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EDITOR Michelle Froese mfroese@nacleanenergy.com

ART DIRECTOR Rommel Ramirez production@nacleanenergy.com

SALES MANAGER lan Stuart istuart@nacleanenergy.com

**SALES** lan Stuart istuart@nacleanenergy.com

Jake Fidler jake@nacleanenergy.com

Dave Benton dave@nacleanenergy.com

**CIRCULATION MANAGER** Kristy Vail circulation@nacleanenergy.com

Accounting Alison Bell abell@nacleanenergy.com

**PUBLISHER** Ian Stuart istuart@nacleanenergy.com

**255 NEWPORT DRIVE, SUITE 336** Port Moody, B.C. V3H 5H1 Phone: (604) 461-6223

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**THEY SAY WE ARE LIMITED**, not by our abilities, but by our vision. So, the key is to dream big, right? Some might say that is exactly what President Obama was doing in his State of the Union address earlier this year. His call is for 80% clean energy by 2035—the most ambitious energy target ever set forth by a president to date.

While there has been much debate on the probability of this goal, recent research has shown that it's more than possible. It's possible on a global level, and before the US deadline of 2035. Too good to be true? The study, published in the journal *Energy Policy*, maintains achieving 100% renewable energy "