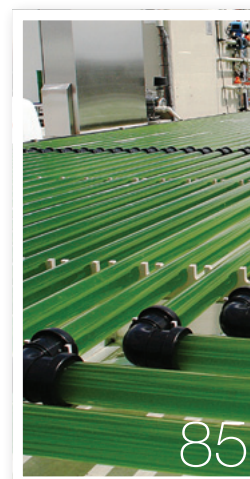
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Photo by Michelle Moore

THE RECESSION IN THE UNITED STATES may officially be a couple years behind us, but we're not out of the woods yet. The effects of a downturned economy, particularly one that was hit with the longest recession since the Great Depression (according to the National Bureau of Economic Research), doesn't go away over night—or even over many nights. Two years later, the financial health of this country still remains fragile with unemployment highs and interest rates at historic lows. Some analysts say recovery is much slower and weaker than expected.

It's tough to imagine an industry that wasn't affected by the recession, and the renewable energy sector is no exception. It's interesting to imagine where America could

have placed in the global clean energy race given an ideal world, and a strong economy all along. Currently, China holds the lead as the world's leading provider of wind turbines and solar panels.

Nevertheless, ups and downs are a part of life and, perhaps, we shouldn't question progress when the US energy sector isn't all that far behind. Second place behind China, according to the latest Ernst & Young "Renewable Energy Attractiveness Index," with India and Germany as close followers, isn't so bad (www.ey.com). With an 80% clean energy target set for 2035, and a few positive statistics in our back pocket, the future does look promising.

For instance, the US solar energy industry continues to be one of the fastest growing sectors of the economy, based on the "US Solar Market Insight: Q1 2011," released by the Solar Energy Industries Association and GTM Research. In total, cumulative grid-connected

solar electric installations have reached more than 2.85 gigawatts, enough to power nearly 600,000 US homes. A visit to WINDPOWER 2011 Conference & Exhibition (www.windpowerexpo.org) in May of this year also proved the wind energy industry is in good shape, especially if California is any example. The state has enacted the strongest renewable target in the country: 33% renewables by 2020. With 600 megawatts of wind power under construction, nearly one million California homes will be powered by wind once complete.

In terms of geothermal energy production, the US ranks number one. This year alone, the geothermal industry is developing 146 projects across 15 states, with the total number of projects and prospects under development increasing 12%, according to the Geothermal Energy Association (www.geo-energy.org). And, this doesn't account for biomass, which represents the largest sector and about half of all renewable energy in the United States.

There's no question that much clean tech growth over the past couple years has come at the hands of the government. Between incentives, tax credits, cash grants, and loan guarantees, the renewable energy sectors have had some post-recession assistance. But, by the end this year (save another last-minute extension), the Section 1603 cash grant program is set to expire. And, come September, the Section 1705 Loan Guarantee Program (created by the American Recovery and Reinvestment Act) will end. So, where will that leave clean energy? Check out the articles on page 8 and 76 for some predictions.

This issue we also look at wind turbine supply contracts, permitting geothermal projects, the potential of waste heat recovery, as well as the latest solar PV technologies, and more. Because despite the economy—or, maybe even in spite of it—research, investments, and projects must go on. Our future depends on it.

Michelle Froese

news bites



US solar energy industry continues record-setting growth

The US solar energy industry continued to be one of the fastest growing sectors of the economy in Q1 2011, according to the "US Solar Market Insight: Q1 2011," released by the Solar Energy Industries Association (SEIA) and GTM Research.

In the first quarter of 2011, the United States installed 252 megawatts (MW) of grid-connected photovoltaics, or 66% year-over-year growth over Q1 2010 installations. Two major factors drove this growth: falling solar energy equipment costs and a rush to take advantage of the Section 1603 Treasury program that was expected to expire in 2010 (the program was eventually extended through the end of 2011). All three PV market sectors (residential, commercial, and utility) continued to grow, with commercial installations showing the strongest gains.

In total, cumulative grid-connected solar electric installations have reached more than 2.85 gigawatts (GW)—enough to power nearly 600,000 US homes.

For the full executive summary, visit www.seia.org/galleries/pdf/SMI-Q1-2011-ES.pdf

SEIA | www.seia.org

Wind-power label standard presented to US market

WindMade, the first global consumer label for companies using wind energy, was presented to the public on June 15th, Global Wind Day. This initiative took shape as the proposed WindMade technical standard enters a two-month public consultation period. The proposed standard requires participating companies to source a minimum of 25% of their electricity demand from wind power. This level is set to strike a balance between an ambitious target and an achievable goal for progressive companies striving to make a tangible impact. Work on the more multifaceted WindMade standard for products is scheduled to begin later this year.

Learn more at www.windmade.org.

AWEA | www.awea.org



Ocean basemap

Esri created and released a new, comprehensive map of the world's oceans and coastal areas that greatly expands the ocean content that's currently available. Traditional basemaps of the ocean have small scales and only include coarse-grained views of features. The Esri Ocean Basemap includes fine-grained bathymetric and altimetric data from coastal areas, where most activity takes place. The first basemap of its kind, the Ocean Basemap is designed to support a variety of hydro and maritime GIS applications.

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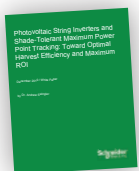
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Uncertainty Over Renewables Incentives

Charting a course through choppy waters

By Allan T Marks | Milbank, Tweed, Hadley & McCloy LLP

With Congress looking to trim the federal budget in every way, it's uncertain whether federal programs that support renewable energy, despite their success and low-net cost to taxpayers, will be renewed. However, all hope is not lost. Other federal incentives will remain in place and increased efforts by states to support renewable energy will bolster their effect. Further, though their appetite has not yet reached pre-recession levels, investors are returning to the market and are positioned to fill the void left by any curtailment of federal incentives.

The challenge facing the renewable industry is to navigate the current political debate in a way that decouples renewable energy policy from the overarching struggle over federal spending and the year-to-year budget battles. This may prove impossible in the short-term, and otherwise worthy incentives like the cash grants may expire. However, in the longer view, the industry can stay above the partisan fray and remain attractive to investors with the right approach. Popular backing for renewable energy remains strong, and incentives for renewables generally enjoy bipartisan support (save for the most ardent of congressional budget hawks), unlike the coalitions supporting other energy sources—coal, in particular.

While the Section 1603 cash grant program for renewable projects managed to win a last-minute reprieve from Congress in 2010, receiving a one-year extension, the possibility of a similar extension before the program expires at year-end appears increasingly remote. Likewise, the US Department of Energy's (DOE) loan guarantee program for commercial renewable projects is set to expire at the end of September, and an extension doesn't appear likely.

Assuming the cash grants expire this year, the PTC and ITC will remain available to renewable projects and reclaim their significance in attracting investment. The PTC is available for wind facilities placed in service prior to January 1st, 2013, and other renewable energy facilities placed in service prior to January 1st, 2014. The 30% ITC for solar, fuel cell, and small wind turbine projects is available for those facilities placed in service prior to January 1st, 2017 (the 10% ITC doesn't expire). The ability of PTC-eligible projects to take the ITC *in lieu* of the PTC will also remain effective alongside the current PTC authorization. As the PTC and ITC return to the equation, the tax equity market will regain importance as developers will again need to monetize their tax credits. While the market has already reopened, tax equity remains expensive and will continue to command a premium until there's a wider recovery in the economy.

Extension of the Section 1705 DOE loan guarantees isn't as critical to supporting the market. The lack of debt available to worthy projects during the recession sparked the need for loan guarantees. The debt markets are recovering, and the DOE hasn't used its authority to issue loan guarantees to fill what gap existed. Instead, the DOE issued guarantees to projects that would have proven difficult to finance, even in the pre-recession environment, whether because of size or the use of new or unproven technology. The expiration of the program shouldn't affect investor interest generally in financing renewable infrastructure.

Still, if Congress can find funds to cover the credit subsidy costs of additional guarantees (a large "if"), an extension may be had as Congress has signaled its continued support of the program, even amidst the standoff over the budget. The FY2011 funding resolution, enacted April 15th, 2011, preserved the DOE's remaining budget authority for the program to the surprise of many, and went further in providing \$170 million in new funds to convert the lesser-used Section 1703 program to the model used by Section 1705, though the program's loan authority was cut substantially. Also, the resolution allows projects that applied for guarantees under either program prior to February 24th, 2011, to qualify under the modified Section 1703 program, regardless of whether applicants under Section 1705 commence construction by the end of September.

Assuming the Recovery Act incentives expire, the more critical fight for the industry is the ongoing extension of the PTC and ITC, though the ITC's current expiration date is still over the horizon (2016 year-end). Congress may handle these as a matter of tax reform legislation, rather than as part of an energy package, given lawmakers' focus on deficit reduction and the low probability any significant energy legislation will move before the 2012 elections.

Irrespective of whether federal tax credits or other programs remain in place, support for renewable energy at the state level continues to grow. State incentives are already

key drivers of investment. Although there's been much handwringing over Congress' failure to pass a national RPS, the states have made significant headway without federal direction. Today, 29 states plus the District of Columbia and Puerto Rico have adopted an RPS, typically requiring 20% to 25% or more of a state's energy to be generated from specified renewable sources by 2020 to 2025. An additional seven states have set renewable goals, and others are considering such policies.

Once an RPS is in place, the industry has had success in increasing its requirements. Most notably, California (with voter support) increased its RPS in April from 20% to 33% by 2021, the highest in the US in that timeframe. State RPS requirements, especially as they begin to ratchet up later this decade, will increasingly drive demand for renewable power, attracting debt and equity even without federal incentives. Further, other state requirements and programs, including carbon regulation, will play a role in encouraging increased use of renewables.

Should Congress move forward on energy legislation, perhaps spurred by record gasoline prices or other events, a central consideration of any package would be the inclusion of some form of the "clean energy standard" (CES) proposed by President Obama earlier this year—a compromise that adds natural gas, nuclear, and clean coal to renewable sources to create a broader portfolio standard. The CES debate is intriguing because it has the potential for broad bipartisan support, adopting a strategy that would frustrate coal supporters and some in the environmental movement, but retain the majority of policymakers who support renewables. Increased nuclear safety concerns resulting from radiation leaks at Japan's Fukushima I nuclear power plant complicate this issue, however, as it would appear more difficult to win support for a CES that includes nuclear power at this time. But, aligning the interests of the natural gas industry with the renewable sector may form the critical mass needed to overcome any opposition.

Although some of the Recovery Act benefits enjoyed by the industry may soon sunset, the outlook for US renewable energy investment remains bright. The PTC and ITC are still in place, and state-level incentives for renewable energy, particularly in the form of RPS requirements, continue to increase in importance and scale. Although particular concerns such as low-priced natural gas hampering

wind development may limit investment in a given year, as it did in 2010, the long-term trajectory for the renewable sector remains one of continued growth and opportunity, and investment in renewable energy will remain an attractive proposition for financiers.

Allan T Marks is a partner at Milbank, Tweed, Hadley & McCloy LLP.

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The 600 kW roof-mount solar array atop the flat roof of the Minneapolis Convention Center.
(Photo credit: Westwood Professional Services)



Building Solar Infrastructure to Last

By Juan Suarez

Racking (def.) ~ A system of components used to structurally support and position photovoltaic (PV) modules in a safe and cost-effective manner.

Infrastructure, such as racking, is often the last component solar project managers and purchasing agents consider—yet, ironically, the first installed. With module prices tumbling, attention is shifting to racking to remove material and labor costs in the balance of systems. The result is a proliferation of racking companies, technologies, and applications, although the mission of racking is unchanged.

Although racking technologies have become specialized by project size and application, there remain three categories where most solar is installed:

- Flush, pitched roof, less than 10 kW
- Tilted, flat roof, 5 kW – 2 MW
- Ground mount, 5 kW – 50 MW

1. Flush, pitched roofs, of less than 10 kW yearly, account for hundreds of thousands of installations in North America. Racking has evolved from angle iron or strut-sourced, to aluminum extrusions with specialized connections, to speed installation. Aluminum rail systems offer great corrosion-resistance and aesthetics. They're also lightweight and easily fabricated onsite to fit a pitched roof.

Some racking systems leverage the structure as part of the grounding system to minimize the amount of copper used. Integrated grounding and bonding products often suffer from building and electrical code issues, which result in less than universal acceptance. Other innovations include integrating the system directly into the module to reduce part count and speed module installation. These new products benefit from adding accessories and functionality to mount auxiliary components currently attached to traditional racking systems, such as micro-inverters, combiner boxes, and conduit runs.

Lastly, manufacturers continue to release new, more cost-effective products by optimizing structural shapes that reduce the amount of raw material per watt. Overall, installation speed and cost reduction are at the core of flush, pitched-roof innovations.

2. Tilted, flat roofs typically range between 5 kW and 2 MW. The industry loves the
Continued on page 12.

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Albuquerque Academy secondary school's 1.1 MW ground-mount installation—the largest solar-powered secondary school in North America. (Photo credit: Consolidated Solar Technologies)



...continued from page 10.

concept of ballasted or penetration-less racking systems, based on the notion that such systems don't cause roof leaks. Conventional wisdom should be evaluated with a grain of salt, however, as racking systems resting on roofing systems can be an equal cause of leaks. To avoid leaks due to tears, look for racking systems that isolate metal components from the roofing systems and minimize the amount of contact.

The engineering behind ballasted systems can also be a concern. Fully ballasted systems are great at resisting overturning or elevating and flying off due to wind forces. But the most likely type of failure is sliding off a roof. All ballasted systems rely on friction produced by ballast between the racking structure and the roofing membrane. Ponding water, snow, and ice are common on flat roofs and can double the amount of ballast needed. Anyone who has walked on a TPO roofing system covered with morning dew can attest to the slipperiness of roofing membranes. As a result, some racking manufacturers recommend a minimal number of structural attachments, which are also required to resist seismic forces.

The quest for innovation pushes racking manufacturers to explore polymers and plastics in complex shapes that, again, minimize part count and speed installation. These systems have met market resistance due to the durability and longevity of polymers under intense sun, heat, and cold.

3. Ground mounts range in size from 5 kW to 50 MW, and represent the fastest-growing solar application. The focus has shifted to large (1 MW+) installations, where material

and labor costs have become the most important factors in evaluating infrastructure.

The lust for lower material costs, coupled with market growth, has brought new manufacturers from automotive and metal fabrication industries. Beams and connections in ground-mounted systems are shedding pounds for cost competitiveness. Fold-out racking systems, combining steel and aluminum components, and innovative foundation systems, have the same goal: to push field labor into the factory where it's of lower cost and is more efficient.

A key innovation is the ability to pre-assemble banks of modules prior to arrival onsite. Typically, 60% to 70% of field labor and cycle time is consumed by installing modules on a structure by hand, one at a time. For the solar industry to gain the next level of efficiency and step closer to grid parity, this paradigm of installing 50 MW, 200 watts at a time, has to change.

A call for codes & standards

Cost reduction and installation speed are common threads among residential, commercial, and utility, whether on the roof or ground. These trends can be diametrically opposed to the increasing need for engineering rigor and reliability, and the subsequent development of codes and standards. Contrary to common belief, just because a manufacturer releases a product doesn't mean it'll last 25 years. If a module or inverter fails during its lifetime, the most probable outcome is lost power production and associated replacement costs. If a racking structure fails, the best-case scenario is lost power production, with a catastrophic

potential for large property damage and personal peril.

The continued adoption of codes and standards will add cost to infrastructure in the short term as all manufacturers are forced to comply with a minimum, common level of engineering diligence. A solar project developer, financier, contractor, and customer are challenged to select a manufacturer who has invested in the appropriate amount of engineering and testing to ensure the racking structure is built to last while also cost-effective.

The promise of warranties and stamped engineering letters and drawings provide a false sense of security. The real risks related to solar structures can only be managed through great engineering, a proven track record, and the financial strength and longevity of an infrastructure manufacturer.



Juan Suarez is the senior director of engineering and program management at Unirac, a North American provider of infrastructure for solar power systems.

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Electrical box cover

ART•TEC Solar introduces an electrical box cover version of its PV-powered solar differential controller. The new model of the DTC-D solar differential temperature controller is available in an electric box cover version to fit in a 4x4 electric switch box. This will allow for attractive and unobtrusive installation in the living space of residences, while the wires can be run through conduit to the solar utility room. The DTC-D is specifically designed for solar or battery powered collector circulation pumps used in solar heating systems. The digital controller includes an internal battery back-up, which allows the controller to continue to display current temperatures and record max/min temperatures at night, or during overcast days. The controller's backlight makes it easy to read in dark utility rooms. Features include: adjustable max temperature shut-off with optional over-temperature audible alarm; freeze alarm with optional freeze pumping for systems that operate from batteries; resettable max/min display of recent temperature extremes; and, the front panel controls allow easy changes to settings and manual override of pump to on, off, and auto modes.

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Diodeless junction box

Heyco Products, Inc. has announced availability of their PVB 001 Potted Solar Junction Box. Specifically designed for applications that require a diodeless junction box, the PVB 001 can be used with USE-2 and 1000V PV wire, features low cost, two-piece construction for potted applications, and has a low profile design that minimizes use of potting material while permitting ample access for electrical connections. Durably constructed of high-temperature polycarbonate with 5 VA and UL F1 ratings to withstand outdoor exposure, with excellent cold impact performance, the junction box's lid securely snaps on without tools to greatly speed panel fabrication. An optional mounting plate (Part S6199) for use on flexible panel applications attaches to plate clips on the opposite side of the panel for added security.

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Solar PV Systems that Pay Off

Determining the optimal yields

By Artur Deger

PHOTOVOLTAICS (PV) are without doubt the most direct way of taking advantage of solar energy. For best results, however, any incentives or feed-in tariffs available must be considered, as well as the efficiency of the solar energy system used. Not only does the capacity of solar modules have considerable influence on the cost effectiveness of a project, so does the way in which they are used.

Basically, there are three different technological approaches for PV systems as follows:

1. Rigid systems. Rigid systems originate from the beginnings of PV technology. Today, they can primarily be found on the roofs of private, commercial, or public buildings. But, in solar parks, they are slowly being replaced by tracking systems, which work more efficiently and cost-effectively.

Tracking systems represent a further development of fixed systems. They work according to two different principles:

2. Astronomically guided tracking. Based on astronomical data, the sunrise and sunset times for astronomically guided tracking throughout the year are stored in the software, as is the angle of the sun's rays. Tracking systems controlled in this way do not take account of weather conditions or other parameters relevant to the energy yield; however, data is provided as a reflection effect through snow, water, or light-colored rock.

3. Intelligent tracking. "Smart" tracking is always oriented on actual conditions by means of light detectors. These systems align the connected solar modules to the brightest, most energetic point in the sky. In this way, reflected light or diffused light that penetrates clouds is also taken into account, which can be referred to as Maximum Light Detection (MLD).

In single-axis systems, solar modules are installed with a fixed angle of elevation dependent on the location. In the southern states of the US, this is usually 20°. In Canada, this is normally around 30°. Tracking takes place only along the horizontal axis, and this is why single-axis systems achieve considerably lower yields than dual-axis systems.

Costs versus benefits

In Germany, the accepted method of approaching the investment and planning for a solar park is to consider the one-off installation costs per kWp. North America is a step ahead: the focus here is on the long-term return of the investment.

If one considers the one-off investment costs alone, rigid systems are the most favorable. Fundamentally, they consist of solar modules, support frames, and inverters. In comparison, tracking systems also require masts, motors, the accompanying moving parts, as well as software, computer power, and an IT network, depending on the technology. By analyzing a typical cost/benefit calculation for a solar park, and including the yield of the different systems in this calculation, the bottom line maintains rigid systems are some 25% more expensive than intelligent tracking systems.

Target yield: 1 GWh per year

Below, the generation of 1 GWh of energy per year is taken as a guideline for a comparative calculation. Since the basic costs for astronomically guided tracking and tracking in accord-

ance with the MLD principle are more or less identical (whereby, the yield from astronomically controlled systems is considerably less), the comparison between rigid systems and dual-axis systems is based on the MLD principle.

The main factor in this calculation is the price of the solar modules used, which affects the overall investment. For this reason, the investment for the assumed yield of 1 GWh per year is calculated on the basis of a Wp price of \$2.15, \$1.43, and \$1.

Results

The investment with a Wp price of \$2.15 comes to some \$2.18 million for dual-axis tracking systems, and to around \$1.83 million for rigid constructions. Therefore, the additional costs for rigid systems lie at around 21% above those for MLD tracking systems.

With a Wp price of \$1.43, the investment for dual-axis tracking systems comes to some \$1.28 million, and for rigid constructions to around \$1.49 million. So, about 16%.

If the Wp price is \$1, about \$1.14 million must be invested for dual-axis tracking systems, and around \$1.29 million for rigid constructions—additional costs: about 13%.

Module prices have only a marginal effect on the cost/benefit analysis. With a module price that is 50% lower (Wp price), the savings potential through dual-axis tracking is reduced by only eight percentage points: from 21% to 13%. It must also be taken into account in this calculation that the payback period for tracking systems is shortened accordingly, which has a favorable effect on the duration and, therefore, the costs of financing.

LCOE value

Numerous parameters must be considered when calculating the Levelized Cost of Electricity (LCOE) value, which is increasingly accepted as an international standard in the solar sector. These parameters not only include total investment costs, but also the annual degradation and annual operation, as well as the ongoing maintenance costs. Inflation, the discount rate, and the service life of a system are also worth mentioning among the multitude of factors.

After the aforementioned calculations, and based on an irradiance of 2,200 kWh typical of California when using one of the largest MLD systems available, an investor will be able to achieve an LCOE value of about 14 cents US per kWh. Until now, only 20 cents was common.

Regional deployment

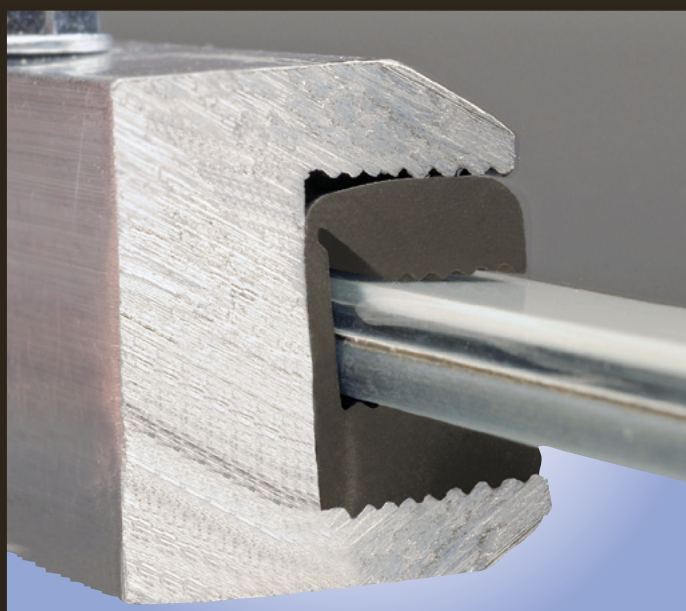
For this study, the solar radiation values were used for locations in central Europe, southern Europe, and the US. It became obvious that the region of deployment has relatively little influence on the cost/benefit analysis. Another result: with more powerful modules, tracking systems become more profitable.

In conclusion, if one compares costs and yield of rigid PV systems with that of tracking systems, tracking is more profitable, since the additional yield is higher than the additional costs.

Artur Deger is the founder and managing director of DEGERenergie, which has successfully developed MLD technology for solar tracking systems.

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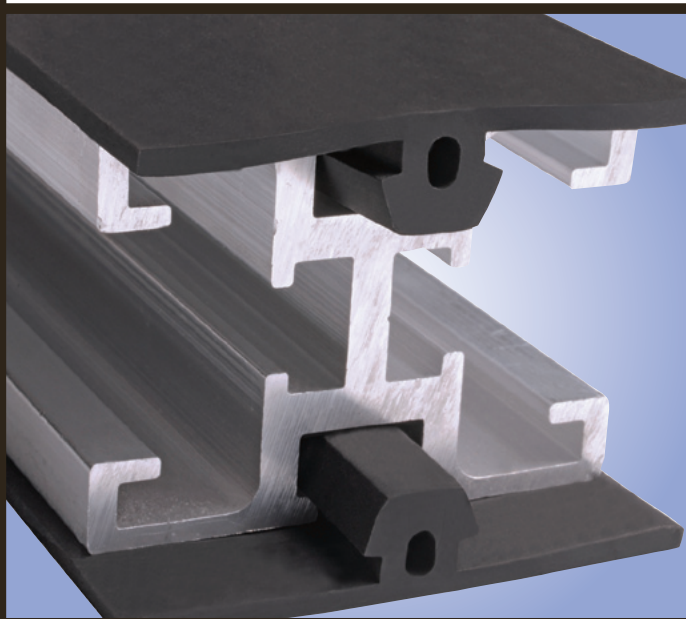
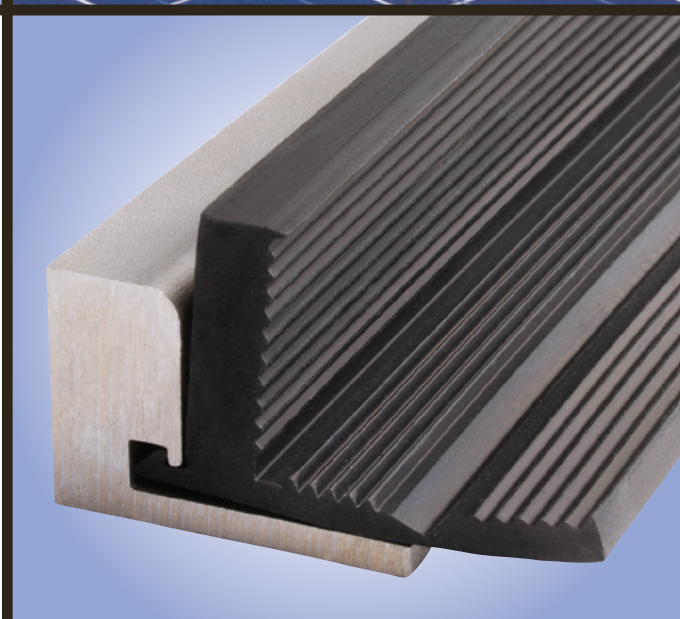
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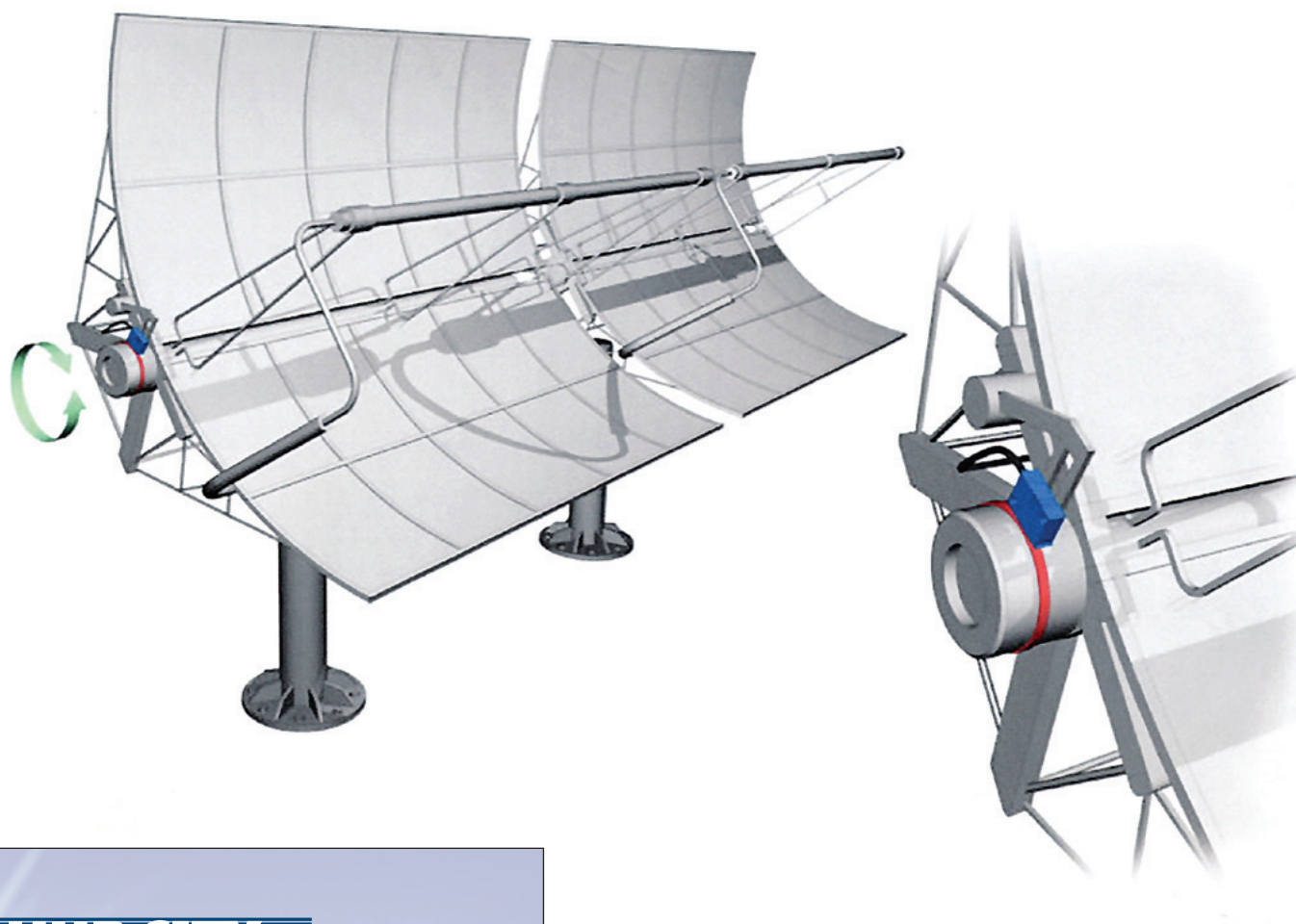


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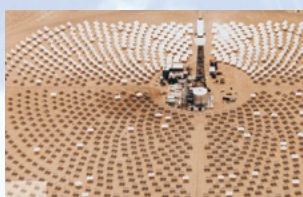
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Tracking the Sun

Magnetic measurement systems

By Maurizio Masullo

WE'VE COME A LONG WAY from the first solar systems, which attempted to catch whatever ray of sunlight that happened to pass them by. Now, flexible solar collectors can fully adapt to the position of the sun throughout a sunlit day. Such a capability allows them to catch each beam of sunlight during the day by means of magnetic measuring systems. This is achieved through sensors, which work according to a magnetic measuring principle, allowing them to move without any physical contact.

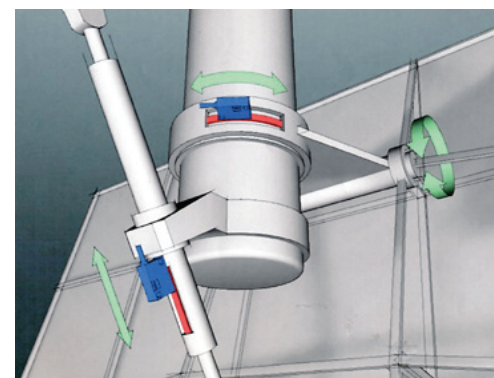
Magnetic measuring systems originated in Germany, where subsidies for photovoltaic (PV) installations on rooftops and open areas were curtailed by the German federal government, forcing solar energy systems purveyors to consider alternative methods for collecting solar energy. So far, this has not been an issue in the United States, but US solar energy providers can still welcome the savings provided by such technology.

How magnetic measuring systems work

In solar thermal power stations, sensors measure the angle of the reflectors, thereby providing a downstream control system via a position message. The required angles (i.e. set value) are stored in a controller according to the time of day (meaning: the position of the sun). As the collectors are able to assume any position, they follow the movement of the sun throughout the day.

The results of these measurements are translated into real time, which is very precise (up to 10 μ m). If the sensors are reflective of high system and repeat accuracy, they can be aligned quickly with the sun to capture as much solar heat as possible. Direct radiation of the sun is then reflected by the collectors to the absorbers, where it is bundled and absorbed.

Continued on page 18.



Nature provides us with the gift of energy through the sun, but unfortunately, nature's wrath may not be all that friendly to your PV system under stressful conditions. Snow, wind, extreme heat or cold, and seismic activities can wreak havoc on underengineered, underdesigned and insufficiently tested racking structures. Only UNIRAC solar structures have been engineered and third-party tested to withstand the harshest of elements and events for a long and enduring service life. Complies with IBC, IRC, ASCE-7-05, ADM, AISI, AISC, NEC and UL. For the highest level of engineering and construction with the lowest cost of ownership in the business, Unirac is the 24/365 solution for performance in and out of the sun. Visit unirac.com for more information.



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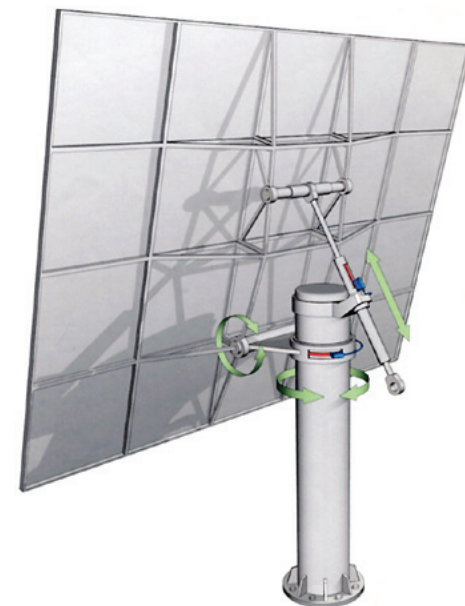
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...continued from page 16.

Generating power with mirrors

Two of the most advanced power stations are solar towers and parabolic trough power plants. The latter use curved through-type mirrors to “bundle” sunlight onto an absorber tube. Because of the shape of these mirrors, the sun shines 30 to 60 times stronger on the tube, allowing this concentrated energy to heat a liquid heat transfer medium, which is used to generate steam. This steam, in turn, powers a turbine and energy is generated via an electric generator.

Solar towers, by contrast, function with thousands of individual concave mirrors, each reflecting rays of the sun into a central absorber on a tall tower. In this case, the tower/absorber concentrates the solar heat onto a liquid heat transfer medium.

Installations prove the system

Though not yet in the US, applications for the parabolic trough type systems are already in use in Spain. In fact, the devices are employed in several Spanish locations, utilizing the optimal alignment of the solar collectors. A system in the Extramadura region of Spain, and one in the Castile region, each use approximately 2500 sensors. They employ a contactless measuring sensor with an integrated evaluation module and a digital signal output. In combination with the magnetic band MB500, these form an open measuring system with high resolution.

Magnetic sensors can also be found in power stations near Seville. Here, the sensors are equipped with an evaluation module, as well as a direct, digital signal output, and are used in combination with the MB320 magnetic band. The magnetic bands are installed quite easily by gluing, and are solidly joined with a steel carrier strip.

Applications for difficult atmospheric conditions

Because they require many sunny days, solar thermal plants are primarily located in warm regions of the world such as Spain, Australia, and the California desert. Measuring devices are equipped to perform optimally in such challenging climates. Temperatures up to 158° F are not problematic. As a result of their compact design, the measuring systems resist shocks, vibrations, as well as sand particles—which is particularly helpful in desert installations. The compact design of these applications also gives the devices a small footprint in terms of any environmental impact.

Magnetic versus mechanical systems

It seems magnetic measurement devices are replacing mechanical systems throughout the industry, especially for linear and radial measurements, angle values, and revolutions. The core element of a solar magnetic measurement is a magnetized band that is mounted to a machine. It's equipped with a code, which is scanned by a sensor during the measurement action. This is done without any contact whatsoever. Then, integrated electronics calculate the path or angle data, making it available either as an absolute value or as incremental signals. Because of the contactless process, no wear occurs on the devices. This process saves on maintenance and replacement costs, making solar magnetic measurement systems economical to run.

Maurizio Masullo is the CEO of SIKO Products, Inc.

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Shine a Light on Plastics

Moving toward grid parity with cost-effective film technologies

By Nikhil Bhiwankar

AS RENEWABLE ENERGY becomes a global priority, solar power has become an increasingly viable solution to the world's energy demand issues, generating sustainable power from a source readily available to everyone. Environmentally sound, reliable, and maintenance-free, the conversion of solar energy into electricity is now being used in a variety of applications in the building, residential, commercial, and industrial sectors. Photovoltaic (PV) module technology has progressed to the point where it's now able to supply a considerable portion of a building's energy needs, paying off the initial capital investment and approaching grid parity—the point at which renewable electricity is equal to or cheaper than grid power.

As solar power moves forward, gaining on fossil fuels, manufacturers are suddenly faced with a growing number of choices when it comes to PV module products. With such a wide range of available options, how can manufacturers meet the unique challenge of choosing a product that meets their needs, as well as those of their customers? As most manufacturers can attest, there are a number of key factors that go into any purchasing decision, ranging from initial development costs to lifecycle performance. The ideal PV technology can deliver a combination of cost-effectiveness, efficiency, and durability.

With rapid technological advancements being made across the PV industry, new materials with unique benefits have recently been introduced to the market. One recent product innovation is ethylene-tetrafluoroethylene (ETFE) films for PV module components, such as frontsheets. As opposed to conventional materials, ETFE films allow PV module manufacturers to deliver a lightweight, high-performance product. Its benefits include increased production efficiencies, lower packaging and shipping costs, faster and easier installation, and enhanced performance properties. Starting with the production process and lasting throughout the product lifecycle, these performance characteristics provide a high level of value to PV module manufacturers and end-users.

Increased production efficiencies

In these challenging economic times, efficient manufacturing resulting in increased production can make a major difference in achieving higher profitability. Making the best use of valuable resources, including optimal energy use and reduced waste, are not only good for the environment but also for a manufacturer's bottom line.

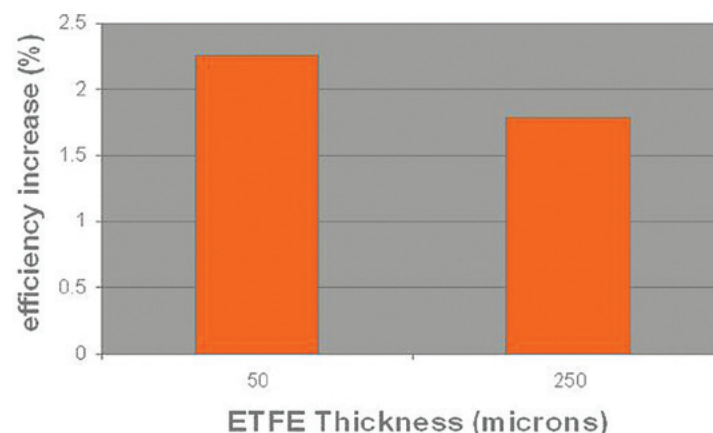
Focusing on production efficiency to increase overall profits, manufacturers cannot afford to waste valuable materials. With this in mind, there are now film options that include frontsheets systems, and which utilize the co-application of two films in one: ETFE frontsheets and ethylene vinyl acetate (EVA) encapsulant. Boosting production efficiency, such frontsheets systems do not require any alignment during the manufacturing process. When used together with EVA films in frontsheets systems, ETFE films exhibit reduced wrinkling, decreasing the amount of waste due to damaged, or unusable film. In addition, frontsheets systems are basically two rolls in one, further reducing packaging, shipping costs, and allowing for easier inventory management.

Faster & easier installation

Lightweight modules made with ETFE components are easier to install than their heavier counterparts made with conventional materials, requiring less time to put into action. Lightweight PV modules, made using ETFE film, are also easier to install from a structural load standpoint, requiring little-to-no additional structural support.

It's not uncommon for large conventional PV module installation projects to get cancelled or downsized due to weight restrictions on the roof. In regions that experience harsh weather conditions, roofs are subjected to the weight of conventional PV modules coupled with snow and wind load, as well, adding further structural burden. Some buildings are not even considered candidates for PV module installation projects, as they were

Efficiency increase of ETFE modules relative to glass modules, based on Isc



not built with the extra load capacity for conventional systems. As customer demand for more power per unit area increases, so does the burden on rooftop structure. It can be expensive and time-consuming to retrofit a rooftop. Lightweight panels made using ETFE film, coming in at roughly half the weight of conventional modules, allow installation projects to be completed as efficiently as possible, without modification to rooftop support structures.

Enhanced performance properties

The most important factor in purchasing any product—particularly one that end-users depend on for their energy needs—is performance. ETFE frontsheets provide key concrete performance benefits throughout their product lifecycle such as excellent light transmission, weatherability, low flammability, stress crack resistance, and insulating properties. These highly transparent films provide frontsheets weighing as low as 0.1 kg/m².

ETFE is more transparent than conventional materials, providing higher efficiency in frontsheets applications (see chart above). Modules made with ETFE and glass frontsheets were compared vis-à-vis for their efficiency. Both the 2mil and 10mil ETFE covered modules showed a comparative increase. Due to higher light transmission of ETFE, PV cells experience more amount of light resulting in higher generated power output. The chart compares this increased efficiency when a PV module is made with lighter and more transparent ETFE film frontsheets, as opposed to conventional glass frontsheets for a same sized module. This higher efficiency would result in less number of modules required to achieve the same power output.

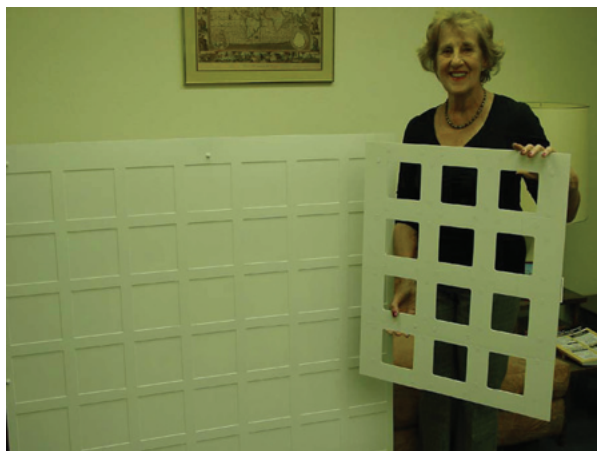
ETFE films also work well when used in tandem with other film products, such high-quality EVA encapsulants. EVA films provide adhesion to frontsheets and backsheets materials for both rigid and flexible modules, and strong electrical and mechanical properties. The increased level of long-term weathering and UV protection is vital in extending the power-generating capabilities of any PV module exposed to the elements.

PV modules using ETFE film components, providing a unique combination of cost-savings and performance, will ultimately help end-users achieve grid parity and move solar power into the mainstream.

Nikhil Bhiwankar is a research associate at Saint-Gobain Solar, which provides solar energy services by combining its traditional field of expertise, housing, and construction, with its solar technology know-how.

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Maximizing Efficiency of Solar Panels

The orientation of rooftop mounting systems

By Tim Fox

AS MORE COMPANIES ARE LOOKING to embrace the developments in solar power, one thing is clear: maximizing efficiency of rooftop solar panels makes good business sense and makes the most of the investment in the “green” energy solution.

The demand for solar panels and accessories has rapidly increased, and there is an abundance of options for mounting panels on a commercial rooftop. The selection of a mounting system can be a major factor in whether a solar panel system operates at its maximum efficiency. In general, designers know they need to install as many panels as possible in a given area. One question that arises during the design process is whether panels should be installed in landscape or portrait orientation.

Common thought suggests that choosing one orientation over the other will lead to an ability to install more panels over a given footprint—and maximize the output per square foot. With that goal in mind, it’s important to consider a mounting system that allows flexibility for either orientation to ensure maximum returns.

Landscape versus portrait

There are two primary issues that result in the debate between which orientation is optimal. The first issue is the number of panels that can be installed in a given length. Figure 1 shows the layout for a given row length, as well as the difference in the number of panels that will fit and may be installed. It’s possible to fit more portrait panels within a given row length.

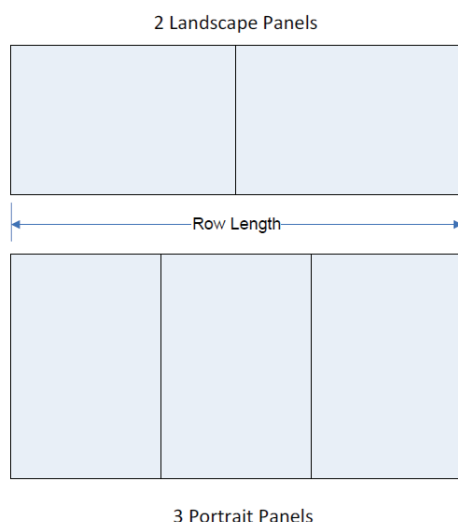


Figure 1 – Number of Panels per Row

The second issue is the number of panels that can be installed within a given height, and the primary consideration for this is the amount of shading provided by a given row. The shading distance is the minimum distance allowed between rows. This dictates minimum row spacing and, ultimately, the total number of rows available over a given space. To calculate shading distance and, therefore, row spacing, the “Solar Energy Handbook” suggests using the following equation as a method to determine the distance from the front edge of a panel in one row to the front edge of a panel in the next row: $D = \sin(\alpha + \Theta) * H$.

Herein, the variable (Θ) is the tilt of the panels, while the variable (α) is a function of the latitude of the installation and the optimal sun elevation. The sun elevation (α) can be found from a sun chart similar to the one published by the University of Oregon at: <http://solardat.uoregon.edu/SunChartProgram.php>. The variables (D) and (H) are described in Figure 2.

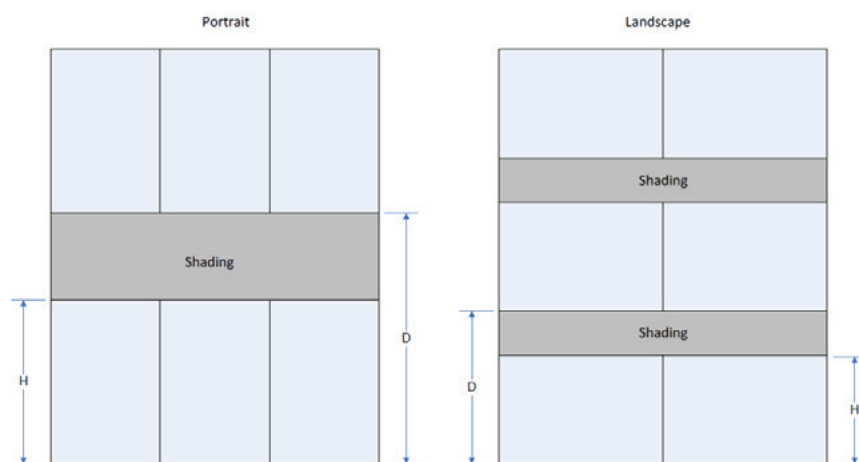


Figure 2 – H is dependent on orientation

As is apparent in the calculation of (D), the row spacing is dependent on the height of the panel and the degree of tilt. Therefore, to correctly calculate which orientation will optimize efficiency, landscape and portrait orientations must be evaluated to determine the relationship the panel height (H) has on the number of panels that can fit into a given area. To do this, it’s appropriate to determine the maximum number of panels (n) that can fit into a given area (A) in both landscape and portrait orientation. The end result is equivalent equations for landscape and portrait layouts, where,

$$n = \frac{A * \sin \alpha}{\sin(\alpha + \Theta) * L * W}$$

showing no correlation between the number of panels in a given space and the orientation of the panel.

In summary, because panels can be in landscape or portrait orientation with virtually no affect on the quantity of panels that can be installed, there’s no difference on array efficiency over a given rooftop space or a given ground space. Efficiency optimization decisions should be based on optimizing panel efficiency and racking systems, rather than on the number of panels dictated by a particular orientation.

Tim Fox is a solar market manager for Cooper B-Line, a subsidiary of Cooper Industries, which is a global provider of labor-saving support systems and enclosure solutions for engineered facility subsystem applications.

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Eaton's S-Max series grid-tied solar inverter is designed to maximize customers' energy harvest, operate reliably in harsh environments, and adhere to high safety standards. The 250-kilowatt (kW) grid-tied solar inverter converts sunlight into clean alternating current (AC), and is Underwriters Laboratories (UL) 1741 listed for 600-volt direct current (DC) and three-phase utility interactive operation. The S-Max Series grid-tied solar inverter is based on Eaton's PowerChain Management solutions, which incorporate programmable logic controllers (PLCs), advanced variable frequency drives, and protective relays. At the heart of the S-Max 250 kW grid-tied solar inverter is the Eaton active front-end (AFE) technology, which reliably operates in harsh environments with 24/7 operation cycles over decades. Emphasizing maximum energy harvest, Eaton S-Max Series has a 96.5% efficiency rating from the California Energy Commission and a greater than 99% accurate Maximum Power Point Tracker (MPPT) efficiency.

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The new "Coolcept" inverter topology, with a circuit design for high efficiency, has been integrated into the StecaGrid 3000 and StecaGrid 3600. The "Coolcept" inverter topology is based on a single-stage transformerless switching concept that uses proven, standard components to implement symmetric step-down converters with downstream pole-reversing circuits. A peak efficiency of 98.6 % means less lost power that must be dissipated into the environment, and improved yields. The efficiencies of the StecaGrid 3000 and StecaGrid 3600 are only slightly dependent on the module input voltage. This allows the number and type of modules to be freely selected without resulting in a yield loss. In addition, a new cooling concept inside the inverter ensures an even distribution of the dissipated heat and a long service. The high efficiency also allows use of a design housing made of plastic, which keeps the overall surface temperature of the StecaGrid 3000 and 3600 very low. The inverters have protection Class II. Also, these products have a graphical LCD display for visualizing the energy yield values, current performance, and operating parameters of the system.

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outcomes. ModSolar is the only platform in the renewable energy industry with a mobile proposal generator. Now you can generate a proposal in the office or on the go, anywhere, and have it available whenever and wherever you want, as long as there's an Internet connection.



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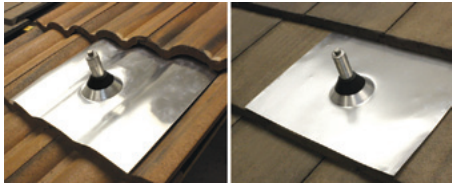


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Universal mount for tile roofs

Quick Mount PV has begun shipping orders of a new, double-flashed Universal Tile Mount designed for use on virtually any flat or curved tile roof. It replaces Quick Mount's Curved Tile Mount. The Universal Tile Mount uses a base-and-standoff mechanical attachment, and spun aluminum primary and secondary flashings to achieve industry best strength and waterproofing. The mount derives much of its strength from the cast aluminum QBase, featuring an inch-deep, reinforced flange engineered to secure the mount's seven-inch stand-off against an average 775 pounds of shear force. The double-flashed design includes a spun aluminum, cone-type primary flashing at the deck level to form a tight, waterproof shield around the QBase, and fasteners. The malleable top flashing is extra large and can be shaped to conform with any roofing profile. Patents are pending.

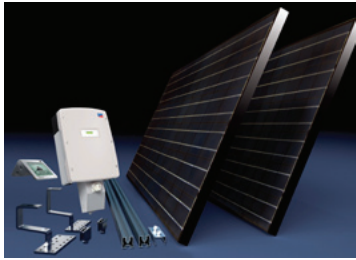
QuickMount PV
www.quickmountpv.com



Junction box

TE Connectivity (TE), formerly Tyco Electronics, introduces a new product for thin-film solar modules: the SOLARLOK 1-rail junction box. It's the ideal solution for PV modules in which the positive and negative leads each have their own access point. One small, flat junction box can be installed in two different places on the back of such panels. The new design of the junction box requires potting. The SOLARLOK 1-rail junction box is 58mm x 30mm large, and 13mm high. It can be installed quickly and discreetly, and is also suitable for building-integrated PV systems. With this solution, module manufacturers can save not only two-thirds of the wiring, but can also offer customers better-looking panels.

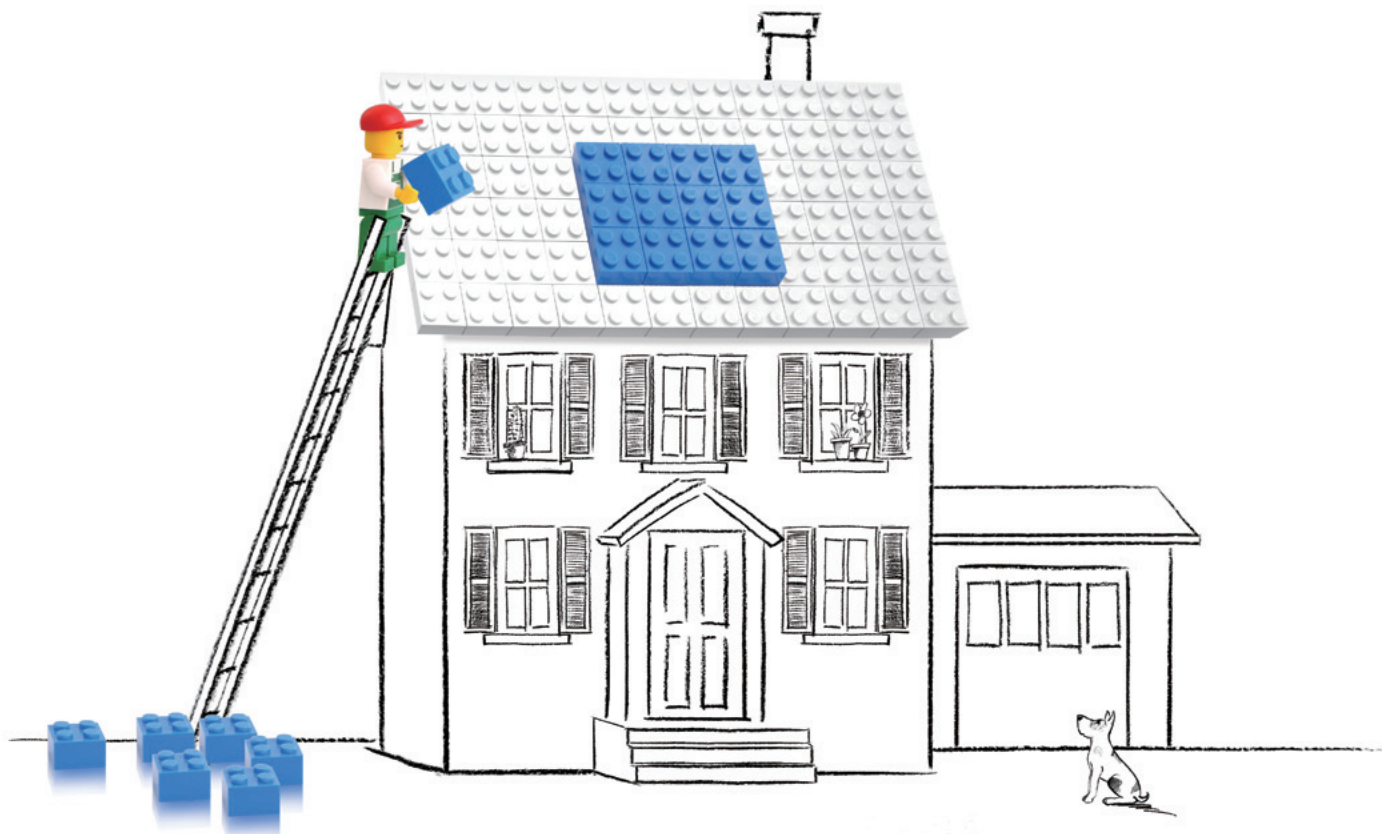
TE Connectivity | www.te.com/solar



Pre-engineered PV kit

Siliken has launched its newest product line: "energyBox" is a pre-engineered PV kit that includes all the major components for a grid-tied residential solar system. The flexibility of the system allows users to design and install custom layouts on any kind of rooftop. High-quality components guarantee the maximum energy yield in a cost-effective, compatible solution.

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Solar Cogeneration: Highest Utilization of the Sun's Resources Renewable heat & electricity in one

By Dr Gilad Almogy

OVER THE LAST DECADE, technology advancements coupled with rebates and incentives have made “going green” not only an environmentally responsible choice, but also a strategic, cost-saving business move. However, while renewable energy can be an effective solution to meet sustainability objectives and improve the bottom line, selecting the right technology can be an exhausting process.

The two fundamental solar technologies, solar photovoltaic (PV) and solar thermal, are valuable energy resources. So, why choose between the two? With solar cogeneration, a need for electricity and hot water are met in a single array. The dual production of energy in both forms results in payback times that are typically one-half that of standalone PV or solar hot water systems.

How it works

Solar cogeneration combines proven PV and solar thermal technologies to maximize total collected energy and optimize economic benefits for institutional, commercial, and industrial customers. Using up to 75% of the sun's delivered energy, a cogeneration solution captures excess heat that standard PV panels dissipate as waste, and transfers the heat away from the solar collector to produce useful, hot water.

This technology improves upon pure PV systems, which are still only 15% to 20% efficient and waste nearly 80% of the sun's usable energy. Cogeneration technology, in contrast, uses up to 75% of the delivered energy with the added benefit of cooling the solar cells in the process—thereby, improving cell efficiency, which otherwise drops with elevated temperatures. By transferring heat away from the PV cells to produce hot water, solar cogeneration increases electricity output, while extending the output and lifespan of a system.

Where it works

Solar cogeneration technology addresses an existing, but underserved market: industrial, commercial, and institutional facilities that use hot water for a variety of applications. According to 2007 data from the Department of Energy's Energy Information Administration (EIA), the United States consumes 315 billion therms per year in heat usage (commercial customers typically pay around \$.75 to \$1.20 per therm—an enormous expenditure). Solar cogeneration can economically reach applicable temperatures to address between 30% and 50% of the nation's thermal energy needs.

Facilities that fall into this market include energy intensive industrial sites that process food, beverages, textiles, paper and pharmaceuticals, among others, as well as institutional sites that house communities of people such as dormitories, military bases, multi-tenant housing complexes, hotels/resorts, and hospitals. The electricity generated is fed directly to a building's existing power supply, while hot water is used for a range of applications, such as washing and amenities, pasteurization, as well as fermentation and boiler pre-heating, to name a few.



The future of solar

The current global commercial and industrial solar hot water market is estimated at more than \$18 billion USD and is expected to continue to grow, exceeding 25% growth per year to nearly \$30 billion USD during 2012 and 2013.

Reducing operating costs, today and into the future, is a major goal. Solar cogeneration solutions result in natural gas (or LPG) and electricity savings, while helping businesses achieve sustainable supply-chain and greenhouse gas reduction goals. Implementing renewable energy solutions also helps customers achieve LEED qualification points and Energy Star ratings.

Another important driver is government mandates for renewables. For example, the 2005 Energy Policy Act requires existing and new federal facilities—prisons, military bases, public hospitals, etc.—to offset 30% of the energy used to heat water with solar thermal where economically feasible. Other solar thermal incentive programs include NYSERDA, California Solar Initiative (CSI), and REC and tax credits in Arizona, North Carolina, and Hawaii. Solar cogeneration technology is uniquely eligible for solar electric and thermal state incentives, in addition to

federal programs, such as the Section 1603 treasury grant/investment tax credit (ITC) and accelerated depreciation, offered for renewable energy projects.

Upfront costs can be considerable, but are no longer a hurdle to adoption. With the recent availability of PPA (Power Purchase Agreement) financing models specific to cogeneration, called HPPAs, or Heat & Power Purchase Agreements, industrial, institutional, and commercial customers can benefit from a dual-power generation solution from day one, locking in fares below utility rates.

Solar cogeneration technology for commercial and industrial applications is a relatively new development, evolving from primitive solar hot water collectors, dating back to before 1900, and comprised of a black-painted tank mounted on a roof. Separately, both traditional solar technologies have been refined and commercialized, so that today customers can benefit by generating electricity and hot water in the same solar architecture—combining existing technologies and mature supply chains. The solar electric and thermal elements form a symbiotic relationship, working in tandem to improve overall system performance and increase energy output at a low cost per energy produced.



Dr Gilad Almogy is the CEO of Cogenra Solar.

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By Greg Smith

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AS THE NORTH AMERICAN solar industry grows, so will the necessity for a safe, efficient, and effective workforce. The kind of training required for this field is as varied as the backgrounds of the people who are making the leap toward a future where renewable energy will compete with oil, coal, and nuclear power. Many news sources report significant growth for the PV industry in 2011, with most estimates exceeding 40%. It stands to reason, therefore, that the demand for trained installers, roofers, electricians, designers, engineers, and salesmen, etc., will also increase.

Someone making the transition to the solar industry without any applicable experience will have many specialties to consider, such as the design, installation, operation, and maintenance of PV systems—all of which require specific types of training. Roofers and electricians, however, tend to make this transition fairly easily as they have requisite knowledge and transferable skills set, and only require PV-specific training.

The direct or indirect goal of most formal PV training programs is to prepare solar professionals for the North American Board of Certified Energy Practitioners (NABCEP) certification.

According to NABCEP, this credential is the “gold standard” of the PV industry and boasts an impressive framework dedicated to safe installation practices and the promotion of consumer confidence. Solar professionals want home owners, plant owners, and utilities to feel safe and confident that the power plants installed on their properties will not only operate correctly, but will also make power safely for 20-plus years. Of course, not everyone in the business needs to earn the NABCEP certification, but it does add credibility, especially to professionals in emerging solar markets.

Resources

- North American Board of Certified Energy Practitioners
www.nabcep.org
- Solar Energy International Training and Workshops
www.solarenergy.org/solar-training-renewable-energy-workshops
- Boots on the Roof Courses
www.bootsontheroof.com/renewable-energy-courses
- CanSIA Training Web site
www.cansia.ca/training-employment
- Bill Brooks Training
www.solarabcs.org
- Mike Holt Code Training
www.mikeholt.com
- John Wiles Code Training
www.nmsu.edu/~tdi/Photovoltaics/Codes-Stds/C-S-Resources.html
- Solar Power International
www.solarpowerinternational.com
- Intersolar North America
www.intersolar.us
- CanSIA Conferences
www.cansia.ca/solar-conference-1



Finding the right training program

The first place to look for PV training is through formal learning institutions. Many community colleges and trade schools have renewable energy programs with solar-related classes. California, for example, has more than 112 community colleges offering some type of solar training with certificates and degrees awarded after program completion. A quick Internet search should yield a similar list of local facilities or programs.

Other options include professional solar industry training organizations, which offer programs for almost every specialty and are typically comprehensive in course delivery and design. The most successful offer a wide selection of hands-on training and online programs tailored to specific areas of renewable energy (check out the list of “Resources” for some examples). Keep in mind, many training organizations can be found online, but it’s important to select one that’s accredited to build a credible portfolio of program certificates.

These types of resources also are available to solar professionals in Canada. The Canadian Solar Industries Association (CanSIA) has a list of colleges and institutions offering solar classes and, similar to the United States, many Canadian professional organizations are answering the call for training.

For specialties such as PV design, training or installation, courses targeting the National Electric Code (NEC) or the Ontario Electrical Safety Code (OESC), which has more specific requirements than the Canadian Electrical Code, are vital. In Canada, the Electrical Safety Authority offers classes on electrical safety, code compliance, and PV to get attendees acquainted with the nuances of installing solar.

The last area of training comes directly from solar equipment manufacturers. Product training ranges from marketing to installation, and from sales points to in-depth technical data. Most people think of product training as being just about inverters and solar modules, but there are many more areas of PV installation that require special training. In addition to learning or keeping up-to-date on NEC, installers need racking and flashing skills along with electrical safety train-

ing. Those installing large central inverters may require something more specialized with OSHA-approved arc flash instruction. To perform a site survey, solar professionals need to learn how to use pyrometers, shade evaluation tools, and software imports. System designers require classes about the latest string sizing programs, while proficiency with data logging and visualization devices necessitates yet another course.

Luckily, many large solar distributors often gather solar equipment manufacturers together for various trade shows and exhibitions, which are a great way to network, share information, and discuss the many facets of the solar industry.

Greg Smith is a technical training specialist for the SMA Solar Academy.

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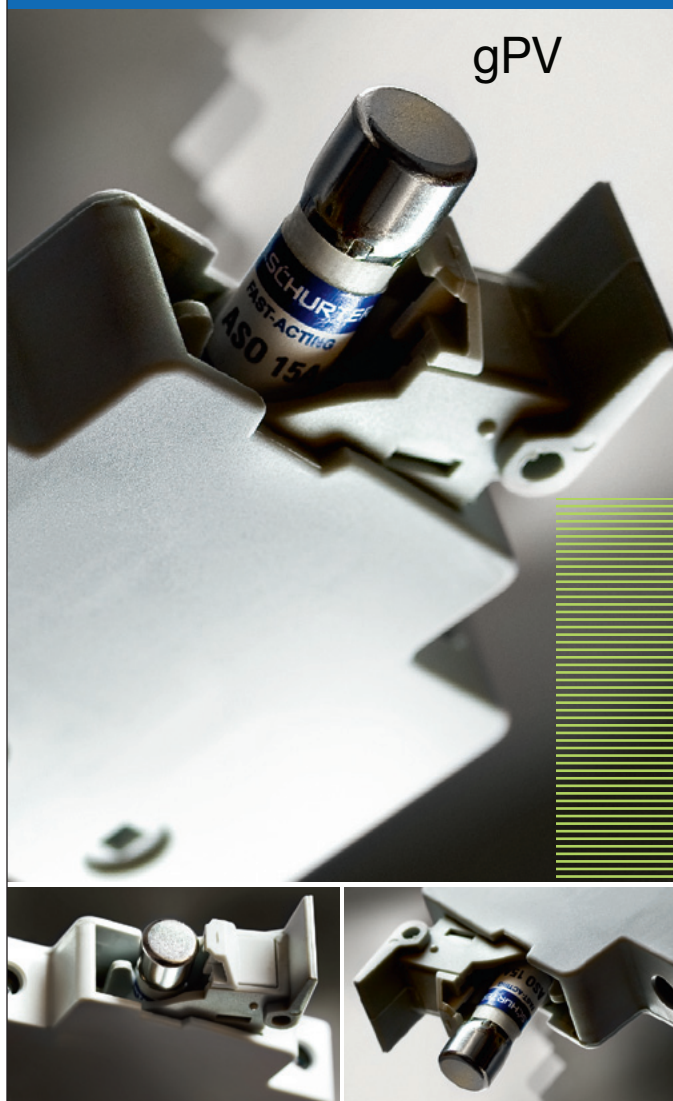
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* Bosch Solar Energy AG guarantees that the modules will yield at least 80% of the declared output over a period of 25 years.



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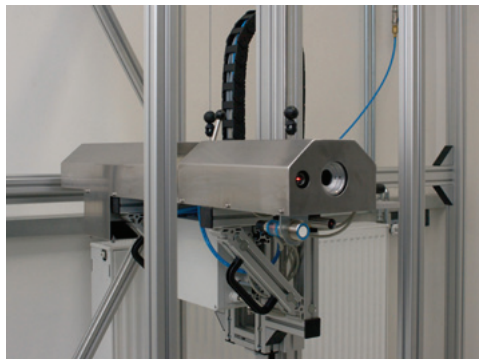
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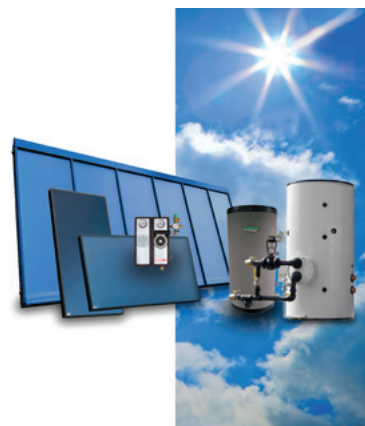
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Hail impact test stand

The new Hail Impact Test Stand of the German PSE AG (currently installed in New Mexico) is used to verify if solar modules and thermal collectors withstand the impact of hailstones. PSE has developed the technology in close cooperation with Fraunhofer Institute of Solar Energy ISE, Germany. The Hail Impact Test Stand can be equipped with 25mm, 35mm, and 45mm ice balls to test various situations beyond the standard conditions. The test sequence determines collector resistance to hail impact at speeds even over 100 km/hr. The molds for the ice ball production are part of the product. Institutes and manufactures are now able to perform the testing and certification of PV modules according to IEC 61215 and IEC 61646, as well as thermal collectors according to EN 12975.

PSE AG | www.pse.de



Commercial solar thermal systems

Lochinvar Corporation and TiSUN have joined forces to bring new solar thermal systems to the North American commercial market. Combining cutting-edge technology and quality with a distribution and service network, this collaboration provides mechanical and plumbing design engineers and contractors the opportunity to offer clients advanced renewable energy solutions. The Lochinvar/TiSUN product offering includes solar thermal panels specifically engineered and designed for commercial use, solar thermal storage tanks, pumping stations used to control and move the solar energy throughout the system, as well as an array of system accessories.

Lochinvar Corporation

www.lochinvar.com



PV & silicon wafer monitor

MKS Instruments, Inc. has introduced the GLM-2000 PV and Silicon Wafer Monitor for quality control in PV and crystalline silicon wafer processing for solar applications. The multi-function GLM-2000 uses a unique, high speed, non-contact RF detection technology to measure photoconductance in PV and silicon feedstocks and partially processed cells, either in-process or post-process. The GLM-2000 metrology tool employs a novel implementation of the current RFPCD measurement technique to instantaneously measure sheet resistance, minority carrier lifetime (Gtau), photoconductance decay (PCD), and photoconductance rise (PCR)—key quality control parameters for PV processing. The GLM-2000 employs a programmable LED array that permits measurements at different light intensities, allowing the user to determine the true steady state minority carrier lifetimes. The use of LEDs also allows flexibility in the choice of light color and this can be useful in distinguishing surface effects from bulk characteristics. The flexibility of the sensor design permits easy integration into the production line as either a standalone benchtop unit or integrated within OEM or custom system components.

MKS Instruments, Inc. | www.mksinst.com



Supports for rooftop solar arrays

New from Legrand, Delta Strut is the only solar panel support system that integrates solar panel support framing and cable management into one support. The welded-wire, open-structure design reduces wind drag and incorporates the cable pathway close to the panels, so cables are less likely to be damaged by wind and are shielded from direct sunlight. Also, there are no water or debris catch-points that require future maintenance or cleaning. Delta Strut is tested to support utility-grade solar panels in 150mph winds and for extreme snow loads. The Delta Strut system is designed to be easy to install—all support hardware is shipped pre-engineered for each building and sun angle, so no engineering on the jobsite is needed. Delta Strut is RoHS compliant so the entire system qualifies for LEED points.

Legrand | www.legrand.us/deltastrut



Dual-axis solar trackers

TITAN TRACKER has just finished a new generation of dual-axis solar trackers achieving a cost reduction of about 30%, thanks to relevant improvements such as centralization of its elevation driving and reduction of the man-hours required in manufacturing. The firm is specialized in the design, manufacturing, and commercialization of dual-axis trackers not only for conventional flat-plate PV, but also for Concentrating (CPV), Concentrating Solar Power (CSP), tower, and Stirling. These new products also include the highest performance and technological advantages of the TITAN concept, such as more energy yield—up to 45% more than fixed systems (30° tilt to South) in 40° North latitude in conventional PV, as well as accuracy that's better than 0.01° in Concentrating PV, CSP, tower, and Stirling.

TITAN TRACKER
www.titantracker.es



Single-axis solar trackers

Sunflower Energy continues to increase their solar product offering by adding the single-axis solar tracker to their line. The single-axis tracker allows PV panels to track the sun from east to west, increasing the module's energy production by up to 25% or more depending upon the latitude of the installation. These cost-sensitive, robust trackers are designed for durability and ease of installation. The one-axis trackers operate on an astronomical method, and are easy to program. Wind sensor ports are available, which allow the tracker to move to the stow position under a pre-set wind load. Additionally, the RS485 communication input ports are designed for programming the tracker's remote control.

Sunflower Energy
www.sunflowerenergyinc.com



Solar inverters

Eltek Valere offers THEIA HE-t PV inverters with the highest efficiency among isolated inverters—at 97.3% (97% CEC)—and a built-in web server requiring no additional software or costly adaptors. THEIA HE-t inverters sport a dynamic color display with a touch-sense screen for easy monitoring and commissioning. They accommodate a wide input range and, at only 44 pounds, allow for installation by just a single person. Eltek Valere THEIA HE-t inverters are made in North America, are ideal for Ontario FiT programs, and will be commercially available this summer.

Eltek Valere | www.eltekvalere.com/theia



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Microinverters: The Next Big Thing in Solar PV

By James Washburn

Given that solar-photovoltaic (PV) generating technology has been around for decades, one might think its general application in commercial and consumer circles might be a little more pervasive. After all, it's clean, safe, and relatively simple. Ask any expert and it's likely you'll get a litany of reasons why it hasn't gained more general acceptance. Implementation costs, tricky installation aspects, long ROI, and performance and reliability issues name just a few. However, there's now game-changing technology available that's ready to push solar PV's acceptance and application past many of the current barriers—microinverters.

Inversion technologies 101

Solar-PV modules produce DC electricity, which typically needs to be inverted to AC before use. The traditional method to invert this power involves string-inverter systems, which combine the energy from various modules in an array on the DC side of an inverter, inverting them to AC all at once.

Microinverter systems for solar PV inversion move the inversion capacity from a single inverter to multiple smaller inverters, immediately located to each PV module. These are connected in parallel on the AC side of the inverter, and connected to the utility system to create a grid-tied system. The technological benefits and applications for such a product make it an attractive choice for PV inversion.

As required by electrical code, microinverter systems on the market today include utility interactive phasing and anti-islanding technologies. Utility interactive phasing allows inverters to properly synch with the utility power that's present. This is accomplished by "pinging" the utility power with a waveform that's slightly different from the utility waveform, and measuring the "push" that's received back. If utility power isn't detected, these systems automatically disconnect AC-power production, a process known as anti-islanding. This is done to protect utility workers who would be under the impression that no power is present when the utility system is down.

Technology with benefits

Microinverter installations offer users many benefits including increased energy output, improved electrical safety, ease of system design and installation, and more precise monitoring capabilities.

The same can't be said with string-inverted systems. With a typical string inversion system, every module in a string is limited by the weakest performing module. For example, if a single module is partially shaded and loses 50% of its output, every module on that string becomes limited to the same 50% output.

More power, more safety

In a microinversion system, each module becomes an independent power-producing unit, and if one module is reduced to 50%, the other modules aren't affected. Because the balance of the string is still producing at full capacity, more energy is harvested from the same modules. Microinverters also offer improved safety as a result of the reduction of scale in the DC side of the system. Most installers are more familiar with AC wiring and AC arcing, and grounding conditions, which are less dangerous and easier to isolate and control than DC arcing and grounding conditions. In a microinverter installation, the amount of DC wiring is reduced to virtually zero.

As there isn't any interaction between modules, installers aren't required to balance systems. That means system designers and installers can use whatever roofs face the sun at any given time (or sun position), and be less concerned with the angles. The design is not as limited by shading issues. Although any of these will affect the performance of an individual module, a microinverter system as a whole can create usable power in layouts that a string inverted system would struggle to match in size and complexity.

Users are also getting more sophisticated and are more frequently requiring the ability to monitor the energy production of their solar PV installations. With a string inversion system, most users are only able to measure total system production as produced by a single inverter. With a microinversion system, each module can be monitored independently, making maintenance and upkeep simple and straightforward.

To eliminate any communications wiring needed to accomplish module-level monitoring, most microinversion systems utilize a power line carrier (PLC) signal. This allows a communication signal to be sent out over the electrical conductors used to carry the power that's



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For shade-prone jobsites, microinverter systems give installers more flexibility in installation location and usable roof area. On the roof of a typical factory, for example, there are rooftop AC units, ventilation systems, and other obstructions such as smokestacks, trees, and tall buildings nearby. Such obstacles present a challenge to string-inverted systems; however, microinverted systems can take advantage of the space as the system isn't universally affected by efficiency loss.

For many installations with non-traditional layouts or rooflines, the varying angles present a problem for string-inverter systems. For those systems to function at their peak, all the modules need to have relatively the same intensity of sunlight. This forces all modules to be mounted at the same angle of incidence of sunlight, while facing the same direction.

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Microinverter-based installations are also inherently scalable. If a facility owner wants to increase the capacity of the solar PV system at a later point, adding modules incrementally is as simple as extending the AC cabling to the next array or set of modules. This is critically important for those enterprises that are in high-growth industries. Capitalizing on advanced monitoring capabilities, the arrays or individual modules across multiple installations can be merged into a single monitoring package. This makes monitoring campus or distributed systems much simpler. Each array can be grid tied independently, then monitored as a bundled, single installation.

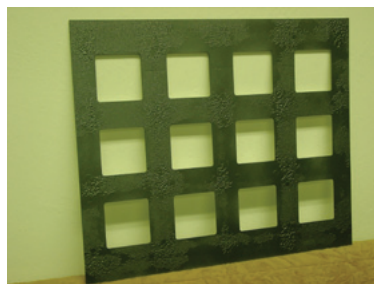
James Washburn is the product manager of Renewable Energy Products at Siemens Industry, Inc. and Building Technologies (a division of Siemens Industry).

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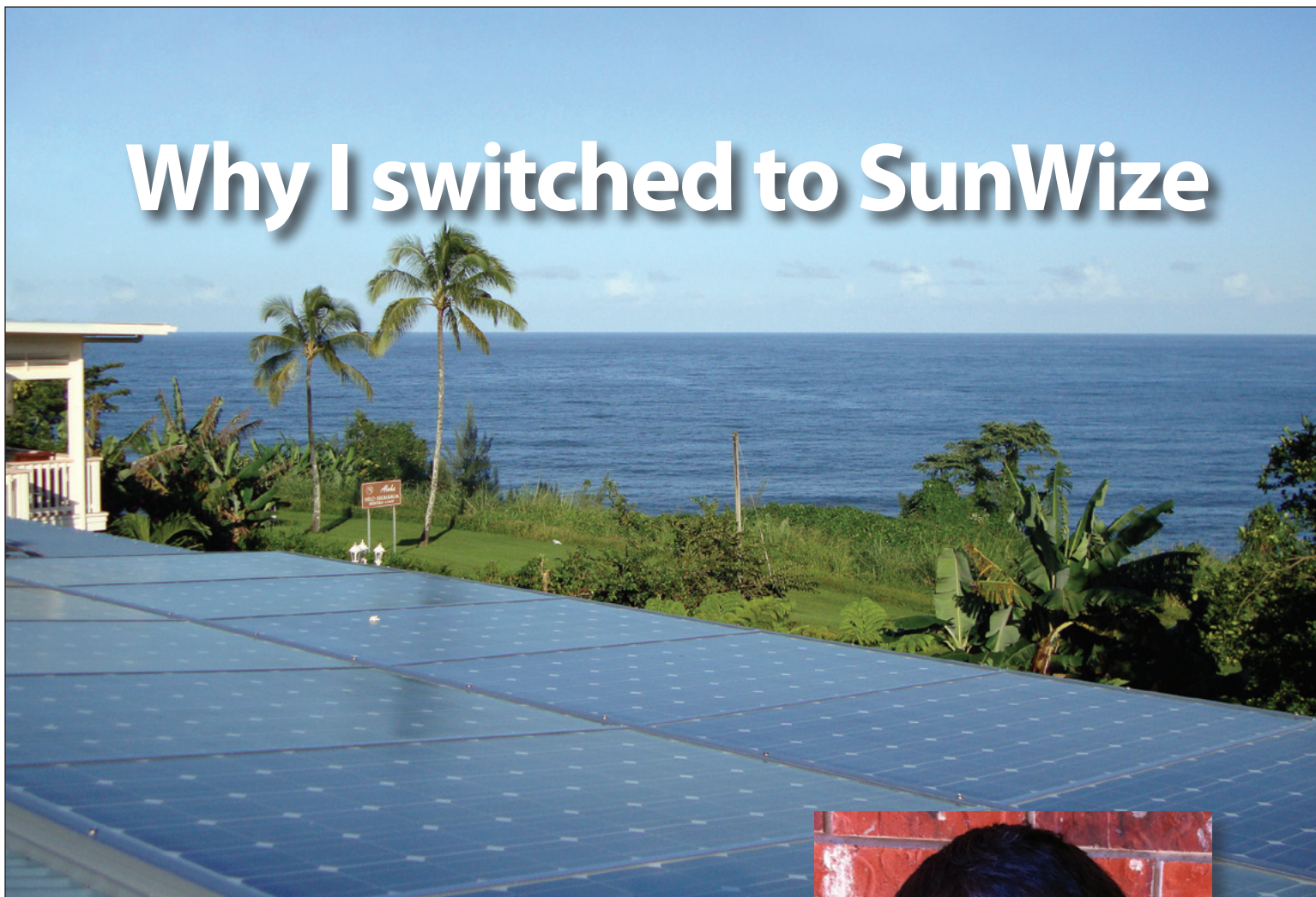


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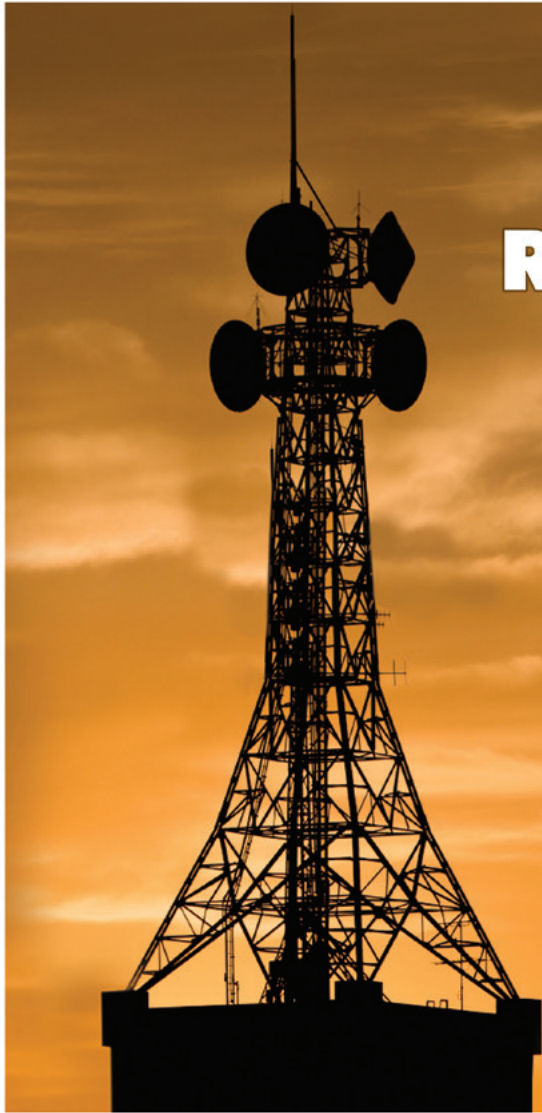
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IND23-4V	977	1233	1500	4 VOLT
IND29-4V	1245	1570	1910	4 VOLT

Existing Conditions*Photographic Simulation of Proposed Wind Farm*

Wind Farm Siting & Design Appeal

Getting an accurate picture

By Tom Neer

WIND FARM SITING VARIES throughout the US. In the Great Plains states, wind farms are generally accepted for multiple-use, allowing farmers and ranchers to utilize their land more effectively. The low population densities and lack of substantial terrain relief of the Great Plains states varies dramatically from the densely populated areas of the eastern states, and the topographic relief in the western states. The siting of wind farms on ridgelines, or near population centers, runs into a unique conundrum where the wind farms are appreciated for their clean energy—but, often times, as long as it's "not in my backyard" (NIMBY). This has led to wind projects being significantly delayed, primarily due to visual aesthetic concern rather than ecological issues.

Though many environmental constraints can be mitigated, the subjective nature of visual aesthetics is making this one of the

key sticking points for proposed wind farms. With plans to reach 20% wind energy by 2030, it's inevitable that wind farms will become more contentious due to visual aesthetics as a fallback for "NIMBY-ism." Integrating aesthetic considerations during the design phase will not remove all concerns, but will hopefully mitigate many stakeholder concerns and provide defensible documentation that visual aesthetics were considered throughout the project design process.

As with any environmental constraint, the acquisition of resources and reference materials are integral to the design process. The same is true for visual resources. Acquiring site-specific and regional maps, relevant environmental documentation, environmental or design regulations, and recreational or tourist information are highly recommended. General site and regional maps, such as USGS and BLM topographic maps, and US Forest Service maps, provide information about the topography, cultural, and environmental features within the project area. Past relevant environmental documentation, such as environmental assessments or impact statements, offers detailed insight into criteria important to the lead agency, stakeholders, and the public. Environmental or design regulations, such as the BLM Visual Resource Management System or US Forest Service Scenery Management System, will guide the placement of turbines and describe sensitive areas.

If possible, it's highly recommended to obtain the scenic inventory notes that were used to classify specific visual resource management areas. Although, unless a resource management plan has recently been completed, such documentation tends to be tough to find. Generally, the most helpful information can be gleaned from either the local Chamber of Commerce or Tourist Bureau. Not only are these good places to find local recreation opportunities, but also a good place to get a sense of the local recreational and population vernacular. In rural locations, it's not uncommon to have unofficial recreation spots. These resources are often overlooked, but should not be. Many inquiries can be done anonymously, without exposing project details, and while obtaining valuable information.

Seen-area and viewshed analysis conducted from sensitive locations (population centers, recreation areas, etc.) are an invaluable tool to assist in the siting of turbine strings. This not only allows upfront knowledge of what may or may not be visible, but also allows engineers to utilize natural terrain features to mask portions of the development. By combining multiple seen-area analysis, areas of visual optimum and minimum can be generated.

Utilizing the viewshed analysis and reference materials, regions around the project are identified for photographic inventory. At this stage, it's important to involve who-

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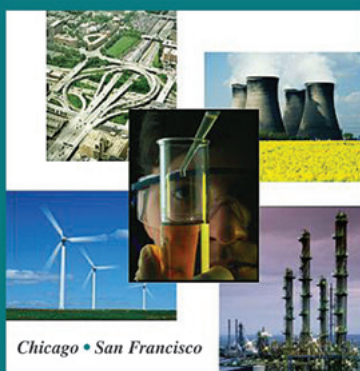
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ever will be producing the photographic simulations. Photographic inventories should be zealously shot to reduce the necessity of multiple field visits, even though only a small percentage may be used for photographic simulations or determined as key observation points. The process to capture photographs for simulation purposes is fairly involved. It requires capturing images at a specific focal length, determining the appropriate field-of-view for panoramic shots, knowing the exact position and time of day, and accounting for issues such as parallax error and additional field-of-view measurements to assure accuracy of the final product. The photographic inventory is used, in part or whole, to determine key observation points from which photographic simulations are prepared for the alternatives—usually, in conjunction with the lead permitting agency.

Many projects skip the importance of including visual aesthetics during the design process of a project, and they are left to the last minute during the permitting phase. The result could lead to getting an application filing and having the lead agency request additional information, which will inevitably delay the permitting approval. Active participation and interaction between the developer, lead developer, and the public goes a long way toward final approval of a project. By integrating visual resource early in a project, one can proactively take hold of their wind power project from the beginning and avoid unnecessary delays.

Digital Data Services, Inc., is a geospatial service bureau combining technology, proprietary processes, and procedures to produce geospatial products and services including visual resource assessments, photographic inventories, viewshed analysis, and more.

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Developing & Regulating Wind Energy Projects

By PJ Saliterman & James Damon

FOR THE BETTER PART OF THE LAST DECADE, as commercial wind energy projects have spread beyond sparsely populated California deserts and west Texas mesas to more populated areas, host communities have often struggled to arrive at fair and balanced siting rules that protect the safety, rights, and enjoyment of residents without choking a sustainable form of economic development. Each state has drawn on its land-use control traditions (e.g. Home Rule or Dillon's Rule) to create its own framework for such deliberations, ranging from township and county boards to state-operated boards and public utility commissions. The one constant element involved in these deliberations is the stakes—wind development means big change from a land-use and economic development standpoint.

Both sides of the siting debate have stances on the appropriate venue for wind energy regulation, and each side has valid points. Advocates for state-level adjudication make the case that it's not unusual for decision makers at township or county levels to have blood relatives and lifelong friends that either stand to gain financially, or lose peace of mind, depending on the regulations imposed. They often argue that public disclosure of these potential or perceived conflicts, while preferable, does not necessarily make them less of a factor. They also point to the mismatch of resources between the developer and the township as evidence that townships lack the sophistication, or capacity, to critically evaluate potential impacts from wind farms.

Advocates for keeping siting decisions in the host community argue that host communities can hire their own technical experts, usually at the developer's expense, and that residents of the host community are more appropriate judges than decision makers in a distant capitol of the pros and cons of wind-based economic development. Both sides might agree, however, that without a well thought-out process that fully incorporates stakeholder input, special interest groups can unfairly influence the debate.

Against this backdrop, many states, counties, and local municipalities have taken a variety of steps to mitigate potential conflicts, prevent public/private minutiae, and provide a streamlined permitting and review process. In Ohio, for example, the Ohio Power Siting Board (OPSB), a division of the Ohio Public Utility Commission, has permitting authority over projects exceeding five megawatts of installed capacity. With 88 counties and hundreds of township zoning boards, Ohio faced a unique challenge for how to create a regulatory environment that provided certainty to the developer, while respecting local planning laws, cultural traditions, and stakeholder viewpoints.

In a two-year process that began with the Ohio Wind Working Group (OWWG), a multi-stakeholder working group funded by the US Department of Energy's Wind Powering America program, participants formulated recommendations, which were used as the framework for state-enacted policy. Ohio House Bill 562, signed by Governor Ted Strickland on June 24th, 2008, directed the OPSB to adopt certification rules for the construction, operation, and maintenance of wind-powered electric generation facilities. Development is underway in Ohio, with the first utility-scale wind farms expected to be operational by late 2011.

Similar state-operated permitting regulations exist in other states, as well. In 2007, the Public Service Commission of Wisconsin promulgated a model wind ordinance, which provided a framework for wind energy facilities' regulation by towns and counties in the state. Since then, installed wind capacity in the state has grown from 53 MW to 469 MW, as of the end of 2010. This incredible momentum may soon be halted though.

On March 1st, 2011, the Wisconsin Joint Committee for Review of Administrative Rules (JCRAR) suspended the Wisconsin Wind Siting Rules, known as PSC128, on the same day they were set to take effect. The rules were developed using a two-year, multi-stakeholder driven, collaborative process that utilized the best available science to reach a consensus-based product. Further compounding this policy decision, Wisconsin Governor Scott Walker introduced the Wind Siting Reform bill, which would require wind turbines be located no less than 1,800 feet from the nearest, non-participating landowner's property line. Although the state legislature did not yet schedule a vote on the bill, his act further illustrates Wisconsin's lack of commitment to a balanced permitting process.

On the heels of this news, a major wind company canceled plans to build a 100 MW facility in the state, further stating, "We'll increase our development efforts outside Wisconsin, in states that offer more regulatory certainty." This retreat from Wisconsin should serve as a warning sign that a fair regulatory process is a critical piece to the wind development process. In a time of economic instability in the US, regulatory certainty in the wind development process is more crucial than ever.

Whether permitting authority rests with local zoning boards or is granted to state-operated siting agencies, the process for which projects are reviewed should be developed by the types of guiding principles used to draft the now suspended PSC128—a process designed to insulate permitting decisions from political influences and to provide a high level

of standardization and certainty in the process.

In reality, it's virtually impossible to separate politics from technical deliberations in arriving at siting criteria for wind projects. Increasingly, communities are acknowledging the *quid pro quo* nature of these debates. They are often focused on maximizing economic benefits and are using their siting authority to extract these benefits. This further underscores the need for collaboration on such key issues. Stakeholder-driven processes, such as this one, are designed to anticipate key issues and their connections to future conflicts, while separating political and economic interests of the few.

Without a regulatory approval process in place, which supports the industry and responds to stakeholder concerns, wind energy development faces an uncertain future.

PJ Saliterman is a senior project manager, and James Damon is a project developer at OwnEnergy.

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Ground-based Wind Remote Sensing Systems Gaining Momentum

By Lee Alnes

AS A COMPETITIVE AMATEUR SAILOR, dealing with wind variability has become commonplace. Listening to the trees every summer morning, one learns the aspens and birches lie about the wind. Oaks are pretty reliable. But when it comes to something more important than a sailboat race—like operating a wind farm—you'd better have some professional wind monitoring equipment. Rustling leaves are hardly “bankable,” and knowing which way the wind will blow, how hard, and for how long, in conditions that can turn millions of dollars worth of equipment into junk in seconds is mission-critical.

Modern wind sensors have a tough job, as do the companies who use them. Windlab Systems started developing wind energy sites seven years ago, and has lived through the experience—multiple times and multiple places. From Australia to South Africa, to Canada to the US, Windlab's tower-mounted instruments have been pummeled by wind, iced over, struck by lightning, and knocked down. Birds have used tower-mounted instruments as perches, and they've even been infested by ants.

“On one of our sites in Australia, a kookaburra bird ate the cups off the top anemometer on our tower,” said company co-founder Nathan Steggel. “That was an expensive repair.”

Many of these obstacles either originated with, or were aggravated by, the wind industry's continued reliance on tower-mounted instruments for gathering wind data. Because investors have traditionally accepted data from tower-mounted instruments as the definitive record on prospective wind energy sites, towers have often been forced into situations where they can't operate to their full potential. Weather, wildlife, site location, and terrain can all hamper efforts to erect met towers and make the wind data gathering process more expensive.

Met towers also face man-made obstacles in the form of local height and safety regulations. Most countries have restrictions on tower height and location. Securing permits can take weeks or months, and cost thousands of dollars. Mandated safety lighting and markers on guy wires can affect wind speed measurements by changing the air flow around instruments. Erecting met towers also poses occupational health and safety issues to workers who have to set them up and maintain them, often times in extreme weather.

The industry's reliance on met towers results in a longer development process, which often leads to higher costs. Exclusive use of met towers prevents developers from moving quickly from one site to another, delaying the search for the most productive sites.

The latest generation of remote sensing systems face different challenges. Fortunately, the primary one—acceptance by the industry's independent engineers—is rapidly fading away as the equipment proves to be accurate and reliable. Although independent engineers still typi-

cally require measurements to be obtained from at least one onsite met tower, this case study examines how one company began adding remote sensing systems into their development process.

Case study

In 2009, Windlab tried remote sensing for the first time, on a site in the US Midwest. The company had 50-meter met towers on the site, but needed measurements from higher altitudes. It moved a sodar-based remote sensing unit onto the site to collect wind speed data up to hub-height. The unit discovered more promising wind resources than a simple shear extrapolation from the met towers had identified, which meant the site was more valuable than the company's original estimates. Based on that experience, Windlab now uses the same technology to evaluate wind on sites in Australia, South Africa, and North America.

“Remote sensing cannot replace masts in every instance because it doesn't work in every terrain,” Steggel said. “However, in any instance where a remote sensor can replace a tower and is considered bankable, I wouldn't bother using towers. Remote sensing helps us to be more flexible at a project's early stage and enables us to do things more quickly. We don't have to wait for met tower permits to come through.”

Banking on remote sensing

Investors want hard data that documents a site's potential before they put their money down. Met towers are still the standard that investors rely on but, at the same time, they are also starting to demand data from heights that met towers can't reach, either because of physical limitations or permitting restrictions. Remote sensing provides the additional data while met tower instruments provide the corroborating data that investors' engineers expect.

“We'll put in a 60-meter mast on a site, but for ‘bankability,’ we have to get as close to the hub-height as possible, even if it's up to 100 meters,” Steggel said. “We can get that data from the sodar-based remote sensing units. It gives us more certainty on a site's shear profile than we have with just data from the mast.”

On many projects, Windlab uses remote sensing units as the first monitoring device onsite. If the site looks promising, the company will bring in a cup anemometer to satisfy investors' current requirements. Remote sensing has also addressed the need for agility in evaluating prospective wind farm sites. Towers are, by design, immobile. They have to be securely anchored to their sites to operate properly. That means it takes time to dis-

semble them and move them to another site, assuming they don't need to be reconditioned before they can be used again. By comparison, most remote sensing units can be moved to a new site in less than a day, typically with no servicing or reconditioning required. That helps keep site evaluation costs low.

“When you start a project, cost is a big factor in the early stages,” Steggel said. “Not all sites are successful. If you can quickly re-deploy a device, the cost and time savings are significant. Breaking down a met tower is expensive and time consuming. You have to recalibrate and recondition the instruments before you can move them to another site. There can be as many as 10 to 12 instruments on one mast, and all have to be restored. The mast and the equipment can cost about \$50,000 new. After moving and reconditioning, you've put \$20,000 to \$30,000 more into it. A remote sensor is much easier. It's built in a modular format so the instruments aren't exposed to the elements.”

Lee Alnes is the VP of Sales & Business Development at Second Wind.

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Using Technology to Navigate Environmental Compliance

By Jonathan Ryan

TODAY'S ENERGY DEVELOPMENT PROJECTS—wind, solar, transmission, and distribution—are often located in rural or undeveloped areas. Unsurprisingly, selecting these less populated locations reduces the potential for impact to humans and also often takes advantage of less costly land. But, while these areas present lower risks or concerns to humans, they often present higher risks and impacts to wildlife. Mitigating and managing these effects during the construction and operational phases of major energy projects is one of the more significant and complex obstacles the energy industry faces.

Impacts to wildlife can come in different forms. The “take” of an animal through a direct collision with infrastructure or equipment is just one example. Another is the removal or conversion of a particular type of wildlife habitat. A specific example of such habitat conversion might be the removal of forest cover to allow the creation of a wind farm or solar field. A third type of potential impact to wildlife comes from removing key areas of habi-

tat, such that the development fragments and a larger habitat becomes a smaller, less suitable micro-habitat. Transmission and distribution lines often can create this type of impact.

An abundance of conditions

How best to address these potential consequences depends on many factors: the jurisdiction under which the project is being permitted, the extent of the impact, and the species of wildlife impacted. Nevertheless, there are a number of steps that help account for the possible impacts in the permitting process, including early and regular consultation with regulatory agencies, conducting site assessments consistent with developed work plans, and undertaking proper alternatives analysis.

Once a permit for a facility is granted, the hard work begins. The construction phase of a development is arguably the phase that presents the highest risk. This phase also presents what might be the highest risk of general permit non-compliance. A facility that presents a risk of wildlife impact might have permitting conditions that restrict the timing or duration of construction activities, that requires the use or implementation of certain construction methodologies or equipment, or that demands oversight by scientists qualified to observe potential wildlife impacts.

Once construction is completed and a site is up and running (regardless of what type of energy development it is), a whole new set of compliance conditions can arise. An operating facility is likely to have regular inspection requirements and, perhaps, even wildlife-specific post-construction monitoring requirements. Beyond permit-specific conditions are those that apply to all operating facilities, such as the US Federal Endangered Species Act, Migratory Bird Treaty Act, Bald, and Golden Eagle Act, and others. Many of these conditions require immediate action in the event a wildlife incident is identified in the field.

The compliance conditions from one site to another always vary, and so the question arises: what steps can be made to best to monitor wildlife incidents and, in turn, limit liability?

Documentation is key

The best and shortest answer is to develop an organized and uniform system of documentation that emphasizes transparency and accountability. Modern technology makes this easier. At the risk of stating the obvious,

tools such as e-mail, web portals, and handheld data collectors can make information transfer and responses to it faster. Quick responses and fast actions can help minimize impacts from spills, wildlife-infrastructure collisions, and other concerns.

An emerging technology in this arena is the wildlife incident reporting system. This type of system, which is typically a web-based data collection and storage network, should be detailed and must emphasize strict compliance to the process. Liability from failing to properly report some wildlife incidents—a take of a bald eagle, for example—is substantial and can involve criminal penalties. Strict adherence to a well-developed and easily followed system is critical. The system must be one that emphasizes the importance of documentation, as it's that documentation that can provide evidence of compliance.

The importance of the wildlife incident reporting procedure should be clearly articulated with staff and contractors, and it should be ready for implementation prior to mobilization of any work. The procedure, whether assigned to consulting biologists or handled by internal staff, must be fully equipped to provide documented evidence of wildlife impacts. It must also clearly set forth responsibility and the chain-of-command (such as exactly when and by whom), so regulators are informed of any wildlife-related events.

A wildlife incident reporting system can be developed and employed such that it operates over the Internet, making it easily and widely accessible to permitted users. Such a system provides the substantial benefit of allowing staff at a site, consulting wildlife experts, compliance officers at the project owner's headquarters, and even legal counsel—all of whom might be sitting in different states—to have immediate access to the same data. Such information transfer allows for quicker decision-making. Quicker decision-making will lead to better compliance, which in turn will lead to a shorter window of liability exposure. And, that's in everyone's best interest.

Jonathan Ryan is a senior associate at Stantec, and directs the company's environmental management practice based in New England.

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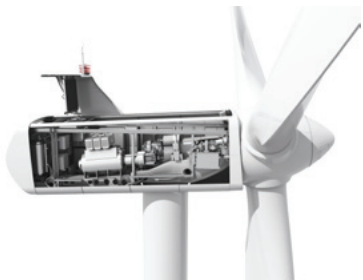
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Foam core system for wind blades

Dow Formulated Systems, a business unit of The Dow Chemical Company, announced the introduction of the COMPAXX 700 foam core system for wind blades, the first in a line of new core materials that will help manufacturers extend blade life through the creation of high-performance sandwich composites. Extensive sandwich panel fatigue testing following the latest Germanische Lloyd requirements showed COMPAXX 700 exhibits long-term dynamic behavior and shear strength properties, yielding lightweight composites with excellent mechanical strength and fatigue resistance. These properties, coupled with peel strength about three times higher than the historical reference of core material PVC 60 kg/m³, create the intimate core-to-skin bond necessary to achieve blade durability. In addition, COMPAXX 700 offers a high run-to-run consistency leading to predictable mechanical properties that structural engineers can use to create more precise blades.

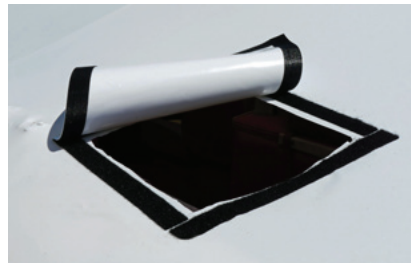
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Vestas announced an upgraded range of two-megawatt GridStreamer turbines that provides significantly higher energy production, integral grid compliance, and a competitive cost of energy for the North American market. Performance gains are achieved by its more efficient, upgraded drivetrain, improved load management system, and full-scale, converter-based power system. It offers a high capacity factor, reaching rated power of 2.0 MW with a 90-meter rotor in areas with high wind speeds, and with a 100-meter rotor in low- to moderate-wind sites. The turbine is certified to the latest IEC standards. The gearbox design and enhanced control systems allow placement of turbines with larger rotor diameters in locations with higher wind speeds. The V100-2.0 MW turbine, for example, can produce about 15% more energy from an IEC II site—with an average wind speed of eight meters per second—than the V90-1.8 MW. The gearbox includes integrated torque arms and a fully integrated lubrication unit with fewer components for reduced service complexity and cost.

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Assuring Wind Plant Availability

Specifying cable & accessory manufacturers' standardized test

By Benjamin T Lanz

THE WIND INDUSTRY has lost tens of millions of dollars due to the use of ineffective commissioning test practices, which cannot detect incipient faults, primarily caused by workmanship issues. The financial impact of the loss of opportunity has driven many in the industry to specify and use the cable and accessory manufacturers' standardized offline 50/60Hz partial discharge (PD) diagnostics—with better than 5pC sensitivity (Defect Specific Diagnostic or DSD technology). The following cases studies are examples of data collected over the last eight years from over 85 projects and 40 million feet wind farm cable systems, demonstrating significant reliability improvement achieved through an effective commissioning test specification.

The collector cable system & failure financial analysis

Wind farm collector systems are typically constructed using 35kV underground cables to connect the wind generator towers to each other, and finally to a common connection point at the substation (see Figure 1). The vulnerability of this design is that if one of the cable systems fail, all of the turbines in the string will experience an outage until the system can be reconfigured or repaired.

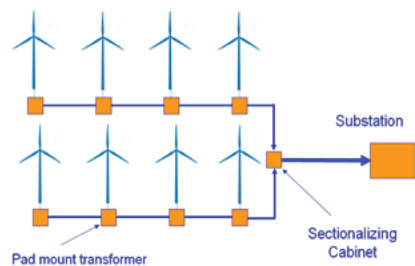


Figure 1: Typical collector system layout.

Though, in this case study, only the failure history of a fraction of the installed wind farms is known, over 150 collector-cable system failures have been documented since 2004, ranging from \$30,000 to \$500,000 each. If the average cost of a failure is estimated to be approximately \$100,000, these outages represent over \$15 million. Considering the known failure statistics and the survey sample size represented here, as a percentage of the total US installed base (over 40GW, according to AWEA or the American Wind Energy Association), the numbers suggest the industry has likely experienced over a hundred million USD in lost opportunity due to cable collector system failures.

Case study I

The discovery of this cable defect at a Sault Ste Marie, Ontario, a Canadian site in the summer of 2006, provided an early opportunity to demonstrate the efficacy of the offline 50/60Hz PD diagnostic test. On a cable of over 1400 feet, the technology was able to locate the defect within six inches. The cable's jacket and outer semi-conducting shield was compromised, which would have caused a near-term failure (see Figure 2). The defect was located and repaired before the cable failed, effectively saving the company from a costly outage of \$50,000 or more.



Figure 2: Suspect sabotage to cable pinpointed.

Case study II

Two, three-phase cable systems, supporting a wind plant in Palm Springs, California, were installed under the ground in a fluidized backfill for the purpose of enhancing ampacity (the current carrying capacity). The cable systems passed a VLF (Very Low Frequency 0.1 to 1Hz) test. By employing the offline 50/60Hz PD diagnostic test, seven defect sites that didn't meet the manufacturers' specifications were located in the cable system (see example in Figure 3). It's believed the damage was caused by the mechanical guide pushing the aggregate of the backfill through the cable jacket and the outer semi-conducting layer. As

these cable systems supported over 30 MW of wind generation, seven outages could have amassed to over several hundred thousand dollars.



Figure 3: One of seven cable damage locations missed by a VLF test and pinpointed with the offline 50/60Hz PD test.

Case study III

Critical shielded power cable systems linking a substation with a wind power generation plant were commissioned using the offline 50/60Hz PD test with better than 5pC sensitivity. All of the terminations on the substation end-of-four, three-phase circuits were found to be performing well below the manufacturers' requirements. The electrical contractor insisted the terminations were installed correctly, and demonstrated the cable systems passed a VLF test. Within one month, one of the terminations recommended for repair by the offline 50/60Hz PD diagnostic test failed (see Figure 4). As these cable systems supported nearly 100 MW of wind generation, 12 outages could have totaled over several hundred thousand dollars.

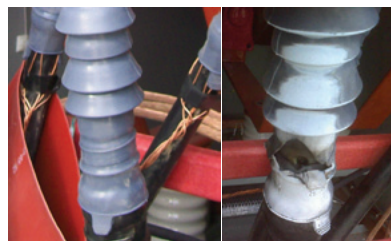


Figure 4: Cable termination with substandard performance (left) & cable termination with failure less than one month later (right).

Discussion & conclusion

On the basis of over 85 wind-farm sites surveyed, there were an average of 15 defects pinpointed, which are considered by cable and accessory manufacturers to be design life issues. Wind farm owners can avoid failures caused by these defects that, in the vast majority of cases, are caused by shipping, handling, and installation errors by specifying an offline 50/60Hz PD test with better than 5pC sensitivity. In some cases, well-meaning engineers have not specified the type of PD testing required by cable and accessory manufacturers' standards, only to learn that tests, such as VLF-based ones, cannot typically achieve 5pC sensitivity. Plus, the voltage source frequency (0.1 to 1Hz) can reduce defect visibility to less than 10% of what an offline 50/60Hz PD test with better than 5pC sensitivity can achieve.

Based on the results of over 30,000 PD tests on wind farm cable systems, there has been less than 0.1 failures/100miles/year, which is a reliability that's superior to many new electric utility systems that have a significantly lower duty cycle. The offline 50/60Hz PD test with better than 5pC sensitivity enables wind farm owners to rest assured that wind site cable systems are built correctly and that incipient faults, which will likely fail post-warranty, are corrected prior to the electrical contractor leaving the site. Additionally, the diagnostic foot-by-foot profile data can be used to develop a strategic maintenance program and manage the wind farm cable assets from cradle to grave at a significantly lower cost.

Benjamin T Lanz is the manager of Applications Engineering at IMCORP.

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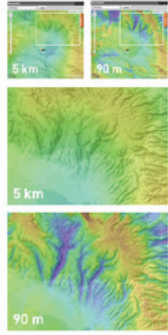
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3TIER has released their 90 Meter Wind Prospecting Tools. The web-based service gives wind project developers and financiers immediate access to 90-meter resolution wind resource data across the continental US—the highest resolution data currently available on demand. Such finely detailed data reveal how even small terrain features will affect wind power generation, enabling anyone with a financial stake in a project to better manage spatial risk during the earliest stages of project development. Clients can now purchase instant, online access to the entire continental US or just a specific region of interest. The 90 Meter Wind Prospecting Tools provide high-resolution wind resource data at multiple hub heights via an online interface that allows users to view annual and monthly mean wind speed data, Weibull distribution parameters, and wind direction data. In addition to viewing the data online, clients will be able to download data in GIS format for a small, incremental cost.

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A Change for The Better

Accurate testing of fall protection products

By W. David Lough

THE ACCURACY AND REPEATABILITY of test results for fall protection equipment has always been in question. Fundamental problems, such as liberties taken with the interpretations of standards, limited conformity of testing apparatuses between laboratories, unknown testing uncertainties, and non-calibrated measuring equipment, etc., have led to inconsistent results between laboratories. Without a benchmark, the ability to trace the source of a discrepancy has also been difficult. Each lab believes their test data is correct. Combine this with the fact most labs are created and maintained by the manufacturer of the final product, and you've got a potential recipe for disaster.

Many design assumptions are based on the results of initial product testing and, therefore, a final product's function can hinge on this information. To start the design process or verify equipment strength and functionality with incorrect, corrupt, or unsubstantiated data can easily result in an end product that's based on a flawed initial premise. Reaction to this knowledge will lay the foundation for the design of future fall protection equipment.

To combat these issues, the ASSE /ANSI Z359 Accredited Standards Committee has established the ASSE/ANSI Z359.7 "Qualification and Verification Testing of Fall Protection Products" standard. This new American National Standard has recently been balloted and approved, and will likely be released in the fall. Once published, manufacturers will have a one-year implementation period to comply with the standard.

Equipment manufacturers

So, what does the new standard mean for fall protection equipment manufacturers? For the first time, manufacturers using the ANSI Z359 marking on their fall protection equipment will have to verify their testing results meet the individual standard the product is supposed to conform to. Manufacturers will have to follow strict testing guidelines, which will require them to either have an in-house ISO accredited laboratory or use a third-party ISO accredited laboratory to perform the qualification and verification testing of their product.

Becoming an ISO accredited laboratory is no easy task and will help to ensure that each laboratory is using the proper technicians and has a thorough understanding of the testing standards. ISO accredited labs are required to have properly calibrated equipment, to ensure test results are correct, and to calculate the uncertainty of an entire test. The intent and the expected final result is that testing in any lab should be repeatable and consistent anywhere in the United States and, theoretically, throughout the world.

Up until now, laboratory accreditation wasn't required and consumers of fall protection products relied solely on the scrupulous nature of the manufacturers and their testing practices. Similar to any industry, there are fall protection manufacturers who are extremely responsible and others who are less so. It's always surprising to find "life-saving" fall protection products that carry the ANSI marking, but don't actually meet these standards; however, they do exist. The failure to meet testing specifications occurs much more often than one might expect.

In most cases, failure doesn't automatically indicate an imminent life-threatening concern, as there is usually more than enough strength in a fall protection product from an engineering standpoint. A failure to meet standards could be caused by a number of factors including poor qualification testing on the manufacturer's part, a change in the product that no one thought would affect the strength, or simply test equipment that isn't properly calibrated or set up. But, it's difficult to determine the root of an issue when no one wants to take accountability for the failure, admit there is a problem, or be able to trace the testing history of a product.

The end user

If you're an end user of fall protection equipment, there will now be a standard that all manufacturers can be measured against, and a method to verify and prove any equipment being purchased has been properly tested. This provides a user with a high level of confidence. If a manufacturer has used the ANSI number on their equipment, they have used an ISO-17025 accredited lab for testing—and there's verification the equipment has met the applicable standard. End users are encouraged to ask manufacturers for documentation of the testing, which any manufacturer will have to provide. Although the fall protection industry has always been a buyer-beware market, this new testing standard will help to even the playing field, and make the purchasing experience a little less confusing. End users can be confident knowing the equipment they're using will have been tested in an environment where the results are not only accurate, but can also be verified.

Testing labs

Test laboratories will have to meet more stringent levels of knowledge, procedures, documentation, test equipment calibration, uncertainty measurements, test weight conformity, and more—the list goes on. Proficiency testing procedures have to be implemented at test laboratories so repeatability in test results can be verified, which will help ensure results are similar no matter what laboratory performs the testing. Presently, it's common to have two labs with different results for the exact same tests on a product. Which lab is correct? Or, are they both wrong? Currently, there's no way to tell unless both labs meet the same basic operating requirements. Until ASSE/ANSI Z359.7 is implemented, there's no way to be certain.

Without a commitment that ensures repeatable results, no matter what laboratory is performing the testing, one can never be absolutely sure the basic premise used to develop and test fall protection equipment is correct. However, the new ASSE/ANSI Z359.7 standard will help foster a culture within the fall protection equipment testing laboratories, which allows them to provide information to manufacturers so they can create safer and more reliable equipment.

Gravitec Systems, Inc. | www.gravitec.com



Wind Turbine Upkeep

In-service & End-of-Warranty Inspections

By Nils Dreischerf & Olaf Robenek

A MAJOR CONCERN when investing in any wind farm project relates to turbine availability, which represents the risk of lower energy yields from turbines due to standstill and repair periods. The reliability of every turbine at a site is essential for a wind farm to perform effectively and profitably. Even a minor failure of a component can cause undesirable downtime and lost revenue. One solution to reducing operation and maintenance costs is to carry out In-service Inspections. In-service Inspections and End-of-Warranty Inspections can detect imminent failures of critical components at the earliest stages, thereby, minimizing the risk of costly repair periods.

In-service Inspections

Many wind farm owners and operators claim that some components, although designed to last the predicted lifetime of a turbine, fail earlier than anticipated, causing unexpected downtime and adversely affecting the overall success of a wind farm. In-service Inspections involve a series of activities, wherein various components of a wind turbine are regularly inspected and monitored throughout their entire operational lifetime. Using a system of diverse inspection and analysis methods ensures that any unexpected degradation from normal conditions is detected as early as possible to prevent unnecessary damage.

It's worth noting, however, that In-service Inspections represent a value-added service to customers, but only when conducted by a reliable third-party supervision company. The

advantages of hiring an independent inspection, verification, testing, and certification company not only result from their skill and experience, but also from their economic independence from the stakeholders. With regular In-service Inspection performed by a third-party company, wind turbine downtime is often considerably reduced, which in return facilitates the economical operation of the wind farm—providing sustainable operational costs with the anticipated return on investment.

Diversified In-service Inspections include, but are not limited to, thermographic inspection, vibration measurement of the drive train, and oil analysis. Thermographic inspection is a non-destructive testing method, developed for inspection of parts, materials, and systems of wind farms by imaging of the thermal patterns at the object's surface. A vibration measurement of the drive train is carried out by installing sensors on the main bearing, gearbox, and generator, with the goal of detecting potential failures on bearings and teeth. This occurs while the turbine is in operation. Oil analysis enables regular monitoring of the chemical and physical changes in a lubricant, taken from the wind turbine gearbox, generator, or hydraulic system, which can provide an early warning of potential failures.

In-service inspections might further cover blade inspection, endoscope inspection, rotor imbalance, blade pitch, as well as angle measurement and industrial rope access.

As monitoring of the condition of rotor blades has become increasingly important, blade

Continued on page 51.



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Up-Tower Construction, Repair, and Maintenance

Reducing injuries, damage & lost work time with the right tool tethers

By John Salentine

WIND TURBINES REQUIRE A HIGH DEGREE OF MAINTENANCE, many times at heights exceeding 300 feet. Although a tool falling from any height is a problem, in the case of wind power maintenance, an object falling several hundred feet endangers everything and everyone below. A large, free-falling tool, such as a torque wrench, could kill someone. Safety is paramount. Even if the tool hits a blade or happens to land on a pump or bearing, it's going to create significant damage, which would cost a company in lost productivity, workmen's compensation claims, medical bills, and equipment repairs.

A safety engineer's goal in correct tethering procedures is to ensure the tool and the application and recoil/retraction force are in balance. When a tool is extended for use, only minimal force should be necessary so as not to cause worker fatigue—or, in reverse, cause a "kick" when retracted. The result of correct tethering is when a tool is stored, held, or used, the dangers of entanglement, fatigue, and annoyance are minimized while worker satisfaction and output are maximized.

A new safety engineer may ask: How do I know which type of tether to use in each application—retractable tool tether, coiled tool tether, or lanyard tool tether? Should the tether be attached to the worker, or anchored to the structure? Do you need a quick-release system to safely change out tools?

When the correct tether is properly matched with the tool, worker, and application, the work is safer, easier, and more efficient. Conversely, a poorly matched tether can become a safety hazard. The challenge for a safety engineer is to provide a tether that is friendly to the user and appropriate for the work environment.

The common lanyard-type tool tether is not a one-size-fits-all solution.

With such a high risk to worker safety, it's unfortunate little has been published on the subject of tethering equipment and safety techniques. Most companies that sell safety equipment or personal fall arrest systems fill out their product line by importing a basic tether in two or three sizes. When a tool tether is ordered without specifications beyond the weight of the tool, chances are it may not be appropriate.

In reality, there are thousands of tethering choices for safety engineers available from US manufacturers specializing in tool, gear, and instrument tethers. Tethering systems have been specified by safety engineers for a variety of applications in a broad range of industries. Each application has its own set of criteria: standing up to saltwater, chlorine exposure, and high temperatures, or special mounting or attachment needs.

Use the appropriate lanyards and tethers for each application.

The objective of tethering is to secure tools to prevent injury and damage to people and equipment below. But, there are factors that can impact the safety of the worker using the tether or lanyard. An improperly mated tool and lanyard can lead to reduced productivity and exposure to injury. When the tethering device limits mobility, recoils too quickly, or exerts too much resistance upon extension, backlash from workers is often the result. Backlash can include fatigue, annoyance, or even non-compliance in the use of the lanyard. Dangerous side effects.

For heavier tools, tethers should be anchored to a structure and not a person.

Tethering heavy tools (generally, over five pounds) to a person is a significant safety concern, and safety engineers should instead consider using anchor tethers. Anchored tethering transfers the shock load produced by a dropped tool from the worker to the structure. For heavier tools (over 10 pounds), structure anchoring should be mandatory.

Retractable tethers are recommended for workers using small hand tools (less than two pounds).

Picture a worker using multiple small tools...the electrician using screw drivers, pliers, amp meters. Or, imagine a maintenance engineer climbing up with a group of tools in his pouch. These tools and working conditions are poor choices for coil type tethers or lanyards. However, they are ideal for a retractable tether that safely permits multiple tools to be attached to the worker with virtually no risk of entanglement or snagging. Tool and gear retractable tethering devices offer hundreds of combinations of mounting systems, line technology, and shock-absorbing capabilities.

Quick-release fittings ideal for multiple tools on one tether.

Change the tool, and not the tether is a slogan worth remembering. A single tool lanyard is sufficient when one specific tool is the only thing tethered, but what if there are multiple tools to tether? This is a common scenario. Here again, there are many options for worker safety in multi-tool tethering situations. Quick-connect tethers offer easy tool change-out and are available on a large selection of tethers.

Tool tether ratings.

Unfortunately, there are no universal specifications governing tool tethers as there are with fall protection devices. As such, a safety engineer has no real basis for choosing proper tethers and arbitrarily determines tether selection based on the weight of the tool (e.g. "I need a tether for a three-pound tool"). Without additional specifications, a safety engineer maybe creating a potentially dangerous situation.

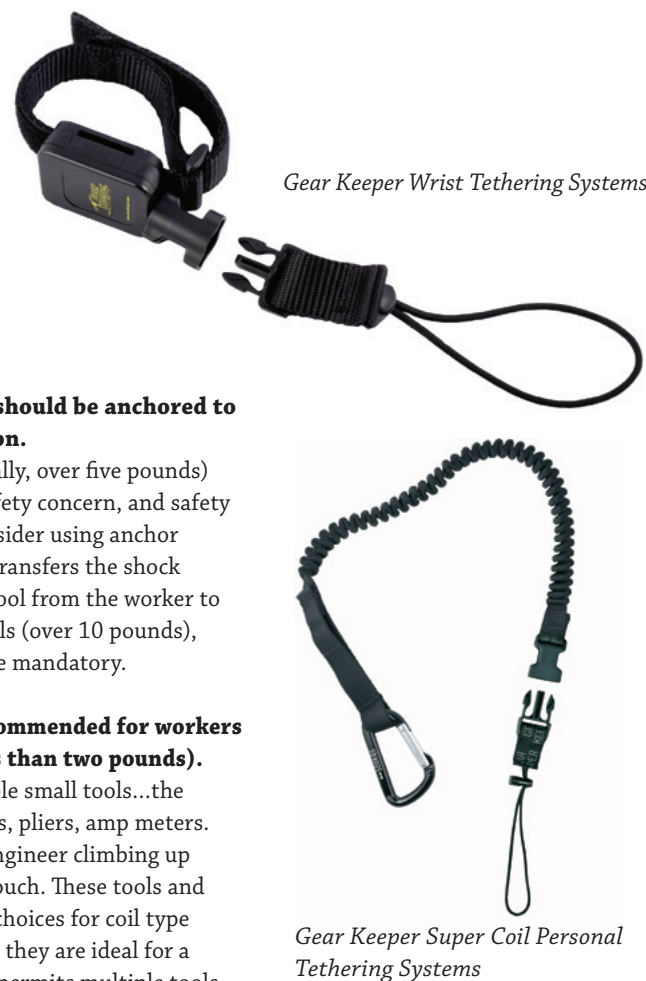
As an example, when a safety engineer requests a tether for a three-pound tool, the distributor might offer to send one that's rated up to 15 pounds, so there will be a higher safety margin. Although both the supplier and buyer may have good intent in this scenario, it's a potentially hazardous situation. Using a tether that is rated for a much heavier tool will not operate effectively because the stretch and the recoil are considerably out of scale for the lighter tool.

A more serious problem is when a worker, assuming a lanyard is rated for 15 pounds, thinks he can connect a 15-pound tool to his tool belt. He can't. That 15-pound tool, at a full drop length, will exceed 250 pounds of a shock load. That's more than enough to knock a worker off his perch, and more than enough reason to learn and adhere to proper tether selection and safety.

To help industrial safety engineers choose the appropriate "dropped tool" safety device, Hammerhead Industries offers a free "Tool Tether Guide."

Hammerhead Industries

www.gearkeeper.com
www.gearkeeper.com/tooltethers/
Resources/ToolGuide.pdf



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...continued from page 49.

inspection should be considered an indispensable part of the inspection process. Hidden defects and damage to rotor blades that cannot be detected by visual inspection can be identified by non-destructive testing techniques. Defects found in this manner include delamination, adhesive defects, laminate thickness variations, and resin-poor areas. Such inspections can be performed either at the place of manufacture, or on the wind farm site itself. An endoscope inspection checks the accessible gearbox teeth and bearings to determine the actual condition of the components, and validates the results of vibration measurement and/or oil analysis.

Other important features of an In-service Inspection include rotor imbalance and blade pitch angle measurement. Maintaining the correct rotor mass balance and pitch angle are vital to preventing the following: damage to important components, higher repair costs, reduced service life, poor availability, and decreased power output. A prudent inspection of the rotor balance and pitch angle is, therefore, highly recommended.

To conduct the inspection and testing of wind farm structures on hard-to-reach locations in an effective and safe manner, the implementation of industrial rope access is necessary. As a cost-effective alternative to traditional rotor blade access methods, industrial rope access is a proven method of achieving a safe working environment at heights in areas that are difficult to access. With these steps, along with regular condition monitoring, which detects failures of critical components as early as possible, undesirable downtime, consequential damages, and unexpected costs or losses of revenue are avoided.

End-of-Warranty Inspections

In addition to In-service Inspections, another method to reduce the costs of operation and maintenance of wind farms are End-of-Warranty Inspections. To ensure a wind turbine's durability and lifetime guarantee, it's essential to keep any potential deficiencies in check and, if necessary, repaired within the warranty period of the manufacturer. These inspections involve a series of activities in which the various components of a wind turbine are properly inspected, and a report is generated that includes a description of all deficiencies. The benefits of End-of-Warranty Inspections include: the discovery of any deficiencies, higher turbine availability (due to the prevention of damages to critical components), a detailed report with descriptions of all findings, as well as the minimization of maintenance costs due to timely warranty claims.

Conclusion

The reliability of wind farm structures has a decisive impact on the profitabil-

ity of a wind farm. To minimize the risks of costly downtime and repair periods and ensure successful functioning of a wind farm, it is indispensable to conduct In-Service Inspections. Nevertheless, In-Service Inspections present a value-added service for wind farm owners when they are carried out by a reliable third-party company.

Nils Dreischerf works as a wind turbine inspector, and Olaf Robenek is the senior wind turbine inspector, onshore and offshore, both at SGS Industrial Services.

SGS is an inspection, verification, testing, and certification company, recognized as the global benchmark for quality.

SGS Industrial Services | www.sgs.com/industrial



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For solar information: www.sapagroup.com/solar
For wind power information: www.sapagroup.com



Ultrasonic wind sensor

The Lufft VENTUS sensor is a high-quality ultrasonic wind sensor proven to operate well in the most extreme conditions. The HALT test is a special wind sensor test that tests extreme corrosion, vibration, heat, and cold. All of this is done in a special wind tunnel that projects high-velocity wind toward the sensor in three vector directions simultaneously. The VENTUS survived to -139° F (-95° C) and 203° F (+95° C), and the maximum vibration and corrosive limits of the test. Lufft has plans to improve the sensor to reach -184° F (-120° C) to 248° F (+120° C) limits of functionality.

The VENTUS wind sensor is designed with turbine control anemometry in mind. Resistance to ice with a 240W heater, and resistance to corrosion is accomplished with a heavy-duty anodized aluminum alloy. IP65 will assure the sensor will resist water intrusion in the strongest storms or offshore environments. VENTUS rugged wind sensor is available in an array of flexible communication options, including current or voltage. Each sensor is fully configurable with free software by Lufft.

Lufft USA

www.lufftusa.com | www.lufftusa.com/video/ventus1.html



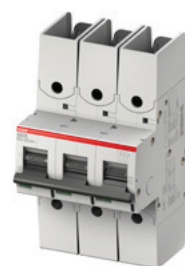
Rope-guided service lift

Zarges is introducing its new rope-guided service lift, which is making the trip from the base of a wind tower to the highest internal platform more stable and user-friendly. The modular design of the new lift, which features a small, flat control cabinet and an external winch system, provides additional space for users. The control cabinet is accessible from the outside; the winch is mounted on a separate frame and electrical equipment is integrated into cable ducts. The design also enhances the driving experience by improving the transit of rope guides and incorporating torsion resistance into the cab. And, since it is fabricated with aluminum, the lift offers exceptional corrosion protection. The competitively priced lift can handle a payload of up to 550 pounds, can rise 80 feet per second, and measures 118 x 39 x 24 inches. The rope-guided service lift meets all American and international standards, including the ASME A17.1 – Safety Code for Elevators and Escalators, DIN EN 1808, and applicable health and safety requirements.

Zarges Aluminum Systems

Zarges-Tubescas

www.zargestubescas.com
www.zarges.com



Self-resetting short-circuit limiter

ABB has released the S803W-SCL-SR / S800S-SCL-SR self-resetting short-circuit limiter, specifically designed for the wind and other power generation applications. S803W-SCL-SR / S800S-SCL-SR is ABB's innovative self-resetting current limiting module, which considerably increases the short-circuit breaking capacity of downstream manual motor starters or high-performance MCBs (S800). Maximizing system availability and compact for DIN rail mounting, the short-circuit limiter provides full selectivity for any downstream motor protection combination. In case of a short circuit in one of the end circuits, the S803W-SCL-SR / S800S-SCL-SR helps the downstream means of protection to break the defective circuit without forcing the upstream protection device to trip. In the event of a downstream short circuit, the limiter will react selective to a group of, for example manual motor starters, until the respective faulty motor circuit has tripped. All other motor starters in the group also remain operative. Two versions are available, to address the UL and IEC markets respectively: S803W-SCL-SR available as 3-pole version, acc. to UL508, and IEC 60947-2 and S800S-SCL-SR available in 1-, 2-, 3-pole version, according to IEC 60947-2.

ABB Inc. Low Voltage Products

www.abb.us/lowvoltage



Wireless alignment tools

The XA Pro has more new features and more content that will make the everyday maintenance at a wind farm a lot easier. One new feature is the Machine Defined Data, which makes it possible to save machine configurations as templates. With the XA Pro alignment tool, data such as all distances, tolerances, and target values for each and every machine, is readily available. Moreover, the GO Pro is a wireless product now available with several useful features, including its unique adaptive user interface, combined with the function Compound Moves. The GO Pro actually recommends how to proceed depending on a measurement result.

Services Techniques

Claude Drouin

www.stcd.ca



Turbine control sensor

NRG Systems, manufacturer of wind measurement equipment for the global wind energy industry, announces the introduction of its new IceFree Hybrid XT turbine control sensor designed to provide longer bearing life and improved vane response characteristics. Suitable for all-weather conditions, including offshore, this sensor meets industry demands for reliability and performance while helping wind farm operators deliver more power more of the time. The IceFree Hybrid XT incorporates protected bearings to guard against dirt and dust, a twin-tail vane design for better performance in off-axis winds, patent-pending magnetic damping for improved stability and accuracy, and enhanced heating properties. The IceFree Hybrid XT, backed by NRG Systems' technical support and warranty, will ship via surface freight free of charge.

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Fall protection & inspection tracking

Capital Safety announced the launch of the i-Safe 3.0 Intelligent Safety System. The system is a significant upgrade to the existing i-Safe 2.0 system, which makes managing a safety program easier and more cost effective. Capital Safety's i-Safe became the first radio frequency identification (RFID) system dedicated to fall protection equipment and inspection tracking. Since the initial launch, Capital Safety has continued to make substantial investments in support of i-Safe's commitment to improve safety compliance and reduce risk. The goal was to enhance the widely accepted i-Safe 2.0 system and build on its value to save time, improve safety compliance, reduce risk, and enhance user safety through consistent inspection and asset management.

Capital Safety
www.capitalsafety.com



Climb assist system

Recently released 1000P IBEX climb assist system sets new standards for portability and durability, and offers the same market performance of the IBEX that users have come to expect. The system features a durable, technician-tested and approved portable control box, which weighs just 8.5 pounds/4kgs. The 1000P's portable control box is easy to set up: just click, plug, and climb. The 1000P's Easy-Climb Controller allows each user to customize assistance from 50lbs to 125lbs (25kgs to 55kgs), providing constant load support regardless of climbing speed and true down-climb assist. The system is designed to be installed in any wind turbine tower and significantly improves employee health and safety, as well as productivity.

Power Climber
www.powerclimberwind.com
www.powerclimberwind.com/
lbex1000P.aspx



Medium-voltage cables

General Cable announces EmPowr Link CL medium-voltage cable, the next generation in renewable energy collection systems that costs less now and pays more later. EmPowr Link CL cable features General Cable's redesign of the concentric neutrals, resulting in less high-cost copper for reduced material cost. With the latest in Cross-Linked Polyethylene (XLPE) cable jacketing, EmPowr Link CL provides better efficiency over the life of the cable through cooler operation, lower line loss, and greater resistance to deformation. These built-in cost benefits and long-term efficiencies, combined with lead-free compounds and General Cable's returnable reels and carbon credit value, makes EmPowr Link CL an eco-friendly option, allowing customers to go green and save green for a better return on investment. Using industry recognized testing, EmPowr Link CL demonstrates a 25% reduction in copper in the concentric neutrals. The reduced copper concentric neutrals increase the shield resistance for lower line loss.

General Cable | www.generalcable.com

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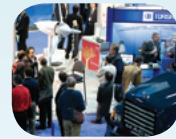
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Since its establishment in 2008, the exhibition and conference have developed into the premier platform for the solar industry in North America. Intersolar promotes the development of business opportunities throughout the solar industry, focusing on photovoltaics and solar thermal technology. It has quickly established itself among manufacturers, suppliers, distributors, and service providers as a vital international industry meeting point. There are 800 exhibitors and 22,000 trade visitors expected at the 2011 exhibition, co-located with SEMICON West.

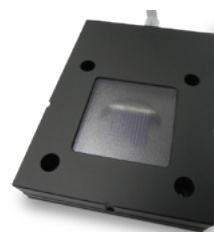
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Recirculation pumps

Designed for the recirculation and transfer of fluids, Gorman-Rupp Industries' (GRI) new integrated magnetic drive pumps bring a uniquely engineered design to GRI's portfolio of custom OEM pumps. GRI's new Integrity Series integrates the pump's components into a compact, lightweight design, eliminating motor bearings and leaving the impeller assembly as the only moving part. Fewer parts promote longer life, quieter operation, and lower power consumption. GRI's Integrity Series Magnetic Drive Pumps will impact OEM applications in the solar and renewable energy markets.

Gorman-Rupp Industries (GRI) | www.gripumps.com
Booth 8013



Reference cells for PV measurement

Konica Minolta Sensing Americas (KMSA) offers a new line of reference cells, which are used as a standard point of calibration to ensure consistent measurements of newly developed PV cells. AK Series reference cells are specifically designed to adjust the illumination of solar simulators for a-si, μ -si, and c-si solar cells. KMSA utilized their advanced optical filter technology to provide high-accuracy measurement for adjusting the intensity of solar simulators used for the evaluation of solar cells, including tandem cells. Initial offerings in the AK Series will include the AK-100 (for amorphous silicon cells), the AK-110 (for microcrystalline silicon cells), and the AK-200 (for crystalline silicon cells). Component manufacturers now have a way to accurately test new materials in the same way a R&D lab would.

Konica Minolta Sensing Americas (KMSA)

www.konicaminolta.com/sensingusa
Booth 5320



Solar support structures

Delivering in-house experience, Baja designs highly specialized engineered solar support structures, engineers light gauge steel structures to perform under any condition or load, and delivers a fully installed system to any jobsite, nationwide. Currently, over 20 MWs of installed solar facilities use Baja's Solar Support System to support the solar modules. Baja Solar Support System is now also the sole provider of a new, emerging market: solar RV/boat storage facilities. In their most recent install, solar panels were attached to Baja's structures, creating the backbone of a 1.75 MWdc solar energy system that was fed back to the grid and monetized using the local utility's Feed-in Tariff. Baja was able to erect the 280 solar canopies (each space approx 12' to 14' x 52') in eight weeks, which also included a wash bay area using the same materials.

Baja Construction

www.bajaconstruction.com
Booth 7051

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PV data & planning software

Version 4.5 of PV*SOL Pro, the dynamic simulation program for the design and yield calculation of grid connected and stand-alone PV systems from Valentin Software, is now available. The new version will feature Photo Plan, the integrated photo dimensioning program. With a photo of the customer's house, the roof, and the planned PV system can be presented photorealistically, providing all the essential dimensions. In addition to the photorealistic presentation of PV systems, PV*SOL Pro 4.5 will include the climate data module MeteoSyn with 8000 global climate records. MeteoSyn makes it easy to select locations from a map. All products in the PV*SOL range include extensive and well-maintained module and inverter databases with data for around 7100 modules and 1700 inverters. Module and inverter data is maintained online by the component manufacturers. The data is then reviewed by Valentin Software, and made regularly available to PV*SOL users via the update function.

Valentin Software | www.valentin.de

Booth 8335G

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the new KACO blueplanet 00xi transformerless inverter series

KACO has worked closely with installers all over the US to provide them with the most reliable and efficient products and technology. Now KACO plans to usher in a new era of solar. KACO has launched a **transformerless inverter** series like you've never seen.

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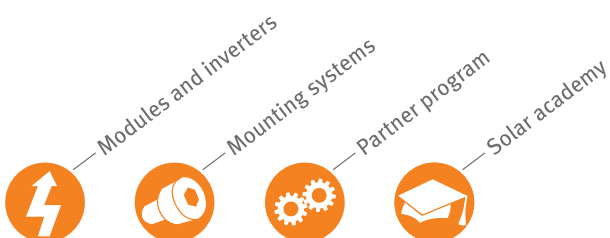
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DIY solar power plant

A small DIY solar power plant, the launch of miniJOULE means anybody can put together the necessary equipment to replace some of the power normally taken from the grid. A miniJOULE consists of one module fastened to two metal brackets, which can be mounted onto the ground, a garage roof, roof terrace, or any other raised surface or base. An XS-format converter transforms the sun's power into alternating current compatible with the standard mains supply. This straightforward, yet versatile system connects to the domestic power supply, and only the last step will require the help of a qualified electrician. The kilowatt-hours that a miniJOULE feeds into the domestic power supply make substantial savings in power possible—the initial investment will rapidly pay for itself as users make an important contribution to climate protection.

miniJOULE | www.minijoule.com
Booth 7152



Solar cell production processes

Roth & Rau introduces their latest technologies for high-efficiency solar cells: the Local-Back-Contact (LoBaCo) technology and the heterojunction technology, which allows cell-efficiencies of about 20%. Roth & Rau provides the core equipment for both production processes. Heterojunction cells are based on a relatively simple low-temperature manufacturing concept that helps to save energy and costs. These cells consist of a monocrystalline silicon wafer on each side, where a thin film of amorphous silicon and a transparent, conductive oxide coating are applied. These cells are just as insensitive as thin-film cells, but are far more efficient. Roth & Rau also presents its new HELiA systems for PECVD- and PVD-coating of heterojunction cells, as well as its MAiA system. This system allows a backside passivation with aluminum oxide on standard-cells.

Roth & Rau | www.roth-rau.com
Booth 8335C
(2nd level, German Pavilion)



Pumps for solar cell manufacturing

Almatec's E-Series AOD Pumps are ideal for use in solar-cell manufacturing. E-Series pumps are created from a solid plastic block that is mechanically machined, not molded. This heavier construction allows the E-Series pumps to operate without "wandering," which can occur to lighter models during oscillating-pump use and lead to product leakage. They are also designed with superior materials—specifically polyethylene (PE) and polytetrafluoroethylene (PTFE)—that are able to withstand the demands of the harsh applications found in the manufacture of solar cells. All Series housing and pump components, even the internal parts including valves, are made with PE or PTFE in a solid-block design. PE has a high abrasion-resistance, as much as seven times higher than polypropylene (PP) and 1.6 times higher than steel.

Almatec
www.almatec.de | www.pumps-g.com
Booth 5229



Foundation bolt

MECASOLAR designs, manufactures, and distributes two-axis solar trackers, one-axis seasonal trackers, and fixed structures with the latest technology, which enables an increase in the production of PV solar energy. This year, the company is launching a foundation bolt that can adapt to the requirements of the ground (soft, medium, and hard). The foundation bolt is a foundation system that will suit all types of terrain without the need to use concrete, allowing structures to be easily installed. Made of hot-dip galvanized steel in accordance with ISO 1461, the bolt maintains maximum durability. Benefits include: concrete-free foundations, which reduce installation time; minimum ground preparation work; design versatility that's compatible with all kinds of structures; and, it can be easily removed and recycled.

MECASOLAR | www.mecasolar.com
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Full layout and loading analysis for every project.



Thermal management connector systems

An expert in quick connection of fluids and power supplies, Stäubli (parent company to Multi-Contact) offers an extensive line of quick connector systems with a proven record of reliability and performance. A number of attributes make Stäubli's quick couplings effective in thermal management. Robust and durable, they can be relied upon to retain their integrity over many thousands of connection cycles. Quality materials play a large part, offering high resistance to corrosion. In particular, seal materials are selected for compatibility with cooling fluids and system attributes. When weight is a factor, lightweight construction materials are an option. Safety is also a key differentiator. Dry break, non-spill design keeps fluids and gasses in the system, preventing them from escaping into electronic cabinets, maintenance spaces, and the environment on connection and disconnection—even in challenging environments and operating conditions. A low-pressure loss co-efficient across the connector ensures minimal impact to cooling circuits.

Stäubli | Multi-Contact | www.staubli.com
Booth 7752



Controlled dispensing

Nordson EFD offers a variety of dispensing systems for applying controlled amounts of solder paste, flux, coatings, silicones, and other fluids used in photovoltaic manufacturing processes. Products include high-speed jet dispensing systems, precision coating systems, pneumatic bench-top dispensers, precision dispense valves for automated production lines, dispensing robots, and high-quality solder pastes.

Nordson EFD | www.nordsonefd.com
Booth 5113



Circuit breaker re-combiners

Bentek Solar's Circuit Breaker Re-Combiners, Circuit Breaker Bi-Polar Re-Combiners, and Circuit Breaker Wall and Rooftop Mount Re-Combiners have no fuses. The Circuit Breaker Re-Combiners provide maximum performance and safety with UL489 breakers. The breaker itself serves as a disconnect, in addition to providing circuit protection. Moreover, the re-combiners are designed to provide the final interface to the inverter with a flexible design for customization and ease of installation.

Bentek Solar | www.bentek.com
Booth 7564



Residential



Buildings



Power Plants

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Solar experts on a global scale

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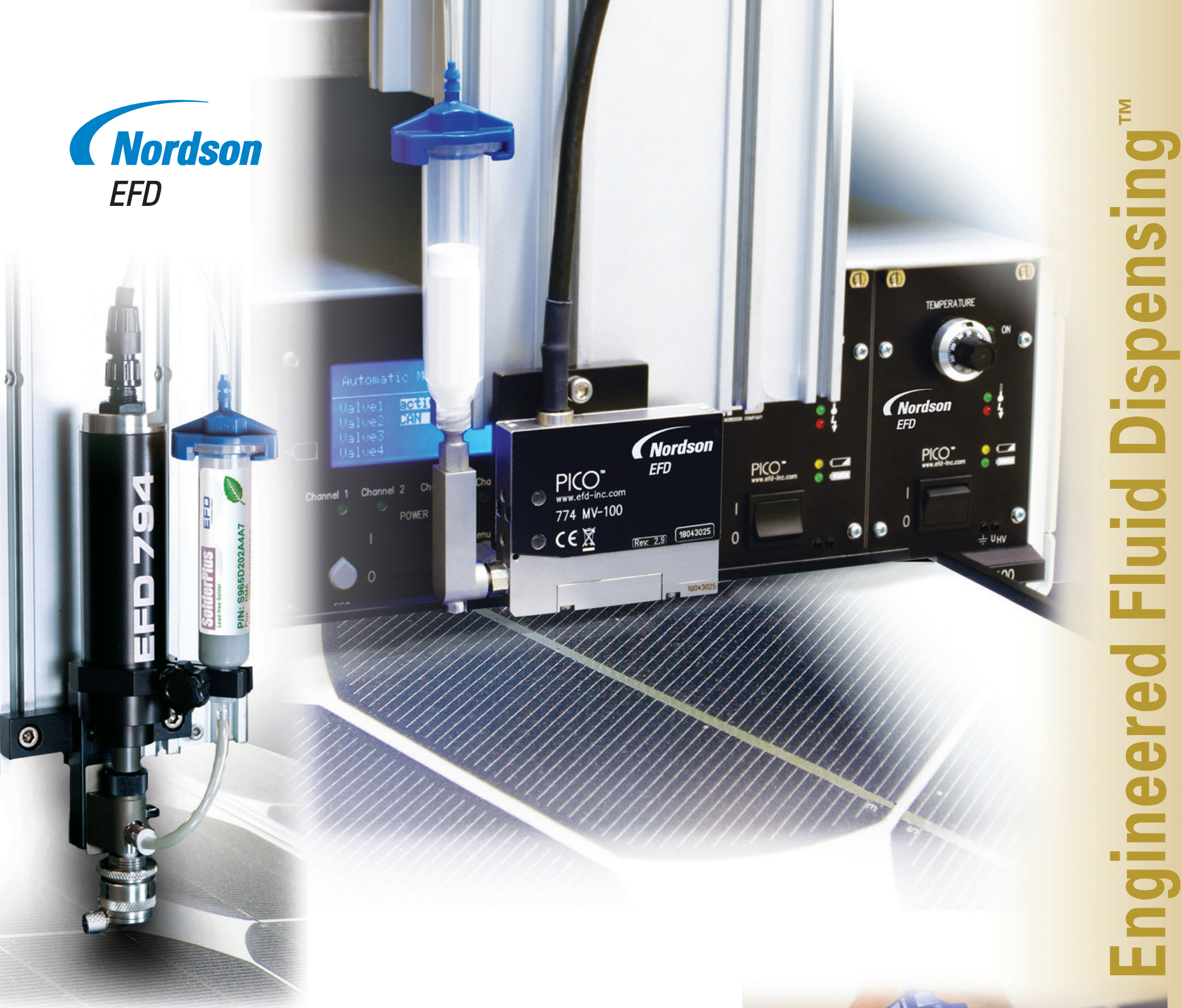
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Nordson EFD's dispensing equipment optimizes your photovoltaic manufacturing processes and provides complete flux & solder coverage.

Nordson EFD's Solder & Flux Pastes are used for cell interconnect during the tabbing and stringing processes. Low-temperature, lead-free formulations are available to better enable thin wafers during the heating process.

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Engineered Fluid Dispensing™



Solar thermal collectors & mounting systems

KIOTO Clear Energy is the parent company of GREENoneTEC in Austria. GREENoneTEC is a manufacturer of high-quality solar thermal collectors and related mounting systems. The company supplies 100% of its products as customer-specific OEM versions to key manufacturers of heating systems and specialists and distributors of solar systems. Large-scale industrial production ensures consistently high product quality, optimal use of resources, and quick implementation of customer-focused solutions. KIOTO Clear Energy provides rapid and pragmatic solutions for customer-specific requirements and, as an OEM partner, a dependable long-term approach based on co-operation. KIOTO offers customers adequate production capacity, and the widest range of absorbers and collectors adapted to the needs of regional markets.

KIOTO Clear Energy

www.kioto.com.mx

www.greenonetec.com

Booth 8112



Web-based monitoring with cellular connection

Solectria Renewables, LLC introduces SolrenView AIR, a cellular connection option now available for SolrenView web-based monitoring. SolrenView AIR gives owners the flexibility to take advantage of SolrenView monitoring options via a cellular connection when a wired connection is unavailable. SolrenView AIR is completely factory installed and configured so installation and start-up are fast and simple. Web-based monitoring allows for real-time reporting of PV system production and is configured to alert a system owner via e-mail and cell phone alerts if a system issue arises. SolrenView AIR is available for PVI 60/82/95KW and SGI Series customers when standard Internet access is not readily available, or in environments where network security is critical.

Solectria Renewables, LLC

www.solren.com

www.solren.com/solrenviewair.html

Booth 7534



Solar thermal pump stations

Free Hot Water (FHW) offers heavy-duty commercial solar pump stations, integrating functionality and safety components into one compact, pre-assembled, pre-engineered, high-quality unit. The pump station features Grundfos variable speed circulation pump(s), providing adequate flow-through a solar thermal system. A solar differential controller with a graphical interface adjusts the speed to extract the maximum energy and efficiency out of the system. FHW's engineers will calculate the pump and pipe size to accommodate collector flow rates, pressure loss in pipes, valves, fittings, and heat exchangers. Standard available sizes are from 3/4" to 2" pump stations. FHW can also custom build larger pump stations upon request.

Free Hot Water

www.freehotwater.com

Booth 8111



Solar racking system

PV Racking has brought a new racking system to the market, which allows solar modules to slide in place, making installation virtually clamp-free for both ground and roof systems. By eliminating the use of tedious clamps, PV Racking makes the installation of solar modules fast and easy. Two people can install 30 kW in a single day, which greatly reduces labor costs. The PV Racking system is more secure than any racking system using clamps to hold solar modules in place. Modules are secured by a continuous edge, giving installers and customers full peace of mind that their systems will stay in place. The continuous-edge capping also creates a clean and finished look presenting a significant improvement in cosmetic appearance. PV Racking designed this racking system using aluminum, galvanized steel, and stainless steel hardware. By making solar installation fast and easy, more secure, and more aesthetically pleasing, the PV Racking system can help solar PV installers increase customer satisfaction and save up to 30% in their labor costs.

PV Racking LLC | www.pvracking.us

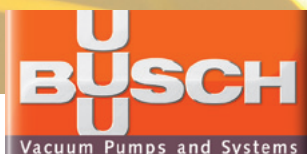
Booth 5347

A vacuum solution just for **YOUR** application.

The COBRA DS series dry screw vacuum pumps are ideally suited for solar applications. These single-stage pumps maximize uptime, reduce energy consumption, provide a high ROI and are capable of advanced monitoring and interfacing between the pump and the process tool. Call on Busch today to meet your vacuum needs.

COBRA DS series pump features include:

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- Low vibration and noise levels
- Idle and speed control capabilities
- Coated, non-contacting internal components
- Small footprint



Expect the best when you specify Busch.

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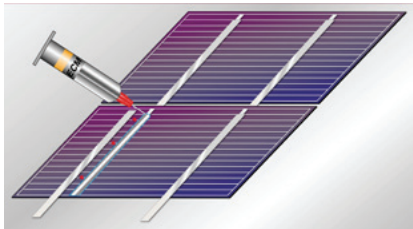
www.buschusa.com



Custom roll forming

Roll Forming Corporation (RFC) has over 60 years of expertise in the design and production of roll-formed steel section. RFC has the capabilities to deliver custom roll-formed and welded shapes, from simple to complex, to fit a customer's exact specifications. RFC is in the business of roll forming solutions for its customers' needs and concerns by utilizing design consultation to develop new solutions, or to improve existing shapes using Finite Element Analysis (FEA). Materials range from HRPO, CR, HSLA, aluminum, pre-galvanized, post-dipped galvanized, and powder-coated steel. RFC offers the latest technologies to transform any unique vision into reality.

Roll Forming Corporation
www.rfcorp.com
Booth 7841



Stringer attach adhesives

Engineered Conductive Materials (ECM) is a global supplier of conductive interconnect materials for PV applications, showcasing their DB-1541-LC and DB-1548-LC Series Low-Cost Conductive Stringer Attach Adhesives. The DB-1541-LC and DB-1548-LC Series of conductive stringer attach adhesives feature up to a 40% price reduction over ECM's standard line, while maintaining optimized rheology for dispensing, and excellent damp heat-resistance and conductivity stability on tin, tin-silver, and silver-plated ribbons. The DB-1541-LC series features a rubber-like flexibility ideal for flexible PV applications with high-peel strength to withstand the stresses induced in reel-to-reel manufacturing processes. Additionally, the DB-1548-LC series features higher strength and modulus materials where "rubber-like" flexibility is not required.

Engineered Conductive Materials, LLC
www.conductives.com
Booth 9015

Solar insolation region

Riverside County is geographically located in one of the premier solar insolation regions in the world, with a large population that creates a demand for clean energy. They assist businesses in finding the right location, providing a highly qualified workforce, and expediting permitting and approvals. Riverside County is an ideal location with reasonably priced land and building leases, as well as purchase rates.

Riverside County | www.rivcoeda.org
Booth 9663



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 it's
i+c

www.ingeteam.com

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Hamburg EUPVSEC	5-8 Sep.
Dallas SOLAR POWER INT.	18-20 Oct.

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Solar-power technologies

With a range of product features, Christopher Associates will highlight the latest sealants and potting compounds from Tonsan, a manufacturer of the frame sealants and potting compounds used in module manufacturing. GSMC PV metallization pastes will also be on display, and they supply a new range of front- and back-side metallization pastes for cell manufacturing. Christopher Associates will further demonstrate Zoomlight high-performance FFC/PET/FFC backsheets for PV module manufacturing. Zoomlight backsheet materials are UL, TÜV, and SGS certified, and are in high-volume use with several of the world's largest PV module manufacturers.

Christopher Associates | www.christopherweb.com
Booth 5712



LED enclosure light

The STEGO LED 025 offers an 870 lumen output at 6500K daylight color temperature. Units are available in commonly used AC or DC voltages. Power consumption is a mere 5W, less than half of equivalent fluorescent lights, and the service life is 60,000 hours, six times the life of a typical fluorescent. Screw- or magnet-mount options are available and it's possible to "through feed" or "daisy chain" from one light to the next, connecting up to 10 lights from the same source. These lights come complete with integral power supplies, are UL recognized, and CE and RoHS compliant.

STEGO Inc. | www.stegousa.com
Booth 7563

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Vacuum pumps & systems

Busch LLC manufactures vacuum pumps and systems for many industries, including semiconductor and solar applications. A vacuum solutions provider, Busch has an experienced engineering team invested in maximizing machine performance, and is able to assist with reducing pump ownership costs, increasing pump efficiency, maximizing vacuum levels, and creating application-specific systems. Busch COBRA DS single-stage, dry screw vacuum pumps are ideally suited for processes in solar and semiconductor industries due to the following product benefits: 100% dry-compression; non-contacting internal components with protective coating; internal-cooling method that eliminates cold spots; keeps temperatures uniform; advanced-monitoring and interfacing capabilities; and, minimal service requirements.

Busch LLC | www.buschusa.com
Booth 9134

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 SLT-006 Rev 7/10

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High-efficiency inverters

The latest innovations by Ingeteam include the new range of Ingecon Sun Power Max HE TL high-efficiency central inverters with rated powers of 315 kW, 500 kW, and 625 kW for “behind-the-fence” projects. These inverters can come without an AC output cabinet (version NAC) to make the best use of available space in the technical rooms where they’re housed. Achieving values up to 98.5%, as with the modular Ingecon Sun 625HE TL model, independent electronic blocks provide increased system availability and ease of maintenance. The integrated solution can include the Ingecon Sun Power Max MT, up to 1,250 kW, featuring a transformer and medium-voltage switchgear, customized to suit the requirements of each customer. Ingecon Sun Power Maxter is ideal for maximizing PV plant performance in conditions of low irradiance. With all Ingecon Sun inverters, users can view parameters and recording data through the Ingecon Sun Manager software or through the IngeconRAS PV web portal.

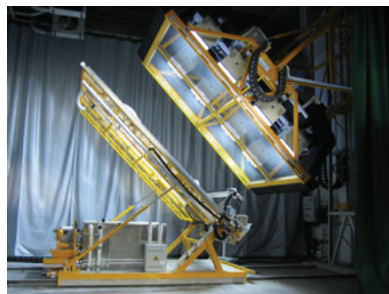
Ingeteam Energy
www.ingeteam.com
Booth 7353



Sputtering targets

As a supplier of planar and rotary sputtering targets, PLANSEE offers thin-film materials for optimal sputtering results and an efficient coating process. In addition to sputtering targets made of pure molybdenum and tungsten, PLANSEE offers molybdenum alloys, chromium, and materials for CIGS absorber layers. Purity, density, and homogeneity, PLANSEE sputtering targets comprise the highest quality. PLANSEE has been manufacturing high-performance materials for 90 years, and covers the whole production process, right from the raw material to the finished product. For the development and testing of high-performance thin films, PLANSEE runs its own sputtering laboratory.

PLANSEE | www.plansee.com
Booth 9122



Solar test stands

The technology department of PSE AG plans, builds, and installs high-quality test stands for the testing of solar thermal collectors and photovoltaic modules. Their indoor and outdoor test products enable manufacturers and researchers to evaluate performance and reliability of thermal collectors and PV modules, as well as accelerate product development. Customers include testing laboratories, research institutes, and collector manufacturers throughout the world.

PSE AG | www.pse.de
Booth L202

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www.canadiansolar.com



Solar solutions

Cooper Industries has a long history of providing products and services that help utility, industrial, and commercial clients meet their electrical needs more efficiently. Solar solutions from Cooper provide labor savings and easy installation, reducing cost per watt for the customer. Cooper B-Line's ARISTA Solar Rooftop Racking System, which is designed with pre-assembled fittings and fewer components, is one example of the innovative solar solutions from Cooper Industries. Quicker to install than many systems, it also offers a superior performance.

Cooper Industries | www.cooperindustries.com

Booth 7722

Renewable energy design builder

Fagen, Inc. is one of the largest merit shop green energy design-builder in the United States. Fagen, Inc. has constructed a variety of projects including wind farms, biomass plants, and power generation facilities. Fagen, Inc. owns the equipment necessary to meet industrial demand growth and is actively pursuing all power generation projects with a focus on renewable energy, including solar power.

Fagen, Inc. | www.fageninc.com

Booth 7303



EPC & design-build services

CG Power Solutions (formerly MSE Power Systems) has experience inter-connecting renewable energy projects to the grid. Their solar team provides full EPC capabilities to design, build, and automate utility-scale solar PV power generation systems. CG Power Solutions' foray into solar is a natural extension of their success in wind, where the company is responsible for connecting over 22% of current US wind power.

CG Power Solutions

www.cgpowersolutions.com

Booth 7259

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AlsoEnergy provides one of the most comprehensive energy monitoring and financial management software solutions for renewable energy developers, distributors, and investors who are establishing today's clean-tech industry standards and best practices. From residential and government to commercial and utility grade applications, AlsoEnergy's technology platform increases business results with online access to critical cost and consumption data. With the industry's only complete client-customized web application, AlsoEnergy's unique architecture and price point optimization reduce risk, improve energy supply chain transparency, reduce real-time electricity demand, and bring strategic vision to energy portfolio administration and the global clean-tech marketplace.

AlsoEnergy | www.alsoenergy.com

Booth 7863

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- Smart
- Bipolar

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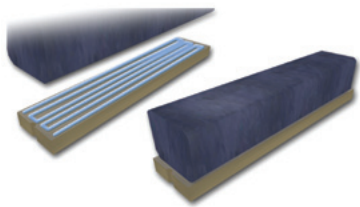
Bentek Solar Recombiners

- Entry, Mid, High-End
- Fused & Circuit Breaker
- Bi-polar

Bentek Solar Cables

- Pre-wired Solar Products
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Silicon wafer processing products

Valtech Corporation supplies the PV industry with specialty adhesive systems, including custom-molded polymers and formulated detergents. Manufactured under the trade name VALTRON, Valtech's temporary epoxy adhesive systems are used in the silicon wafering process, specifically designed for mounting ingots for squaring and wafer slicing. After the ingots are sliced, the adhesive is easily and completely removed when heat is applied to the substrate. Valtech's polymer mounting plates and support beams are used to mount silicon ingots and various PV and semiconductor materials in preparation for inside diameter and wire saw wafering. The beams are designed with a special grooved surface that ensures a consistent adhesive layer. Pre- and final cleaning of sliced wafers using either ultrasonic or in-line cleaning methods is enhanced with VALTRON formulated detergents, which include regular and low-foam formulations that exhibit excellent sequestering ability, and leave no residue after rinsing.

Valtech Corporation
www.valtechcorp.com
Booth 9115



Rotary sputtering targets

Indium Corporation is featuring its newly developed copper-gallium and indium rotary sputtering targets. The targets are made by Indium Corporation's vertically integrated proprietary process utilizing aerospace powder metallurgy technology. The production process output produces a consistently homogeneous alloy with low PPM contaminate levels and consistent density throughout the target—resulting in very consistent sputtering film properties. The Cu/Ga targets can be produced in chemistry ranges from 50% to 80% Cu atomic weight. The In targets are typically 4/9-5 plus grade. They are both produced as a monolithic material, and bonded onto the backing tube during Indium Corporation's unique hybrid consolidation process.

Indium Corporation
www.indium.com/solar
Booth 5228



Solar-power production & integration

Renogy is a global player that produces solar ingots, wafers, cells, and modules, ensuring reduced cost at each step in the production chain. This vertical integration enables Renogy to carry out quality control processes, while offering competitive pricing.

Renogy | www.renogy.com
Booth 8892

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Location: Hamburg, Germany
Booth: B6/B38



Solar Power International
Date: 17th-20th October, 2011
Location: Dallas, Texas, USA
Booth: 2737



ET Solar is dedicated to bringing clean energy to the US and the globe.

Our innovative products and systems are building blocks to a greener way of life.

www.etsolar.com





Wireless access to solar tracking controllers

P4Q Suntrack has developed a zigbee wireless interface to their solar tracking controller management system. This allows for fewer wires in deployment, lowers the time for deployment, and gives a user all the advantages of a wireless system. Through the management system actions such as system set-up, tracker reference, backtracking, and tracker stop are enabled.

P4Q USA | www.suntrackpro.com
Booth 7635



Double enveloping worm gearing

Solar tracking applications require high-resolution motion control and very slow output speeds. To accomplish this, large, overall reduction ratios are needed. Depending on the motion profile and motor speed, overall ratios as high as 50,000:1 may be necessary. Multiple stages of gearing are required to achieve such high ratios. A cost-effective solution for this motion control problem is a gear train divided into two discrete drive segments: a primary epicyclic and secondary worm gear drive. Cone Drive offers double enveloping worm gearing, which has more gear teeth engaged with the threads of the worm than cylindrical worm gearing. Typical cylindrical designs have one to 1½ gear teeth engaged compared to up to 10 of the gear teeth engaged in a double enveloping design. This reduces contact stresses in the gear mesh, significantly improving wear life. Cone Drive's double enveloping gearing will handle more torque and experience less wear than other worm gear geometries.

Cone Drive | www.conedrive.com
Booth 7944

Providing Products and Support for the Renewable Energy Industries



Products for the manufacturing of polysilicon and the finish processing of silicon wafers for photovoltaic (solar) energy.



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Solar mounting systems

CreoTecc mounting systems, manufactured in the USA by Session Solar, are proven to reduce module installation time while providing increased flexibility and durability. With over 125 MW installed worldwide, CreoTecc roof- and ground-mount systems are compatible with all common mounting fixtures and module frame widths. The original clampless module insertion technology is one of the most stress-free mounting solutions on the market. No need for clamping on the modules, no tedious screwing, and no drilling required. Inserting modules is fast, easy, and secure. CreoTecc mounting systems allow contractors to compete on cost and aesthetics.

Session Solar | www.sessionsolar.com
Booth 7728



PV kit

S-5! once again offers innovations to industry standards for attaching solar panels using the S-5-PV Kit. The S-5! stainless steel mounting disc is ETL Listed to UL 1703 but, more impressively, the S-5-PV Kit is Listed by Underwriters Laboratories Inc. to 2703 (a new subject for Rack Mounting Systems and Clamping Devices for Flat-Plate PV Modules and Panels). The S-5-PV Kit has been subjected to thorough conductivity and mechanical load testing by UL to the new UL 2703 subject. The new PV Kit provides module-to-module continuity within a string of modules; when properly installed, ground lugs and copper wire will only be necessary to connect module strings and ground the system. In most cases, the emergence of UL 2703 will produce cost savings sufficient enough to pay for the entire S-5 clamp/PV Kit set-up. The S-5-PV Kit continues to be the easiest, most cost-effective way to install solar panels directly to standing seam metal roofs, remaining a popular choice worldwide.

S-5! | www.s-5.com
Booth 7910



Pole-mounted system for solar panels

Snake Tray offers a new utility grade dual-panel pole rack-mount system to accommodate municipal and private solar installations when mounted on existing or dedicated utility poles. Developed in conjunction with high-performance micro-inverters that allow 2.5 times more solar power captured from a single pole site, the Snake Tray Solar Utility Pole Rack installs quickly to save on the cost of installation. Snake Tray also manufactures a series of products for the solar industry all designed and proven to significantly save on labor, time, and materials. All Snake Tray products are made in the USA, utilizing solar power generated from their rooftop solar array.

Snake Tray | www.snaketray.com
Booth 7751



Grid-compatible solution light commercial & residential applications

Siemens Industry, Inc.'s next-generation solar microinverters are now available. Siemens Solar Microinverters will drive cost and complexity out of residential solar installations and provide more reliability and flexibility in to solar PV renewable energy systems. Inverters take the direct current (DC) voltage produced by the sun and convert its energy into grid-compatible alternating current (AC) voltage. Traditional string inversion technologies commonly added technical and economic barriers, limiting broader access to solar PV energy solutions.

Siemens Industry, Inc. | www.siemens.com
Booth 8522

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Quality, reliability, and innovation. Upsolar's experience is available throughout the value chain, from product development through to launch. When you choose Upsolar, you can be certain that you are buying and offering a top of the line photovoltaics module, made of high quality sustainable materials. Our goal is to surpass the requirements of international certification organisations and to anticipate tomorrow's technical standards. That is our guarantee of a bankable and profitable investment, for the long term.



www.upsolar.com



Safety & performance testing

TÜV Rheinland PTL, LLC is a provider of safety and performance testing, and market certification, serving every sector of the PV and solar thermal marketplace—from the supply chain through installation. TÜV Rheinland PTL is a member of the TÜV Rheinland Group, which has the largest network of solar energy laboratories. The lab was formed as a unique partnership between Arizona State University and TÜV Rheinland, a global provider of independent testing, assessment, and certification services.

TÜV Rheinland PTL, LLC | www.tuvptl.com

Booth 8962

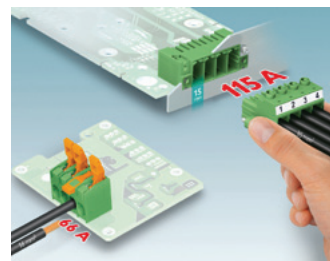


PV mounting systems

IronRidge designs and manufactures photovoltaic mounting systems for the solar industry. By partnering with industry integrators and distributors, IronRidge delivers mounting solutions that offer simplicity and the lowest cost of installation. IronRidge products are relied upon every day in installations that range from small, single-use residential applications, to some of the largest industrial deployments, worldwide.

IronRidge | www.ironridge.com

Booth 7922




PCB connectors for solar applications


With Phoenix Contact's extensive line of power terminal blocks and connectors, solar inverter manufacturers can save wiring time in the factory and the field. The PLH 16 PCB terminal block provides easy termination without the use of tools. A soft-touch lever comes in the open position, ready to accept the wire. Light finger pressure is all it takes to complete the connection. The spring cage creates a gastight wire termination, which self-adjusts with temperature changes and vibration conditions. The PC 35, a pluggable PCB terminal block, can carry up to 115 amps. It features standard screw-connection technology and accepts wires up to 2 AWG. It's UL-rated for field wire termination, which is accomplished with a screwdriver. The through-panel mount capability increases design flexibility.


Phoenix Contact | www.phoenixcontact.com

Booth 7740



Wieland Electric – the foundation for a reliable PV system.





wieland
www.wielandinc.com


Wieland Electric offers 100 years of innovative technology.

Pluggable connector solutions

contacts are green.

With 100 years of interconnect experience, Wieland manufactures reliable, pluggable connectors for the DC side of photovoltaic systems. Complete solutions include our PST 40i1 connector family, rated to 40A DC, and our new line of combiner boxes to complete the installation on the inverter's DC side.

Our PST 40i1 connector series includes panel mount and field-assembled connectors. Silver-plated contacts reduce resistance losses. Ingress protection to IP 68 ensures safe operation in difficult environments. Wieland's PST 40i1 connectors meet UL & CSA standards.



**Wieland Electric
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Data-acquisition packages for solar monitoring

Campbell Scientific offers pre-configured and custom automated data-acquisition packages, specifically designed for solar monitoring applications. A full range of pre-configured packages is available for PV and concentrated solar technology (CST) arrays of all sizes. Two such packages are the SOLAR1000 and CST100, designed to meet CaISO EIRP Solar Telemetry Standards. The SOLAR1000 is an automated data-acquisition package designed for flat-panel PV monitoring applications. Typical uses include pre-construction phase solar resource assessment, baseline data collection, and performance monitoring. The CST100 is an automated data acquisition package specifically designed for CST monitoring applications where active, direct normal, and diffuse irradiance measurements are required. Typical uses include research and development, resource assessment, and performance monitoring of concentrated solar power (CSP) and concentrated photovoltaic (CPV) technologies.

Campbell Scientific, Inc.
www.campbellsci.com/solar-energy
Booth 7251



Weathering & testing services

Q-Lab Corporation offers accelerated weathering test equipment and outdoor testing services. Products include the QUV Accelerated Weathering Tester and Q-SUN Xenon-Arc Test Chamber, which are widely used to simulate sunlight and the effects of weathering in a variety of industries, including solar. Durable and cost effective, Q-Lab products meet industry standards and make weathering simple.

Q-Lab Corporation | www.q-lab.com
Booth 8938



Supply & return lines for hot water systems

Solar-Trac offers flexible and corrugated stainless steel insulated and un-insulated supply and return lines for residential and commercial solar heated domestic hot water systems. Solar-Trac's advanced corrugated tubing, coupled with Solar-Flare self-flaring fittings, offers installers the highest levels of quality for tomorrow's energy.

Solar-Trac | www.solar-trac.com
Booth 8217

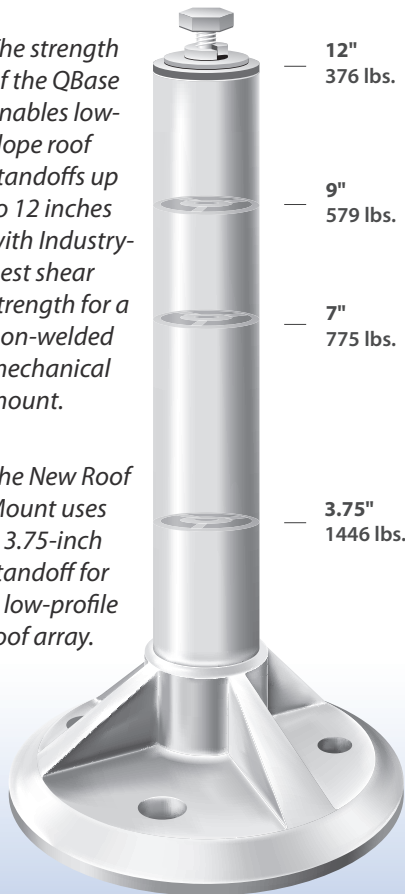


New from Quick Mount PV...

The World's Strongest Solar Mounts

The strength of the QBase enables low-slope roof standoffs up to 12 inches with Industry-best shear strength for a non-welded mechanical mount.

The New Roof Mount uses a 3.75-inch standoff for a low-profile roof array.

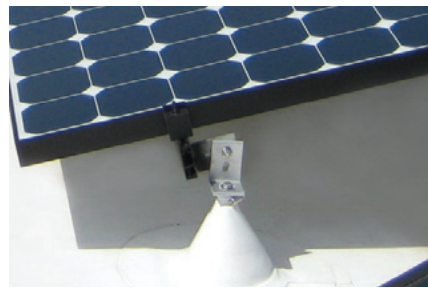


QBase

WHERE THE ROOF MEETS THE LOAD

The Low Slope and New Roof Comp Mounts are built around the all-aluminum QBase. With four buttresses to support the load, QBase makes these off-the-shelf solar mounts the world's strongest – by far.

Quick Mount PV announces new 100% code-compliant, waterproof mounts for low-slope commercial roofs and for new home construction and pitched roof replacement.



Low Slope Commercial Mount

The **Low Slope Mount** is the strongest mount you can buy for mechanically attaching commercial PV systems to TPO, PVC, EPDM, built-up asphalt, and virtually all other non-metal low-slope roofs.



New Roof Composition Mount

The **New Roof Composition Mount** integrates PV installation smoothly into the workflow between the trades during new home construction or roof replacement.

Also from Quick Mount PV:

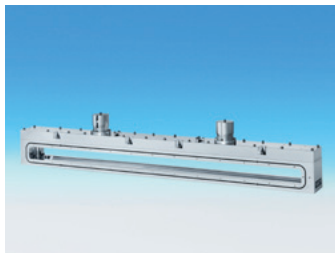
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Transfer valves

VAT's latest addition to their large transfer valve series, the FlapVAT, offers vacuum equipment manufacturers what it claims is the best price/performance ratio available. Equipment suppliers in the PV industry are facing continuous cost pressures. Simultaneously, the production throughput, yield, and uptime have to be improved to reduce the manufacturing cost-per-watt, which requires high-performance transfer valves at the lowest cost possible. The valve design allows differential pressure opening, along with options for the actuator to be placed on top or at the sides of the valve, stainless steel or aluminum construction, and horizontal or vertical orientation. FlapVAT slit openings from 30mm x 500mm to 80mm x 3000mm are available. It can be used in door, valve, or insert configurations.

VAT | www.vatvalve.com

Booth 9026



Solar support mounts

CHEM LINK'S E-CURBS, designed to secure solar mounts and other roof penetrations, are a specialized version of the CHEMCURB SYSTEM Penetration Seal. E-CURBS replace metal pitch pans to provide a quick, reliable seal for virtually any penetration on commercial roofs. The slim, versatile two-piece curbs are quickly joined with "slip-fit" technology. They come with solvent-free M-1 Structural Adhesive/Sealant to bond them to the surface and 1-Part Pourable Sealer. Choose these 2" high, round, flanged supports in 3", 4", 6", and 9" i. d. The 2" corners and 8" straights add additional sizes and shapes. M-1 Structural Adhesive/Sealant is a premier tool in many areas of construction and maintenance because of its bonding strength, flexibility, ease of use, and solvent-free, non-shrinking properties, which are inherent in all CHEM LINK polyether-based products. M-1 is a crucial component of E-CURBS, the SOLAR SHOE, and Solar Shoe LS for mounting solar panels on shingled and low-slope roofs.

CHEM LINK | www.chemlinkinc.com

Booth 5251

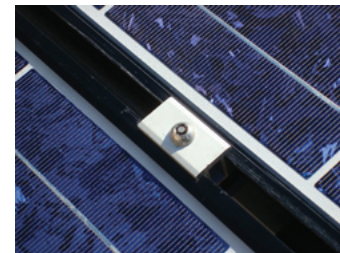


Dual-axis trackers

Patriot Solar Group's Dual-axis Trackers are pole-mounted motorized systems, ideal for small to medium commercial and residential projects. Available in 2 kW and 4 kW sizes allows each installation to be tailored to the specific need of each individual project. Heavy-duty worm gear azimuth drive and actuator drive for elevation allow the dual-axis tracker to track the sun from sunrise to sunset, increasing the power output by up to 40% or more, depending on the latitude of the installation. Each system comes standard with modular rails that fit nearly any commercially available module, Patriot Solar Group's SunScout tracking controller, and robust power supply. Also available: ground-mount, single-axis, and solar trailer products. All Patriot Solar Group's dual-axis trackers and mounting systems are manufactured in the USA.

Patriot Solar Group
www.patriotsolargroup.com

Booth 8956



Solar security solutions

Bryce Fastener offers simple, maintenance-free, and long-term security solutions for solar arrays. Custom-locking fasteners can be integrated into any mounting technology, and will last the 25- to 30-year lifespan of a panel. Cameras, alarms, and fencing require extra maintenance costs and won't protect in remote areas. However, Key Rex works as a security preventative measure, even against theft of large, remote ground-mount applications.

Bryce Fastener, Inc.

www.brycefastener.com

Booth 7950



Polycarbonate enclosures

Stahlin Non-Metallic Enclosures has introduced PolyStar Polycarbonate Enclosures, some of the most durable and reliable NEMA 4X polycarbonate enclosures available for use for renewable energy projects. Made in the USA, PolyStar polycarbonate enclosures can withstand rain, sleet, snow, splashing water, and even hose-directed water while providing superior impact- and flame-protection. The enclosures' latches and hinges do not penetrate enclosure, and they are equipped with a flush-fit side-mount swing panel and a DIN rail system. Other features include: easy to remove lid; high-performance inserts; integrated lock hasp; molded in bosses; and, they have multi-directional mounting feet. Five standard sizes are available: 8x6x4, 10x8x4, 12x10x6, 14x12x6, and 16x14x8. Rated Type 3R, 4, 4X, 12; Rated IEC 66, and are UL/cUL Approved.

Stahlin Non-Metallic Enclosures

www.stahlin.com

Booth 7365

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High-efficiency PV Inverter

With the best-in-power class 98.7% peak CEC efficiency rating, Advanced Energy's Solaron 500 HE inverter generates more value for project developers, owners, and financiers, and drives the industry's best levelized cost of energy (LCOE). The stable, high-voltage, transformerless engine inside this robust, 500 kW inverter allows many units to be wired in parallel into a single medium-voltage transformer, making it ideal for utility-scale PV installations. With true 98% average efficiency, without carve-outs for auxiliary power or other adjustments, the Solaron 500 HE enables higher, faster PV system ROI, and better balance of system (BoS) optimization. An optional Remote PV Tie (RPT) accessory can further reduce BoS costs. AE's SiteGuard solutions simplify operation and maintenance (O&M) on the entire PV site.

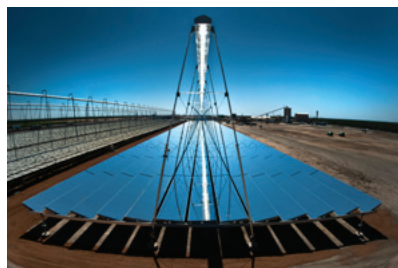
Advanced Energy Renewables
www.advanced-energy.com/
renewables
Booth 7335



1000-volt UL 1741 inverter

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American Electric Technologies, Inc.
www.aeti.com
Booth 5453

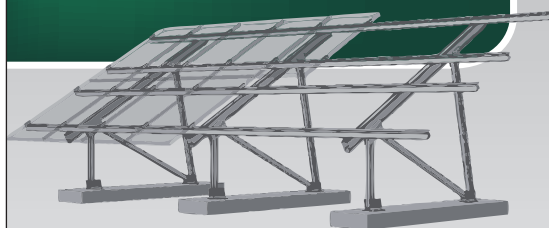


Solar steam generators

AREVA Solar designs, manufactures, and installs solar steam generators for its global power generation and industrial customers in a dependable, competitive, and environmentally responsible manner. AREVA's CLFR solar thermal technology is water-conservative and one of the most land-efficient renewable energy technology available.

AREVA Solar | www.solar.areva.com
Booth 8211

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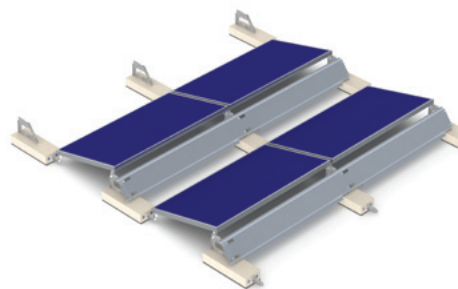


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Solar mounting solutions

PanelClaw's new Polar Bear FR Gen II and Grizzly Bear FR Gen II represent the next generation of flat-roof mounting solutions, delivering greater design flexibility, advanced roof protection, and lower lifecycle costs. Gen II builds upon PanelClaw's innovative three-component design by integrating additional flexibility, including a new five-degree solution and greater inter-row spacing options. All Gen II solutions offer enhanced thermal compensation and factory integrated recycled rubber pads, delivering superior roof protection, faster installation, and lower total project costs. Gen II also offers drastically reduced grounding costs through the recognition of PanelClaw's module mounting Claws as UL 2703 certified electric bonding and grounding devices.

PanelClaw | www.panelclaw.com
Booth 7851



Transformerless grid-tied inverters

KACO has launched a transformerless inverter series, which is highly efficient and offers the best string inverter pricing for the line worldwide. The 96.5% CEC efficiency on all 00xi series inverters ensures lowest energy losses. The easyinstall T-bracket minimizes mounting time to approximately 15 minutes. The inverters produce more kilowatt-hours (kWhs) than ever before, and they enhance efficiency numbers by using a single stage DC conversion process. KACO has been manufacturing power electronics for more than 60 years with more than 3 GW of inverters in the field worldwide.

KACO new energy
www.kaco-newenergy.com
Booth 7522

Modular controller for PV installations

To satisfy the rising demand for green technologies, Carlo Gavazzi has expanded its' energy management portfolio with the addition of the EOS-Array—a unique, modular controller for solar PV installations. The EOS-Array is a combination of modules that perform the complete control of a PV plant. It's also extremely expandable. The core unit is the VMU-M, which performs the local bus management of the measuring units, including the VMU-S and the VMU-P, as well as the I/O unit—the VMU-O. The VMU-M assigns the proper local unit address automatically, and gathers all the local measurements coming from VMU-S and VMU-P. The VMU-M can provide, by means of VMU-O modules, two relay outputs to manage alarms and/or external loads (such as a lighting system, a PV washing system, etc.) and two PV panel temperature inputs. The VMU-S is the DC power-measuring unit (generated by PV panel), which features a built-in fuse holder. The VMU-P collects relevant environmental data (through external sensors) such as wind speed, air temperature, and sun irradiation.

Carlo Gavazzi | www.gavazzionline.com
Booth 7547



Panel & racking system

Trina Solar and Zep Solar have combined the power of Trina Solar's high-quality panels with Zep Solar's fast and easy racking system. The result is Trinamount. Its innovative frame design allows for installations in a quarter of the time versus traditional installations. The Trinamount system is sleek, aesthetically pleasing, and cost effective. Trinamount offers fast and easy installations because of its low parts count. This means reduced inventory, as well as faster and less intensive engineering and freight costs. It has a theft-resistant design and autogrounding. These features are designed to help solar installers increase profits while offering some of the best panels on the market.

Trina Solar | www.trinasolar.com
Booth 8347



Ballasted racking system

DPW Solar announces their new high-density Ballasted Power Rail top-clamping module system, designed to install fast and provide a secure mounting structure for most framed crystalline modules. Qualified test results from a full-scale wind tunnel facility support designs that require less ballasted weight, and no roof penetrations for most site applications. A unique modular concept provides the flexibility to design and install the mounting system around roof obstructions, while avoiding shaded areas. The Ballasted Power Rail system incorporates high-strength rails with integrated wiring channels and pre-installed EPDM material to protect the roof surface. The top-clamping rail utilizes a single tool with a RAD fastener for quicker bolt placement. The unique shape of the RAD provides an anti-rotation feature, locking the bolt in place when installed. All components in the Ballasted Power Rail mounting system feature corrosion-resistant materials to assure long-term service and reliability.

DPW Solar | www.dpwsolar.com
Booth 7017



Surge protector

CITEC's DS50VGPV Surge Protector is designed with their patented VG Technology, a hybrid Metal Oxide Varistor (MOV) + Gas-filled Spark Gap (GSG) surge protection circuit, which dramatically increases the life expectancy of the surge protector and eliminates working current and leakage current. Rated for DC Power Applications up to 1200Vdc and UL 1449 3rd Edition.

CITEC | www.citec.us
Booth 7265



Solar racking products

With more than 300 MW of installed, PV mounting systems manufactured in their US facility, Schletter offers innovative products for roof- and ground-mount systems for residential, commercial, and utility applications. Their latest edition is the new PVSpin now available for module cleaning.

Schletter | www.schletter.us
Booth 5146 (for ground-mount systems)
Booth 7758 (for roof-mount systems)

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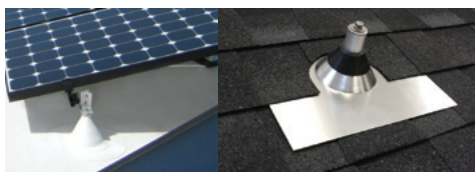


www.cityoftemecula.org



www.cveza.org





Integrated roof mounts

Quick Mount PV offers a new mount that brings superior quality and ease of PV installation to new roof construction. The Roof Composition Mount interfaces smoothly with new home construction, saving time and money. The base is fastened to the rafters by the solar installer, and the posts and flashings are left for the roofers to weave into the shingles. Then, the solar installer simply mounts the array. Made with the cast aluminum QBase, the mounts feature inch-deep, reinforced flange engineered to give the 3.5-inch standoff an average shear strength of 1,446 pounds. QuickMount also offers a new mount that brings the company's 100% code-compliant quality mounts to the commercial low-slope roof market. The Low-slope Mount integrates easily with commercial PV installations on single-ply membrane, built-up asphalt, and many other roofing materials. Also made with QBase, these mounts feature inch-deep, reinforced flange engineered to enable standoffs up to 12 inches with an average shear strength of 376 pounds.

QuickMount PV

www.quickmountpv.com

Booth 7663



Grid-interconnection solution for utility-scale PV

American Superconductor (AMSC) offers a range of proven solutions for the renewable energy industry. Based on its proven D-VAR reactive compensation technology, AMSC recently launched its SolarTie Grid Interconnection Solution, designed specifically for megawatt-scale PV power plants. SolarTie incorporates AMSC's D-VAR technology and proprietary Power-Module power converter systems to create the first fully optimized solution for utility-scale PV power plant developers. This solution is the only to incorporate sub-cycle detection and response times to grid disturbances of less than 16 milliseconds, enabling solar power plants to meet local grid-interconnection requirements in a single solution. The SolarTie additionally incorporates a proprietary "Smart Grid" Interface (SGI) Controller, which provides efficient energy production and precise regulation at the point of interconnection.

American Superconductor

www.amsc.com

Booth 7542



UV-Vis & FTIR spectrophotometers

Shimadzu's comprehensive line of analytical instruments provides testing solutions for photovoltaic manufacturing processes and research and development that contribute to higher conversion efficiencies, reliability, and yields from solar cells. This includes testing of first-, second-, and third-generation PV cells created from silicon and non-silicon material such as polycrystalline silicone and dye-sensitized/organic thin films. These instruments are ideally suited for a range of applications, including transmission and reflectance measurements on substrate materials and thin films, analysis of deterioration of EVA, and other organic materials, as well as analysis of contamination by organic foreign substances. These instruments reduce measurement workload and achieve more efficient non-destructive analysis of PV materials.

Shimadzu Scientific Instruments

www.ssi.shimadzu.com

Booth L317



Solar mounting solutions

Featuring their innovative solar mounting solutions, Applied Energy Technology (AET) designs, engineers, and manufactures solar mounting solutions for any type of solar installation. Their unique and modular product designs simplify ordering and installation of PV mounting systems.

Applied Energy Technology

www.aetenergy.com

Booth 7335



Monocrystalline cell technology

MAGE POWERTEC PLUS modules utilize a monocrystalline cell technology with a cell efficiency of up to 17.81%. With allowable tolerances of up to +5 watts, maximum power is guaranteed without any compromise and nominal power is obtained or even exceeded. MAGE SOLAR's competitive 10-year product warranty surpasses industry standards, and the added guarantee of 90% nominal power for 12 years and 80% for 30 years provides customers with three decades of reassurance. The German-engineered MAGE POWERTEC PLUS modules meet maximum demands with regards to stability and corrosion resistance. Starting this summer, MAGE POWERTEC PLUS modules will be produced at the North American Headquarters in Georgia, which is also home to the new MAGE SOLAR ACADEMY, a 10,000 square foot facility with classroom technology and an indoor/outdoor simulation area for hands-on training.

MAGE SOLAR USA

www.magesolar.com

Booth 7223

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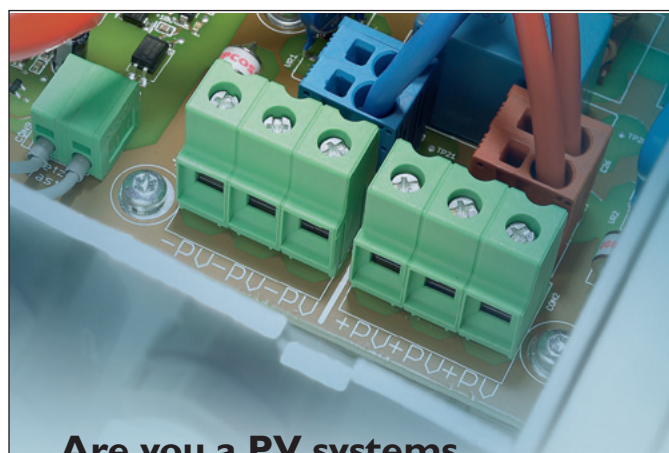
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PV wafers

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Schunk Kohlenstofftechnik GmbH
www.schunk-group.com
Schunk Graphite Technology
www.schunkgraphite.com
Booth 8534E

PV performance verification tool

Solmetric is a supplier of tools for solar installers including the PV Analyzer, a complete electrical test solution for verifying photovoltaic array performance. The PV Analyzer measures the I-V curve of PV strings and compares it to the predictions of a built-in performance model. The measurement unit can be connected at the DC combiner box, and it communicates wirelessly with a tablet, netbook, or laptop running the PV Analyzer software. Measurements are initiated from the software, and the results are available in seconds. An additional wireless sensor kit provides readings of temperature and irradiance nearly simultaneous to the electrical measurement, creating a highly accurate performance model and automating the commissioning process. Measurement results can be saved in the form of a CSV file. Data from an entire commissioning visit can be easily imported into the Solmetric IV Data Analysis tool for further inspection. Also featured: the SunEye 210, SunEye Extension Kit, and PV Designer.

Solmetric | www.solmetric.com
Booth 7138



Resistance brazing system

Miyachi Unitek Corporation, a manufacturer of resistance welding equipment and laser processing systems, showcases its resistance brazing systems for PV panel manufacturing. The company also features its IPB-5000A inverter power supply, its 70 series servo-motor driven weld heads, and pincer weld heads. Miyachi Unitek's IPB-5000A inverter power supply provides metallurgical bonding of tin-plated copper ribbon and buss bar interconnects for PV panel manufacturing. The resistance brazing system, which consists of a power supply, transformer, and brazing head, is easily integrated into most PV panel manufacturing operations. It offers 5 kHz fast feedback for the best welding control, as well as a full-color LCD to show all parameter traces for easy understanding of the welding process.

Miyachi Unitek | www.miyachiunitek.com
Booth 5425



Central inverters

Schneider Electric Renewable Energies business presents full solar solutions, including the Xantrex XC 1000 Vdc inverter, which will be available for shipment in early 2012. The XC Series is a new line of central inverters designed for high efficiency and flexibility for any PV panel type and installation. The XC series has peak efficiencies of 98.7%, and its flexibility allows the inverter to be configured with voltage and power outputs up to 680 kVA. In addition, the XC series is designed to allow for DC inputs up to 1000 Vdc for longer string lengths.

Schneider Electric
www.schneider-electric.com
Booth 7510



Custom extrusions for solar market

Sapa Extrusions, a global manufacturer of aluminum profiles, is a key supplier to the solar industry. Sapa's Renewable Energy Organization provides solutions to all solar market segments, including: PV racking and mounting systems (open field, flat roof, and residential); solar thermal (H₂O) applications; module frames and components; concentrated solar power (CSP) collectors; inverter housings and components; and, thermal management solutions. Supporting Sapa's 16 North American manufacturing facilities is Sapa's North American Technical Center. Sapa's NATC works with customers to establish finished designs for innovative custom features and improved end-use applications. Sapa's manufacturing capabilities include standard and custom extrusion, finishing (painting and anodizing), as well as full fabrication and logistic services. Sapa supplies critical components for solar applications that help customers optimize the value of their products.

Sapa Renewable Energy | www.sapagroup.com/solar
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In Defense of the Imperfect But Important Loan Guarantee Program

By Larry Eisenstat & Steven Wellner

ON MAY 10TH, 2011, the US Department of Energy (DOE) announced it will process only a select few of the last pending applications under the Section 1705 Loan Guarantee Program, created by the American Recovery and Reinvestment Act (“Recovery Act”), which is set to expire at the end of September 2011. For those applicants who didn’t make the cut, this was the last in a long series of frustrations in trying to obtain federal backing for their projects. So, as the Section 1705 program winds down, taking with it one of the Recovery Act’s last major energy related initiatives, what’s next for the loan guarantee program? And, has it really been worth all the trouble?

Criticism of the loan guarantee program has been plentiful. To some, the program was remarkably slow to ramp up after its creation in the form of the Section 1703 “innovative technology” program, in the Energy Policy Act of 2005. Processing times were often interminable (frequently running into years) and the OMB’s conservative risk evaluations dramatically increased the cost of the guarantees, thereby frustrating applicants and advocates (both from outside and within DOE) alike. These and other criticisms turned the program into a favorite whipping boy for Recovery Act critics, so much so that when the DOE ostensibly failed to issue guarantees “fast enough,” the \$6 billion appropriated for the Section 1705 program was raided like a piggy bank to fund other stimulus initiatives, including the Cash for Clunkers program and a multi-billion dollar state aid bill.

Although the program’s slow progress was the subject of multiple congressional hearings, and its administrators’ record-keeping practices were criticized in a federal oversight report, it has, so far, survived repeated attempts to eliminate it altogether. In fact, Congress elected to breathe new (if limited) life into the program in April 2011, appropriating \$170 million of new funds to cover the credit subsidy costs for renewable and energy efficiency projects under the surviving Section 1703 program. As of June 1st of this year, the DOE has not announced how it intends to allocate those funds, although the appropriation makes clear that some Section 1705 applicants will be eligible to receive them. This should, at least, soften the blow for a few of the projects that didn’t make the September cut.

Given its tumultuous history and the number of projects that failed to secure a Section 1705 guarantee, some question whether the program is worth saving at all. Yet, for all the criticisms, it’s reasonably clear the program has, and continues to serve, a critical role in the financing and development of a variety of high-dollar, technically innovative or otherwise high-risk energy projects. Though some of the awardees might never get to the finish line, even with a loan guarantee, the fact remains that in just over two years since the Recovery Act jumpstarted the loan guarantee program, DOE has issued more than \$30 billion in loan guarantees or conditional commitments for those guarantees to projects—ranging from the first new nuclear project in roughly three decades, to innovative large-scale solar and wind projects, to cutting-edge efficient, end-use energy projects. Those \$30 billion,

in turn, support over \$47 billion in total investment. And, as the DOE races to close its remaining guarantees before the end of September, those figures will likely climb closer to \$40 billion and \$60 billion, respectively.

Simply put, at least at a macro level, the program is working, however slowly, to move important renewable and other clean energy projects toward financing and construction. In fact, the program’s importance is obvious when one stops to consider the impact on those applicants who failed to obtain an acceptable loan guarantee. For many applicants, the unavailability of a loan guarantee plainly has left them somewhere between being on life support and dead in the water. Most notably, perhaps, is Constellation, which reportedly abandoned its proposed expansion of the Calvert Cliffs nuclear facility after learning the expected cost of the loan guarantee would exceed what it believed the project reasonably could bear. And, more recently, there’s NRG Bluewater, which decided indefinitely to suspend work on a proposed wind project off the coast of Delaware upon learning that DOE didn’t include its application in the group of Section 1705 applications still to be processed. For these projects, and presumably others that successfully proceeded through the program, obtaining a loan guarantee was not simply gravy (i.e. a financial add-on to a *pro forma* already sufficient to justify a project’s construction)—it was a necessity. Indeed, as noted, obtaining a loan guarantee was a prerequisite even for many applicants with significant access to private capital. In the case of NRG Bluewater’s Delaware project, it was even an executed, long-term power purchase agreement with a major utility.

These high-profile cases and the dogged commitment of other applicants to obtaining a guarantee notwithstanding the program’s drawbacks, suggest that many—and, perhaps, even most—of the loan guarantee recipients wouldn’t have been able to develop, finance, and build their projects without DOE support. Although, admittedly, a rather unsatisfying defense of the loan guarantee program, it’s fair to say that whatever the program’s faults, many project developers are still better off having received the benefit of this arguably flawed program than not at all.

Finally, the success of the loan guarantee program should not be measured primarily by its ability to churn out guarantees, but rather by the value of the guarantees to their recipients and the long-term success of the projects with respect to which guarantees were issued—the latter measure not being fully assessable for some time. We do know that for those developers fortunate enough to obtain a loan guarantee, the program has served and, hopefully, will continue to serve, as a valuable tool in turning innovative and high-risk projects from concept to reality.

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Recent Trends in Turbine Supply Contracts

By Joanna K Horsnail & Nate Galer

For professionals in the wind development industry, it's essential to stay up-to-date with ever-changing turbine supply trends to maintain a competitive advantage in today's market. These trends, including longer financing terms and impacts of rapidly changing technologies, have made turbine supply negotiations more complex. The following highlights some of the areas in flux likely to impact parties negotiating turbine supply contracts, warranty agreements, as well as operations and maintenance (O&M) agreements in the near term.

Contract assignment restrictions

Though turbine suppliers have always been wary of assignments by project owners to competitors of the supplier, some turbine suppliers are moving toward even more restrictive positions. Turbine suppliers are extending this restriction to cover not only direct competitors of the turbine supplier, but also any affiliate of a competitor. Additionally, they are increasingly concerned with extending this restriction to financing parties looking to assign the turbine supply agreement as part of their remedial rights under a project financing. These trends can be challenging for owners and financing parties alike. Affiliates of certain turbine manufacturers are active equity investors in the US wind market (and cutting them out reduces resale/investment options), and financing parties are not used to being bound by such restrictions on foreclosure options.

IP escrow agreements

Some turbine suppliers are also seeking to toughen intellectual property escrows in two ways. The first is to lengthen the standstill period after bankruptcy filing. This means owners must wait longer after the commencement of bankruptcy (to allow for a reorganization) to get access to the drawings needed to keep the project running. The second is to require, before an owner can access the escrow, that all turbine supplier affiliates be unable to provide spare parts, as well. This places owners in a difficult position: they may not know what affiliates exist, have no contract or guarantees with such affiliates, and often have the burden of demonstrating these affiliates (many of which are foreign) are incapable of providing spare parts.

Serial defect warranties

Turbine suppliers are increasingly reluctant to provide serial defect warranties, arguing that the combination of a standard equipment warranty and availability warranty offers sufficient protection. Some owners and financing parties have countered, however, that warranties provide comfort that serial defects will be fixed before they become a larger problem, which impacts revenues.

The periodic calculation of availability (often only once a year) can adversely impact owners in a couple of ways. For one, long calculation periods allow the turbine supplier to cover poor performance from a serial defect during the rest of the period. Therefore, as long as the project averages the guaranteed availability, no damages are owed, but owners and financing parties are still impacted by the revenue that could have been received if proactive measures had been taken. Moreover, even if damages are owed, they are only paid out after the relevant period (i.e. one year or longer) and cash flow and loan repayment may be impacted in the interim.

Sound warranties

Many turbine suppliers increasingly offer only a basic sound warranty, if any, coupled with a disclaimer of any other sound-related liability. Whether done to eliminate local ordinance risk or protect against not-in-my-backyard (NIMBY) claims of nearby property owners, the impact on owners and financing parties is clear—turbine suppliers are avoiding exposure to disputes over the sound levels of their turbines. As a result, owners and financing parties must seek comfort on sound-related NIMBY and ordinance issues through the due diligence and siting process, rather than relying on the turbine supplier sound warranty.

Duration and exclusivity in O&M agreements

Where two- to five-year contracts were once the standard, it's not uncommon now to see turbine suppliers offering durations of 10 years or more as a way to lock in long-term revenue flow. Many owners (and their financing parties) welcome such arrangements if provided at a reasonable price and accompanied by corresponding warranty extensions. Along with increasing duration, many turbine suppliers require exclusivity provisions in which the owner agrees that the turbine supplier will be the only entity providing operations and maintenance services during the term. Owners and financing parties often struggle, however, with whether it's a good deal to lock-in one provider for a long duration.

"Phase II" O&M agreements

Some lenders have recently been requiring so-called "Phase II" O&M agreements as a precondition to funding. These Phase II agreements essentially lock-in an aftermarket O&M provider to step in and perform services once the turbine supplier leaves, and provide comfort that a capable party will be operating the project for the term of the loan. This trend is far from settled, however. Some owners/lenders are reluctant to allow, let alone require, a Phase II agreement, as they believe the future US market is likely to be increasingly full of capable and inexpensive operators. This is particularly true as most Phase II operators are reluctant to offer termination for convenience provisions and require the same exclusivity provisions mentioned above.

Future trends

While many of the trends discussed in this article are being driven by major turbine suppliers (notwithstanding the challenging market conditions in which they are currently operating), some short-term future trends may be driven by financing parties. As financing terms seem to be lengthening for US wind energy projects, and new turbine products are coming on the market, financing parties are looking to mitigate their exposure to long-term technology risk. As suppliers, owners, and lenders try to balance their competing interests in a rapidly changing market, parties can make turbine supply negotiations more efficient by keeping informed of market trends and drivers.



Joanna Horsnail is a partner in Mayer Brown's Renewable Energy Industry Group. She advises on design, construction, supply, warranty, O&M, and more for complex development and financing matters, with expertise in the renewable energy sector.



Nate Galer is a senior associate in Mayer Brown's Renewable Energy Industry Group. He has experience representing lenders, investors, owners, developers, and suppliers in reviewing and preparing a wide variety of wind farm documentation.

Mayer Brown LLP | www.mayerbrown.com

Global Solar Projects Turn to Technology

To track, measure & justify investments

By Robert Schaefer

WITH DIMMING SUPPORT FROM LEGISLATION, grants, and subsidies, capital markets remain as tight as ever in the risky world of clean energy investing. While the economy may be slowly recovering, most solar companies looking for capital infusion still face difficulties in raising funds from banks, venture capital, and private equity firms wary of the next bubble. As solar firms search for new ways to keep the lights on, some are finding salvation through strategic partnerships with enlightened investment firms looking to achieve “triple-bottom-line” goals, defined by environmental stewardship, social responsibility, and solid economic metrics.

The struggling global economy has put the brakes on building solar projects for the sake of feel-good environmentalism. Today’s business executives want to know the dollars and sense of their solar systems, and not just feel good about them and hope for the best. Comprehensive energy monitoring and financial management software solutions for renewable energy developers, distributors, and investors are establishing today’s cleantech best practices, and bringing business sense to the partnerships that will drive the industry to the next phase of development. When the right data is available for financial and performance metrics, businesses and shareholders can start seeing the trajectories

of increasing performance and decreasing risk, along with returns on those long-term investments.

Today’s fastest-growing solar developers are taking advantage of the latest technology innovations and falling software price points to bring new standards to solar installation performance monitoring. From the inverter to the grid, sophisticated financial partnerships are shifting business paradigms with cloud-based solutions that deliver 360-degree views of their systems—making it easier to predict future performance, set pricing, market competitively, and illuminate the benefits of solar power to multiple constituents.

“These software, data, and user-interface tools are the key to managing assets and making triple-bottom-line business sense for the solar projects we’re developing around the world,” said Jonathan W Postal, Main Street Power senior vice president of business development. “The partnerships we’re building on this technical foundation are leading the solar industry toward commercialization, and toward the greater goal of achieving environmental, societal, and financial success.”

By bringing this level of detailed analysis and financial asset monitoring to the table, the solar industry is finally attracting big investment firms to prioritize these projects and embrace the triple bottom line business ethic. Many of the larger financial institutions now have internal practice areas focused on developing and implementing environmental, social, and economic sustainability strategies.

“We are focused on expanding these innovative partnerships,” said Martin Mobley, vice president of MS Solar Solutions at Morgan Stanley. “These partnerships help distribute solar power in a way that makes business sense and supports our commitment to triple-bottom-line business metrics.”

One example of how these partnerships are putting technology to work are the recently completed solar installations by the state of Colorado, dedicated this past Earth Day by Gov. John Hickenlooper. The 390 kW distributed solar PV installation on four state correctional facilities was made possible through a sophisticated partnership whose multiple and diverse players rely on an asset-monitoring platform with a universal, understandable, and accessible user interface.

“This project shows the value of creative thinking and collaboration to promote renewable energy, cut red tape, and create jobs,” said Hickenlooper.

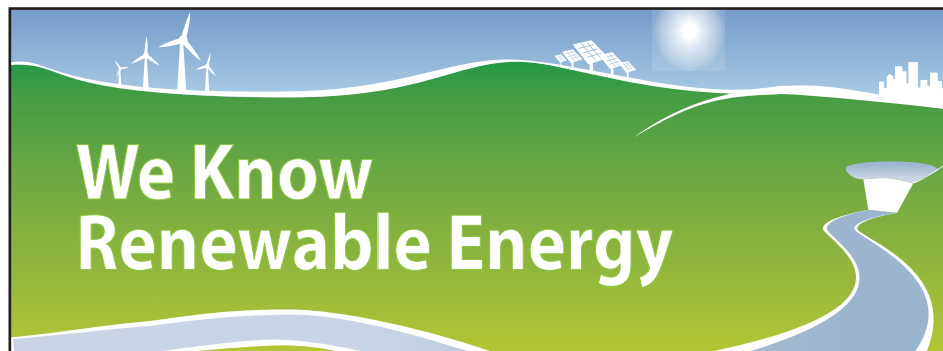
Although the project illustrates the state’s social commitment to renewable energy, the focus has been as much on the business benefits about saving the cash-strapped state money and creating jobs in a tight economy. It’s through the software monitoring tools installed at these sites that the Governor and others were able to tout the triple-bottom-line economic and environmental benefits of the system. The same systems have been used to analyze the development and financials of more than 50 MW at more than 300 solar projects around the world, including K-12 schools, colleges, and municipal, and state government facilities.

From residential and government to commercial and utility-grade applications, energy and asset monitoring technology has become a pivotal piece to the commercialization puzzle, increasing business results with online access to critical cost and consumption data. With the ability to create client-customized web applications that can be accessed and shared by wide-ranging investors and constituents, solar developers and financial institutions can now model, reduce risk, optimize price points, improve energy supply chain transparency, reduce real-time electricity demand, and bring strategic vision to energy portfolio administration. Mission-critical, real-time monitoring technology is here today, making it possible to deliver cost-competitive solar energy in the march toward electric power grid parity.

Robert Schaefer is the CEO of AlsoEnergy.

AlsoEnergy | www.alsoenergy.com

“We are focused on expanding these innovative partnerships... These partnerships help distribute solar power in a way that makes business sense and supports our commitment to triple-bottom-line business metrics.”



Troutman Sanders LLP is one of the world’s leading energy law firms. We have represented clients in energy matters since the 1920s, and our climate change practice has been active for nearly two decades. From this foundation of experience, we have developed a dynamic renewable energy practice that advises clients worldwide at every stage, from investment and tax structuring to development, construction and operation.

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WindGen Energy
www.windgenenergy.com
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Wind turbine manufacturer

Aerostar, Inc. is a US manufacturer of wind turbine systems. Their six-meter 10 kW and Independence 32 kW two-blade design is rugged and efficient, particularly at low-wind speeds. The induction generator interfaces directly with the utility grid, without a complicated or expensive inverter. The color touch screen display and web-based monitoring system makes for simple operation. All Aerostar systems have tilting towers, which allow for cost savings and installation and maintenance. Aerostar has introduced the 32 kW Independence Mid-America Edition designed for the country's heartland farming operations. It includes an 80' tilting lattice tower, raising winch system, enhanced electronics package, and complete turnkey installation performed by the Aerostar Wind Group organization.

Aerostar, Inc.
www.aerostarwind.com

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www.smallandcommunitywindexpo.org



Community wind farms

OwnEnergy develops community wind farms (10 MW to 80 MW) in a way that addresses the siting, permitting, and transmission issues that frequently challenge other wind development projects. By teaming up with landowners and local developers to develop mid-size wind farms, OwnEnergy capitalizes on the converging trends of consumers' desire for clean energy and distributed generation. Because of their size, community wind farms often require little or no upgrade costs to interconnect to the existing transmission system. Local ownership results in community support rather than opposition.

OwnEnergy | www.ownenergy.net



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Nordic Windpower is a designer and manufacturer of one-megawatt, two-bladed wind turbines, ideally suited for onsite generation, community wind, and small wind farms. Their N1000 incorporates a patented, flexible teeter-hub, which dissipates loads caused by wind shear from passing into the drivetrain, thereby increasing reliability and lowering maintenance. It enables a lighter, simpler, more affordable turbine, which is less expensive to transport, install, and maintain.

Nordic Windpower
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Wind energy equipment provider

Free Breeze Energy's premier product is the RRB (V47) PS600. RRB's PS-600 is still manufactured using the same exacting standards that have always made the V47 a work-horse, with over 5000 installations. It is still equipped with the same European brand-name components in the nacelle (e.g. gearbox and generator), the same V47 OEM hub assembly, and the same blades, formed on the same OEM blade machines installed at the original time of tooling.

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Consulting services

Electric Power Engineers, Inc. (EPE) offers engineering consulting services for the energy industry. They have extensive experience in guiding generation developers through the process of evaluating transmission grid deliverability, applying for interconnection, and coordinating design/engineering/procurement. They also offer expertise in generation interconnection to ERCOT, SPP, WECC, MISO, and NYISO. EPE addresses all aspects of transmission grid evaluation, including: generation export analysis; analysis of transmission deliverability and wheeling across networks; generation interconnection feasibility studies; system impact studies; congestion and loss analysis; and, estimation of electricity sales price (\$/MWhr) using LMP analysis.

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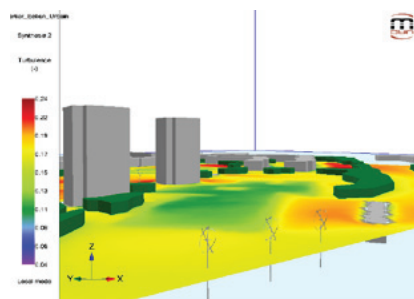


Small wind vertical-axis turbines

Urban Green Energy (UGE) offers small wind and renewable energy systems. With over 100 quality distributors and installations in 50 countries, UGE designs, manufactures, and markets vertical-axis wind turbines and hybrid renewable solutions with safety and reliability in mind. Their vertical-axis turbines include the eddy (600W), eddyGT (1 kW), and UGE-4K (4 kW), which can be installed with a tower or roof mount and a grid-tie or battery backup option. Plus, their two hybrid streetlamps operate entirely on renewable wind and solar energy.

Urban Green Energy

www.urbangreenenergy.com



Small wind assessment

Computational Fluid Dynamics (CFD) method is a good solution to assess small wind resources. For engineering firms, community wind developers, ranchers, industrial facilities, farmers, municipal utilities, or architects, the first step is to identify how a wind project would perform while ensuring it will be economically viable. CFD provides accurate results wherever the small wind power project can be: in open rural spaces or in complex urban environments. Meteodyn CFD software model wind circulation around urban obstacles and allows representation of the turbulence and the wakes around buildings. CFD software can also evaluate the wind energy potential in rural areas and community land. All the wind characteristics are given—wind speed-up factor, wind gust, turbulence intensity—to optimize the small wind turbine location and wind production assessment.

Meteodyn | www.meteodyn.com



Variable speed turbine technology

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Suzlon | www.suzlon.com

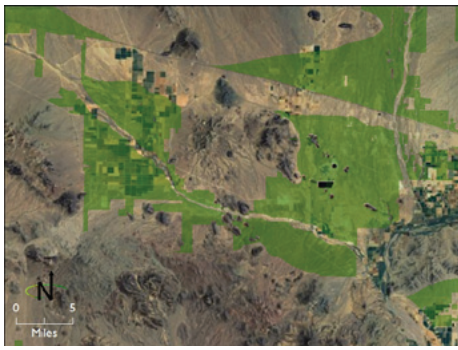


Self-raising tower systems

American Resource & Energy offers Assembled Foundation System (AFS) and Ground Control self-raising tower systems. AFS is a cost-effective pole solution for smaller turbines and can be installed above ground. The 30-foot tower is easily raised and lowered via the hand-operated hydraulic jack, allowing added components like solar panels or lights to suit specific needs. The Ground Control manual self-raising tower system features a fixed vertical gin pole to raise or lower towers up to 50', depending on the turbine loads, in 15 minutes. The motorized system uses a non-hydraulic 120v/240v motor and worm screw jack in various sizes for tower heights up to 100', depending on the turbine loads.

American Resource & Energy

www.arendtowers.com



Smart Permitting of Geothermal Projects on Federal Lands

By David Batts & Andrew Gentile

EMPSi's Constraint Assessment for Siting (CAS) model incorporates over 30 variables, including environmental and infrastructure, to show the best places for development (as shown in green) and methods to mitigate impacts.

THE FEDERAL GOVERNMENT manages approximately 60% of the lands in the western United States—lands that also happen to hold the best geothermal resources in the country. Most projects in the west affect federal lands either directly, through proposing power generation on those lands, or indirectly, through transmission line routes that must cross those lands to get the power to market. Along with solar and wind developers, geothermal developers are increasingly working with federal agencies to get projects underway. Developers find themselves most often working with the Bureau of Land Management (BLM), which has the delegated authority to lease and permit geothermal projects on most federal lands.

For geothermal projects, development on federal lands first requires a geothermal lease. After acquiring a lease at a public lease auction, a geothermal developer must go through the BLM permitting process for all future activities, including exploration and development. As a decentralized agency, permitting requirements can vary across the BLM and, where not mandated by law or internal BLM direction, are decided at the Field Office or District Office level. This lack of consistency, combined with a lack of BLM personnel with experience in permitting geothermal projects, has created a sometimes nebulous and cumbersome process for industry proponents.

Over the last few years, the BLM has made great strides in improving the leasing and permitting process for geothermal projects. Leasing has significantly increased since 2008, when the BLM implemented the findings of the Programmatic Environmental Impact Statement for Geothermal Leasing in the Western United States (BLM 2008). Likewise, the issuance of new guidance for permitting drilling and utilization has clarified expectations, while the hiring of more agency staff dedicated to processing geothermal project applications—including the establishment of several Renewable Energy Coordination Offices—has helped to alleviate workloads. These changes mean industry proponents can expect greater expertise and more efficient permit processing from the BLM.

Other trends that offer a peek into what the future may hold for geothermal developers on federal lands include the following:

- **The ongoing release** of the BLM guidance at the Federal and state levels. Guidance from Washington and state offices means BLM decision makers in the Field and District Offices have narrower parameters within which they may employ their discretion. The BLM State Office for Nevada now has a standardized project schedule for processing

geothermal applications. This is good news for proponents because it means greater consistency in how the BLM processes permit applications, and it offers proponents a better idea of the timeline and steps involved in the permitting process.

- **Ongoing development or adoption** of survey protocols for individual biological species, as well as for classes of species. Here, the upside for proponents is they will be able to better estimate the time and cost commitments required to address biological resources in a given project area. The downside is that protocols for techniques and calendar survey windows are often very specific, resulting in more time and cost than the previously common general biological surveys. Adding this to the recently released guidance for golden eagle surveys, the exact details of which are defined by the local Fish and Wildlife Service on a project-by-project basis, geothermal proponents are seeing substantially higher costs for these baseline surveys than in the past.
- **Changes to National Environmental Policy Act (NEPA)** mitigation requirements. For those readers familiar with NEPA's more stringent cousin, California Environmental Quality Act (CEQA), these two environmental regulations may now have more in common than ever before. Where NEPA has historically been fairly loose in the

identification and monitoring of mitigation to reduce environmental impacts, CEQA has long required specific and detailed mitigation measures, often incorporating a mitigation monitoring plan that identifies what's to be monitored and by whom. The gap between the two approaches seems to be narrowing with the January 2011 release of the Council on Environmental Quality's (CEQ) final guidance on the "Appropriate Use of Mitigation and Monitoring and Clarifying the Appropriate Use of Mitigated Findings of No Significant Impact."

The guidance mandates federal agencies issuing permits to:

1. Commit to mitigation where the environmental analysis assumes implementation of that mitigation;
2. Monitor the implementation and effectiveness of mitigation commitments;
3. Make information on mitigation monitoring available to the public; and
4. Remedy ineffective mitigation when there is Federal action remaining to be taken.

To be successful in this decade of renewable energy, project proponents must have the commitment and the resources to conduct up-front planning, collaboration, and innovative designs. A focused analysis of not only

the geothermal resource potential, but also the environmental and cultural constraints is essential prior to investing in a potential lease nomination area. Available technologies and models can easily guide projects to areas where development is compatible with existing resource values.

Likewise, plans of operation and utilization should include rigorous value engineering analysis to encompass site-specific constraints. Proponents would also be wise to build potential mitigation measures into the project as design features, and to provide alternative approaches to implementing the project. Lastly, proponents should invest in and proactively promote early, continuous, and effective collaboration with all stakeholders. The shifting demographics of the western US have given rise to an involved public and engaged stakeholders that must be vested in the project for it to succeed.

David Batts works for the Environmental Management and Planning Solutions, Inc., (EMPSi) in Boulder, Colorado, while Andrew Gentile works for EMPSi in San Francisco, California.

Environmental Management and Planning Solutions, Inc.
www.empsi.com

National Geothermal Summit

Conference & Expo
August 16-17, 2011
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For more information, and to register, visit: <http://www.geo-energy.org/nationalgeothermalsummit/main.aspx>

Understanding Geoexchange Heat Pump Technology

By Ruben Arellano, P.Eng. & Michael Schriver, P.Eng.

GEOEXCHANGE, also known as ground-source or geothermal heat pump technology, takes advantage of the abundant low-grade solar thermal energy that's stored in the ground year-round—free energy under our feet. This energy is captured and delivered by use of a ground-heat exchanger (GHX) and standard heat pump technology.

The heat pump is the mechanical device which, through the well-understood vapour-compression refrigeration cycle, readily concentrates low-temperature heat energy into high-grade, useable heat for space heating and hot water heating. The same heat pump can operate in reverse to use the ground as an efficient heat-sink to provide cooling. The heat pump can distribute water for hydronic applications, or distribute forced air with a fan-coil, much like a standard boiler or furnace.

There are many types of GHX, and each is suitable to particular site locations and applications. Ground heat exchangers are commonly one of two broad types: closed-loop or open-loop.

Closed-loop GHX circulates water-based heat transfer fluid through a closed circuit of durable, sealed plastic pipe. As the fluid circulates, it provides low-grade heat from the ground to the heat pump, which then provides heating or cooling as described above. The circuit is typically installed into a number of sealed boreholes, which are drilled up to 500 feet below ground surface. The number of holes depends on the ground formation and energy demand of the building; a typical residence may require two to six holes, while commercial-scale projects may require dozens or hundreds. Some closed-loop systems have the piping laid horizontally in shallow trenches or submerged in ocean, lake, or river water.

Open-loop systems utilize a readily accessible body of water such as the ocean, lake, or, more commonly, a groundwater aquifer. In surface water open-loop, a simple intake and outfall piping system is used to exchange heat with the heat pump. In a groundwater open-loop system, a water supply well is used to pump water out of a suitable aquifer and, most commonly, returned to the same aquifer in another well a suitable distance away.



There are many other types of GHX applied around the world including loops set in foundation piles (energy piles), metal plate heat exchangers (Slim Jims), direct exchange (DX), and more. Only a small amount of electricity is used to operate the system while it extracts and concentrates free energy from the ground, resulting in overall energy efficiency that is 300% to 500% greater than can be achieved with common natural gas or electric equipment. Greenhouse gas emissions are reduced by the same dramatic degree.

The Canadian GeoExchange Coalition reports: "According to information provided by Natural Resources Canada and the US Department of Energy, a typical three-ton (36,000 Btu/hr) residential geoexchange system will produce approximately 450g less carbon dioxide per hour than a conventional system. Therefore, conversion of 100,000 homes to geoexchange systems would produce a reduction in carbon dioxide emissions comparable to converting 58,700 cars to zero-emission vehicles."

Natural Resources Canada states that "Geoexchange is the most energy efficient, environmentally clean and cost-effective space-conditioning system available on the market today," and many other authorities agree, including the US Environmental Protection Agency and the Pembina Institute.

Geoexchange systems have been in use for decades, but initially consumers were slow to adopt this technology due to low energy costs, lack of environmental stewardship and government incentives, and limited equipment options. The past few years have seen exponential growth in the demand for these systems of 40% to 60%, annually. The Canadian GeoExchange Coalition reports there are at least 30,000 residential homes and 6,000 commercial and institutional buildings in Canada with geoexchange systems. These environmentally friendly and efficient systems provide heating, cooling, and domestic hot water for every type of facility imaginable: from single family homes and vacation cottages to towering luxury condominiums and hotels, and from ice sports centres to libraries, schools, and supportive housing.

Many incentive programs are now offered by governments and electric utilities to make geoexchange systems even more affordable. The Database of State Incentives for Renewables & Efficiency (www.dsireusa.org) is a source of information on US federal, state, municipal, and utility incentives that promote energy efficiency. Natural Resources Canada's Office of Energy Efficiency Resources provides a similar database.

Since geoexchange systems are not off-the-shelf, completely pre-packaged systems, each system must be specifically assessed, designed, and constructed to suit the particular attributes and objectives of each building or application. This requires a multi-disciplined and multi-stakeholder approach not commonly required with other building elements such as plumbing, electrical, and HVAC. Specialized training and knowledge is required for design and installation. Such training is readily available from national associations in Canada and the States, and several vocational institutions are now offering trades and apprenticeship training programs.

GeoExchange BC is a non-profit, industry association of private and public interests. Founded in 2003, its focus is to provide information, education, professional development, training, and resources for the growing geoexchange industry in BC.

Authors

Ruben Arellano, P.Eng. is the chair of GeoExchange BC. He also leads the renewable energy services team at Hemmera, a consultancy based in Vancouver, BC.

Michael Schriver, P.Eng. is a project engineer with XCG Consultants in Toronto, Ontario. He leads XCG's geoexchange services team on projects in partnership with Hemmera.

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Case Study: EGS Technology Demonstration & the Idaho Geothermal Power Project

By Gloria Mabbutt

Case history

DURING THE 1970S, the Department of Energy (DOE) was mandated to develop new non-petroleum sources of domestic energy. Raft River, Idaho, 200 miles southeast of Boise, was selected as a site for DOE research because of its hot geothermal water. From 1975 to 1983, \$40 million was spent on wells, injectors, and other infrastructure to test binary cycle power technology and experiment with direct uses of geothermal fluid for agriculture and aquaculture.

This was a landmark achievement as the world's first binary power plant was developed. It had a capacity of seven megawatts (MW). Binary cycle technology proved at the time that electricity could be generated from moderate-temperature geothermal reservoirs (212° F or 100° C to 572° F or 300° C). DOE sold the site in 1984 when project funding ended. But as population increased in the western states, so did the demand for electricity. Technology improvements and reduced cost of geothermal power, combined with volatility in the natural gas market, led to increased interest in geothermal resources.

Binary geothermal power

Binary geothermal power plants have grown in the western United States and the world. With binary technology, hot geothermal water passes through a heat exchanger and heats a binary liquid called isopentane, which boils and vaporizes at a lower temperature and creates higher pressure than water. The vapor produced from the binary liquid spins the turbine-generator unit, and then it's condensed back to liquid before being re-used in the heat exchanger. After a portion of the heat is used from the geothermal water, it exits the binary plant and is injected back into the reservoir.

In 2003, financing became available to develop Raft River. By 2005, a 20-year power purchase agreement was signed with Idaho Power Company, and the first commercial-scale binary power plant in Idaho was developed with a nameplate production capacity of 15.8 MW. Commercial operations began in January of 2008.

In June 2010, two production wells were shut down; however, a Repair Services Agreement was signed in May of this year to repair the wells. This presented an opportunity to demonstrate the effectiveness of a new type of geothermal power called Enhanced Geothermal Systems (EGS).

The DOE is currently providing funding in a cost-sharing arrangement. Scientific data and an existing test well are the non-cash, in-kind contribution to this project.

Until recently, geothermal power systems have used resources where naturally occurring heat, water, and rock permeability allow

energy extraction from production wells. However, the vast majority of geothermal energy within reach of conventional techniques is in dry and/or non-permeable rock. EGS technologies enhance and/or create geothermal resources in this hot, dry rock (HDR) through hydraulic, thermal, and chemical processes, as well as stimulation causing fractures that have been sealed to open, extend, and interconnect.

Demonstration environment

Raft River's favorable characteristics make it ideal for testing. It has abundant, accessible, and moderate temperature resources at shallow to intermediate depths. It's also located within the MIT-designated High Grade EGS Area of North America, and is a favorable rock and stress environment with rock temperatures of 392° F or 200° C within 4.5 kilometers in depth. With an existing transmission and power generation infrastructure, it has a proven reservoir that may provide fluid for a deep system.

As part of this project, the reservoir will be pre-conditioned and thermally fractured using low-temperature water injection in a series of staged simulation treatments. Earlier testing indicates injection of cool water can significantly enhance injectivity. Seismic activity will also be measured and modeled.

Conclusion

Testing of EGS reservoir development is currently lacking in this country, so Raft River will again be at the forefront of geothermal explo-

ration with demonstrations expected to substantiate the range of possibilities for use of these valuable resources in the United States.

Gloria Mabbutt is part of the Division of Marketing and Communications for Idaho Department of Commerce.

Idaho Department of Commerce
www.idaho.commerce.gov

Advantages of geothermal project demonstration

- Development of new technology expected to lead to lower costs for future reservoir development and increased power generation;
- EGS/HDR technologies are distinct from hydrothermal geothermal systems in that they may be shown to be feasible anywhere in the world, depending on the economic limits of drill depth;
- HDR wells are expected to have a useful life of 20 to 30 years before the outflow temperature drops 50° F or 10° C, and no longer has the economic benefit;
- Project builds on expertise from the geothermal, oil, and gas industries;
- New geothermal scientists are being trained; and
- The 2011 Geothermal Energy Association report states the geothermal industry is producing clean power in nine states: Alaska, California, Hawaii, Wyoming, Idaho, Nevada, and New Mexico, Oregon and Utah and developing 146 projects across 15 states.



Geothermal indoor split system

Designed for installations where space is an issue, the GeoStar Aston Series Indoor Split provides the efficiency of geothermal and the versatility of a split system. When added to an existing fossil fuel system, the geothermal unit provides highly efficient heating and cooling with backup. When combined with a GeoStar air handler, the unit is ENERGY STAR rated and eligible for the 30% tax credit. Available in two- to six-ton capacities, the Aston Series Indoor Split features a microprocessor that sequences equipment for peak efficiency.

The Comfort Alert option adds advanced self-diagnostic features, additional status display features, as well as smart communication between the unit and thermostat. Premium scroll compressors provide exceptional efficiency and reliability. All compressors are mounted on a heavy-duty isolation plate with sound dampening rubber grommets to reduce operation noise. In addition, an optional hot water generator allows the Aston Series Indoor Split to pre-heat water and deliver it to a water heater. In heating mode, water is heated at the efficiency of the unit. In cooling mode, the heat from the home is transferred to the water heater rather than the ground, providing free hot water.

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re-li-able

1: suitable or fit to be relied on

2: giving the same result on successful trials



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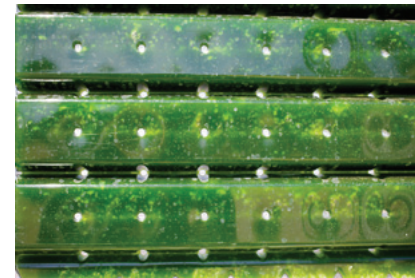
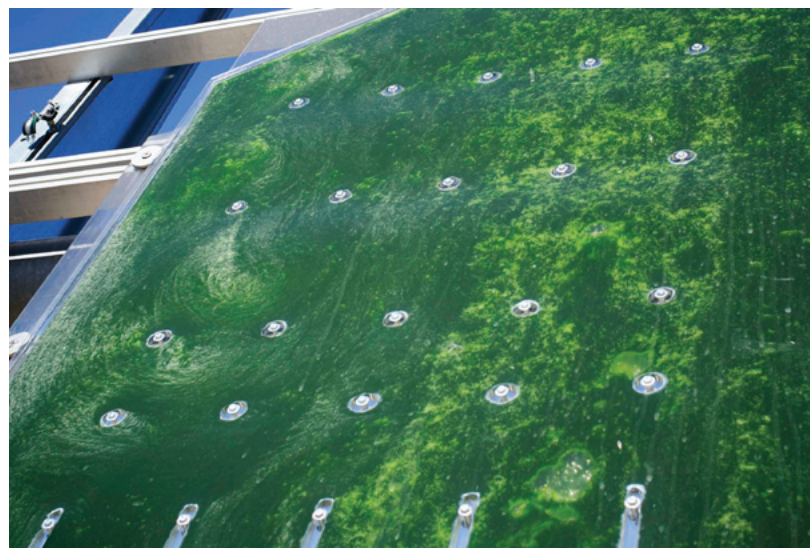


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Algae's Path to Alternative Fuel Feasibility

By Hoyt Thomas

WE'VE KNOWN FOR YEARS that algae contain oil. Yet, commercial interest in algae's potential as a meaningful, economically feasible source of alternative fuel is relatively young. Whether the cause is ever-increasing fossil fuel costs, concern about carbon, or simply scientific progress, algae is now on the world's fuel radar. Considering the United States' target for biofuel production is 36 billion gallons by 2022, one can see why algae will play a role in meeting the advanced biofuel mandate.

Investment and advances in algae strain optimization and algae growing technology make its' contribution to the fuel mix increasingly realistic. Research and development, as well as commercialization activities have been funded by a mix of government grants, private equity, venture capital, and public offerings. The funding committed to algae companies exceeded \$600 million in 2009. One industry report concluded that the market for algae cultivation, harvesting, and oil extraction technologies is expected to grow from \$271 million in 2010, to \$1.6 billion in 2015—an astonishing 43% compounded annual growth rate—as commercialization accelerates with additional backing from major industry leaders.

Two main algae growing platforms, photosynthetic (dependent on sunlight and carbon dioxide) and heterotrophic (dependent on carbon sources and oxygen), are advancing toward commercialization. Both platforms demand a cost-effective approach to producing bio-based products from algae. Innovative new players are expanding beyond nutraceuticals, and are using waste inputs to lower operating costs. Photosynthetically-grown algae is the focus of much of the recently funded activity as many believe that photosynthetic approaches will provide the scale and cost profiles needed for biofuel applications.

Regardless of the growth platform, however, algae already yield key ingredients for nutraceutical and cosmeceutical applications. Today, algae and algae-derived products are used in infant formula, nutrient supplements, food coloring, food additives, aquaculture, animal feed, and more. Using algae for these applications routinely calls for using the biomass in its entirety, or extracting and separating the oils using methods that turn the biomass into a waste stream.

Why is the biomass discarded after the oil is extracted? Two primary reasons:

1. Current separation and extraction processes to recover the oils typically contaminate the biomass with solvents, rendering the biomass unusable for other applications; and
2. Margins in nutraceutical and cosmeceutical applications typically are high enough to justify the waste. In fact, the largest algae oil producer in the US discards its algae biomass after extracting the oil; the cost of solvent removal outweighs the market opportunity.

To unleash the full potential of algae, processing methods must evolve to the point that oil and biomass streams can both be sold

as commodities into the highest value markets available, as is the case with soy. As low-cost processing methods become available, the algae industry will mature more rapidly. Companies that routinely discard biomass after extracting oils will have new markets to pursue. Wastewater treatment facilities using algae to clean water will have access to new revenue streams. And, the industry will make progress toward the large-scale prize: renewable fuel from algae.

Algae's potential to generate biofuel, food products, and renewable chemicals via waste streams and/or sunlight has drawn attention from a broad spectrum of industries. The commercial airline industry is eager to have access to renewable jet fuel. First-generation biofuels, ethanol, and biodiesel cannot be used as drop-in fuels by the aviation industry. As carbon controls continue and carbon is—perhaps—eventually priced, advanced biofuels will help the airline industry meet emission requirements and avoid fines associated with excess emissions. The availability of renewable jet fuel is also a high priority for the US military, as most military vehicles burn jet fuel blends. In particular, the Navy has established aggressive goals for renewable jet fuel adoption. Aviation fuel is a critical first step toward general-purpose algae-based fuel development.

Algae processing solutions are emerging in response to demand from many industries, as well as in response to increased algae growth productivity, decreased growing costs, and renewed focus on larger-scale applications. Just as Halliburton and Schlumberger offer equipment and services in the oil patch, technology companies are developing customizable units that will enable rapid and efficient harvesting of algae and algal oil at grower sites. These new technologies concentrate dilute algae, open the algae cell wall to release oil, and efficiently recover oil from the disrupted cells, minimizing power use and water movement, and avoiding biomass contamination from solvents. Such technologies will help algae growers develop and validate algae as a commercially viable feedstock, and will do so efficiently and cost effectively.

By using emerging technologies, algae growers will improve their ability to manage production of biomass and prove the economic viability of their business plans. Parallel advances in strain optimization, growing approaches, and production and extraction technologies will work together to move the algae industry forward.

Hoyt Thomas is CEO of OpenAlgae, a Texas-based company that is developing algae-specific processing technologies to enhance the economics of oil production from algae. The company's algae concentration, electromechanical cell lysis, and solvent-less oil recovery technologies were developed in conjunction with the University of Texas at Austin, and are designed to help emerging biofuel platforms achieve cost parity with petroleum.

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MICRO-ALGAE are one of the most readily available and easily converted resources for clean-burning biofuels including hydrogen, ethanol, and biogas. With more than 100,000 strains of algae, each has its own ratio of oil, carbohydrates, and protein molecules. Those that are high in carbohydrates can be fermented into ethanol, while the oil can be turned into biodiesel. At its simplest, algae needs only water, sunlight, and carbon monoxide to grow—although the levels, temperatures, and species must be carefully monitored to be sure conditions are ideal.

Up to 50% of algae's weight is comprised of oil, which is much higher than that of the current largest producer of biofuel oil, palm oil trees, which weigh in at 20%. Algae's oil yields are also impressive. They can produce up to 10,000 gallons per acre annually; palm only produces 650 gallons. In addition, algae are less taxing on the environment. Unlike soy or corn, it does not need land to grow. Since it grows so quickly, it can be harvested several times a year—in some cases, doubling its volume overnight. Agricultural-based biofuels crops may often only be harvested once a year.

Research in the US

US research on algae-based biofuels began in earnest during the oil crisis of the 1970s. Through 1996, the US Department of Energy Office of Fuels Development funded the Aquatic Species Program, which centered on producing biodiesel from algae grown in ponds, using waste carbon dioxide from coal-fired power plants. Although this program advanced research into production strains and systems, it was not successful in developing an economically viable large-scale operation.

Rising crude oil prices, increased energy demand and a global desire to "go green" has renewed interest in algae biofuel research. In 2010, the Department of Energy awarded \$78 million in total to the National Alliance for Advanced Biofuels and Bioproducts and the National Advanced Biofuels Consortium for the purpose of researching large-scale biofuel development from algae.

Research overseas

The Netherlands has some of the most ambitious clean energy goals in the world, and is making strides toward

a bio-based economy—one that includes the use of algae. By 2020, the country plans to obtain 14% of its power from renewable energy sources. According to a 2010 report by the Dutch Ministry of Economic Affairs, Agriculture and Innovation, the Dutch are moving steadily toward that goal. Current levels of renewable energy use in the Netherlands hover around 4%, with 75% of that energy being supplied by biomass. Last year, 20 new bioenergy plants were installed in the country. The report also identified big gains in the production of bioelectricity and biogas, and the use of biomass in the transportation industry.

As of June of this year, the first large-scale research center in the world dedicated to algae biofuel research opened at the Wageningen University & Research Center (WUR) in Gelderland, a province in the eastern part of the Netherlands. Researchers there are working toward developing an industrial-scale, sustainable, and economically sound process for commercial production of biofuels from algae within the next two to three years. Within 10 to 15 years, they expect that technology will have advanced to the point that airplanes will fly on algae-based fuels.

AlgaePARC features four unique micro-algae production systems that will eventually allow researchers to determine the most efficient system for microalgae production. The four systems include a horizontal tube-based bioreactor, a vertical tube-based bioreactor, a traditional pond system, and an entirely new system based on plastic foil. Additional features include three photobioreactor systems, and four to eight smaller outdoor units to test for the best strains, feedstocks, new ideas, and reactor concepts. Scientists will also examine how variables affect algae growth, including comparing fresh water to salt water, and how various nutrients affect the strains.

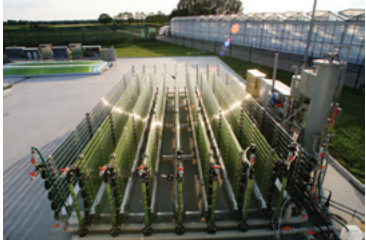
The future

It's clear that scientists worldwide are committed to breakthrough algae biofuels research. But will it ever replace petroleum as a main source of fuel? If current research succeeds, algae-based biofuels will likely be too plentiful, inexpensive, and environmentally friendly to ignore.

A Closer Look at Algae:

Researching bigger benefits for biofuels

By Hans Bakker | Photo credit: Wageningen UR



Hans Bakker is the executive director of the Netherlands Foreign Investment Agency (NFIA), a Dutch government agency that assists North American companies with expanding operations into Europe with a strategic location in the Netherlands.

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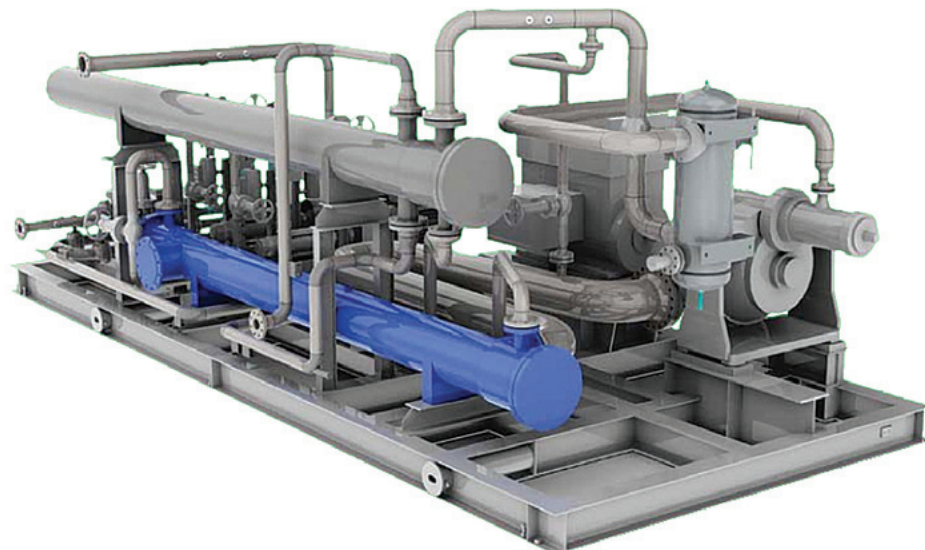
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Waste Heat Recovery

The next wave of clean tech

By Jason Gold



Waste heat recovery technology has as many renewable benefits as wind, solar, and geothermal power.

It employs environmentally friendly materials to produce useable CO₂-free electricity.

And, if utilized to its full potential, the heat recovery industry could generate a \$40 billion investment toward our economy.

THE TERMS RENEWABLE ENERGY AND CLEAN TECHNOLOGY conjure up certain images. It could be a photovoltaic panel baking in the desert, or perhaps a wind turbine slowly rotating in the Great Plains. Or, even a massive dam generating hydropower. However, there is another important and growing clean energy technology the average consumer often hasn't heard of yet: waste heat recovery.

Waste heat recovery employs a process that has been around since the 1960s, called the organic Rankine cycle (ORC), which easily integrates into existing manufacturing infrastructures. ORC units capture heat that is currently being released into the atmosphere and converts it into useable CO₂-free electricity.

The ORC process uses organic, environmentally benign refrigerants that are able to produce electricity from low-temperature heat sources and in water-restricted environments. ORC technology has a small footprint—approximately the size of a tractor-trailer flatbed. Interest in this energy generating skid is on the rise as companies look to maximize the efficiency of existing investments and infrastructures.

This technology has a proven track record with more than 150 installations in operation around the world—including 25 in the US—that have produced millions of hours of emission-free electricity. Given its relative simplicity, carbon neutrality and diminutive physical footprint, ORC is also one of the cheapest sources of renewable power generation currently available. The economic benefits of waste heat recovery systems are significant when compared to wind or solar power generation. ORC's utilization factor of more than 95% far eclipses the 25% to 35% utilization factors seen in other renewable solutions like wind and solar.

The market for waste heat recovery is virtually limitless. According to researchers at University California Berkley, the US currently consumes about 100 quadrillion BTUs of energy per

year. However, between 55 and 60 quadrillion BTUs are currently vented into the atmosphere as unused waste heat. With ORC technology, these emissions are harnessed on-site to generate useable CO₂-free electricity that is fed directly back into a manufacturing process. Pulp and paper, lumber, refinery, cement, and power plant operations are especially well suited for waste heat recovery systems since they consume large amounts of electricity and maintain consistent waste heat streams with temperatures between 400° F and 800° F.

A wave of new focus and project development activity has occurred as a result of rising energy costs, growing environmental concern, and improvements to the ORC manufacturing process. Today's new systems are modular, customizable, easily deployed, and economical to the facilities that deploy them.

The rise of independent project developers and new financing models have also helped accelerate customer adoption of waste heat recovery systems. Project developers shoulder the responsibilities of designing, engineering, constructing, and operating the ORC systems for their industrial customers. Additionally, project developers can offer customers financing options that allow resource-constrained organizations to explore the myriad benefits of waste heat recovery projects. Popular financing options include the purchase of a complete turnkey power system, leasing the system, or simply purchasing energy produced from a system installed at their site. The latter model, often referred to as the "PPA Model" (because the customer enters into a Power Purchase Agreement), relieves a company of capital expenditures and substantially shortens the sales cycle for new ORC systems. After all, who can say "no" to an offer of clean electricity, at a lower price than the utility can deliver, without any capital investment?

Facility managers, environmental experts, and forward-thinking legislators are beginning to recognize waste heat

recovery as a win-win clean energy solution. Now it is time to get Congress to pay attention to this renewable energy "hidden gem" and recognize waste heat as a renewable resource eligible for tax and environmental credits. By tapping into existing but unused energy sources, American companies can reduce energy spending, reduce carbon footprints, and reduce dependence on non-renewable sources of energy. And that's why waste heat is about to become a lot more relevant.

Jason Gold is the CEO of KGRA Energy, LP, a developer of electricity generation projects that harvest waste heat to create clean, renewable energy.

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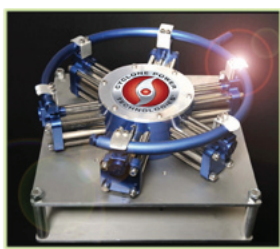


Biomass wood residue cover

Logging residue is an inexpensive and easily accessible source of biofuel. But to improve the energy content, the residue must first dry on the ground and then be stored in piles for several months. To shelter the piles from moisture through rain, snow, and ice, Walki has developed a paper-based, waterproof cover that can be chipped and burned together with the residue. Walki's biomass cover might not look high-tech, but it's an ingenious invention that efficiently improves the energy content in logging residue.

The cover itself is a four-meter wide laminate, mainly produced from renewable fibrous materials. It shelters the top of a pile, leaving the sides open to allow moisture to evaporate. A thin plastic layer within the cover makes it waterproof and strong, but because of the characteristics of the plastic, the cover can later be chipped along with the residue and used as fuel. A six-meter wide version that can cover even bigger piles of logging residue and other wood-based biofuels is in development.

Walki Group | www.walki.com



External combustion engines

Cyclone Power Technologies Inc. has developed two types of External Combustion Engines for power generation and transportation. Cyclone Supercritical Engines are capable of running on any fuel including solid, liquid, and vapor fuels. Liquid fuels include algae fuel, biofuel, gasoline, diesel, ethanol, JP8, and others. Cyclone external combustion "Clean Air" engines have extremely low emissions due to the fact that Cyclone Engines burn fuel at atmospheric pressure, thereby eliminating toxic levels of carbon monoxide and nitrous oxide. Cyclone Engines are: water lubricated; scalable in size; highly efficient; compact and lightweight. They also offer a low production cost and high torque at low RPMs. Applications include everything from portable generators and automobiles to freighters and large, stand-alone generators.

Cyclone Power Technologies
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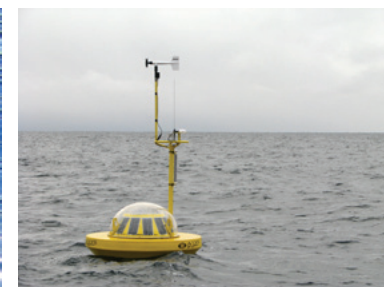
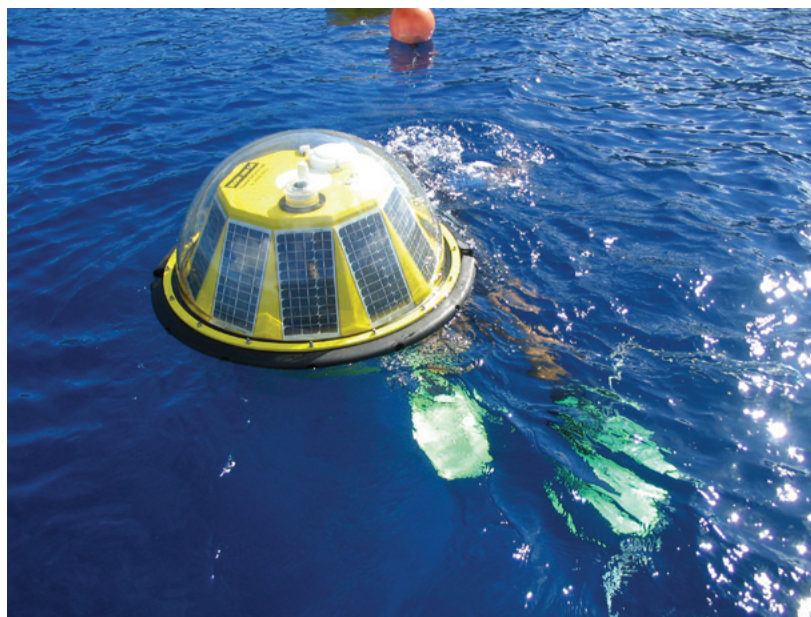
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The Value of Environmental Monitoring in Offshore Renewable Energy Developments

By Graham Howe & Don Bryan



The three leading offshore renewable energy technologies are winds, waves, and tides. While widely different in form, these technologies all employ an energy capturing mechanism using either sea or wind.

Although a relatively new technology, offshore wind energy is the leader of the three technologies with 2,946 MW currently deployed in Europe, and plans for North America's first offshore wind farm to be developed during 2012. The wave and tidal energy industries are at an earlier stage, lacking the head start the offshore wind industry gets from historical success with onshore wind. However, the Carbon Trust in the UK has estimated that 240 GW of wave and tidal energy could be deployed globally by 2050, with the majority of that coming online starting in 2020—the bulk of which will likely come from wave power.

All three of these sectors are still in a phase of significant technology development and accurate measurement will be critical to their future rollout.

Project lifecycle monitoring

The project lifecycle in these three industries develops along a similar and consistent path. Environmental monitoring at each stage is a critical factor in the success of the energy capturing device, whether it's a wind turbine, a wave-energy converter, or a tidal-energy converter.

Initially, developers work through an assessment phase where environmental measurement is crucial to the overall success of the site; not only in assessing the potential of the location, but also the positioning of the energy capturing devices.

Considerations include:

- Energy potential at the deployment site;
- Long-term survivability of the device;

Left: Wave buoy at work

Top right: Meteorological buoys: wave & weather monitoring

Bottom right: Wind resource assessment

- Ease of access for maintenance and service; and
- Proximity to the community that will receive the energy.

Of these, the most important factor is energy potential at the site. This data can be acquired from historical sources such as wave watch models, or using *in-situ* instruments such as wind, wave, and current buoys. These buoys provide reliable, highly accurate, real-time data over a long period of time, which allows developers to evaluate the location and make informed decisions about whether to use the site being monitored. In addition, the weather data analyzed by oceanographic consultants can be useful in determining if the energy capturing device will stay anchored in place so as to provide long-term energy.

Once the assessment phase is complete and the site has been confirmed, the energy farm is then developed. Given the cost of working in such a harsh environment, accurate environmental weather data is essential to control expenses and protect assets. For example, it costs approximately £12,000 (about \$19,500 US) per day to hire a service vessel, which could potentially go out to a location only to sit idle because the sea state doesn't allow the location to be serviced. Knowing the weather in advance from a data buoy transmitting environmental conditions by satellite can save developers thousands of dollars during the manufacturing phase.

Once the energy farm is built and in a production stage, it still requires constant monitoring to ensure the maximum power output is maintained. Monitoring equipment can help developers understand if they are getting the estimated amount of power from their capture



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device that they were initially expecting. To ensure developers get this data when required, a reliable telemetry choice such as Iridium, Argos, or Inmarsat satellite can be used. Data from the monitoring equipment should also be logged on-board as a backup, just in case there are transmission issues. To keep the energy capture device working year-round requires a dedicated team of trained and experienced offshore experts. The costs of ongoing service work over the long run are a significant part of the annual operational cost of offshore energy.

Finally, at the time of upgrade, developers face similar challenges to those seen at the start of a project since they're required to reassess and commence again. Initial program success is essential to gaining ongoing support from stakeholders.

Monitoring solutions & how they work

• Wave & current buoys

Wave and current data is an important parameter to monitor to ensure safe and secure waterway navigation, as well as the energy potential for a renewable energy capture device. The inclusion of water level, 3D currents, and wave height, speed, and direction spectrum are essential details for offshore developers. Wave and sea surface temperature data are collected, processed, and logged on the buoy, and then transmitted to a base station where developers can analyze the data to make informed decisions regarding their project.

• Meteorological buoys

Ocean and coastal monitoring buoys can be designed and configured a variety of ways, depending on the data requirements and environmental conditions. A typical buoy can measure wind speed and direction, atmospheric pressure, air temperature, relative humidity, water temperature, currents, waves, pH, and other water quality parameters. Raw data is processed and can be logged onboard the buoy and then transmitted to the end user. These buoys provide the dual function of automated weather station and navigational aid. Deployments can be in a variety of locations, from calm, shallow waterways to 5,000m depth in open oceans.

• Wind buoys

The standard solution for gathering wind resource assessment data is to construct a met mast equipped with anemometers. In the offshore environment this solution is difficult and expensive. New buoy-based technology uses a laser wind sensor, or LIDAR, to gather wind data at turbine hub-height that can survive in the hostile environment and provide accurate data due to its unique in-built motion compensating capacity. These buoys can be used to assess power from a loca-

tion prior to setting up or building a turbine, and then manage that turbine going forward. Additional sensors can also be integrated onto the buoy including, weather, water quality, and even bat and bird sensors.

Conclusion

Even though the offshore renewable energy industry is still in its infancy, ocean-monitoring technology has been in use for decades,

and can play an important role in making offshore renewable energy a success in the years to come.

Graham Howe is part of the International Business Development for Renewables at AXYS Technologies Inc., while Don Bryan is the company's Marine Systems manager.

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- 05-09 26th European Photovoltaic Solar Energy Conference & Exhibition**
CCH: Congress Center—Hamburg, Germany; www.photovoltaic-conference.com
- 12-13 AWEA Wind Power Supply Chain Workshop**
Des Moines, Iowa; www.awea.org
- 12-14 4th Annual Utility Scale Solar 2011**
San Diego, California; www.infocastinc.com/index.php/conference/525
- 14 CanGEA Annual Conference Exhibition & Investment Forum**
One King West Hotel & Residence—Toronto, Ontario; www.cangea.org
- 14 CanGEA 3rd Annual Geothermal Investment Forum & Networking Event**
Toronto, Ontario; www.cangea.ca
- 15-17 AWEA Small and Community WINDPOWER 2011 Conference & Exhibition**
Des Moines, Iowa; www.awea.org
- 15-17 Small & Community WINDPOWER 2011 Conference & Exhibition**
Alerus Center—Des Moines, Iowa; www.smallandcommunitywindexpo.org
- 20-22 RETECH 2011**
Walter E. Washington Convention Center—Washington, DC; www.retech2011.com
- 27-28 Optimizing Wind Power Performance – in a Post Warranty Environment**
Chicago, Illinois; www2.greenpowerconferences.co.uk

OCTOBER

- 03-06 CanWea 2011 – 27th Annual Conference & Exhibition**
Vancouver Convention Centre—Vancouver, BC; <http://canwea2011.ca>
- 11-13 AWEA Offshore WINDPOWER 2011**
Baltimore Convention Center—Balimore, Maryland; www.offshorewindexpo.org
- 11-12 BioGas West**
San Francisco, California; www2.greenpowerconferences.co.uk
- 12-14 Biodiesel & Renewable Fuels**
Houston, Texas; www.acius.net/aci/conferences/biodiesel-and-renewable-fuels.asp
- 13-14 3rd Annual RFS2, RINs & Biodiesel Forum**
Renaissance Blackstone Hotel—Chicago, Illinois; www.opisnet.com/rfs2rins/index.html
- 13-14 Global Commerce Forum: 4th Annual International Conference on Energy, Logistics & the Environment**
The Grand Hyatt—Denver, Colorado; <http://globalcommerceforum.org>
- 16-19 Electrical Energy Storage Applications and Technology (EESAT)**
Marriott San Diego Hotel & Marina—San Diego, California; www.sandia.gov/eesat
- 17-20 Solar Power International**
Dallas Convention Center—Dallas, Texas; www.solarpowerinternational.com
- 23-26 GEA Geothermal Energy Expo 2011**
Town and Country—San Diego, California; www.geothermalenergy2011.com
- 25-27 2011 Algae Biomass Summit**
Hyatt Regency Minneapolis—Minneapolis, Minnesota; www.algalbiomass.org/events

NOVEMBER

- 8-9 Advanced Biofuels Markets**
Parc 55 Hotel—San Francisco, California; www2.greenpowerconferences.co.uk
- 8-9 PV Power Generation Mid-West and East**
New York; www2.greenpowerconferences.co.uk

DECEMBER

- 14-15 AWEA Wind Resource & Project Energy Assessment**
Seattle, Washington; www.awearesourceassessment.org

JANUARY

- 9-10 AWEA Wind Power Health & Safety Workshop**
San Diego, California; www.awea.org/events
- 10-11 AWEA Wind Project Performance & Reliability Workshop**
San Diego, California; www.awea.org/events
- 16-19 World Future Energy Summit**
The Abu Dhabi National Exhibition Centre—Abu Dhabi, United Arab Emirates; www.worldfutureenergysummit.com
- 24-25 Offshore Wind Power Congress USA**
Boston, Massachusetts— www2.greenpowerconferences.co.uk
- 30-01 Energy, Utility & Environment Conference**
Phoenix Convention Center—Phoenix, Arizona; www.euec.com

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63	Canadian Solar (USA) Inc.	www.canadiansolar.com
47	CanWEA 2011	www.canwea.ca
66	Carlo Gavazzi	www.gavazzionline.com/solar
20	Ceramic Supply International	www.fjaind.com
39	CG Power Solutions	www.cgpowersolutions.com
54	Citel	www.citel.us
85	Clear Span	www.clearspan.com
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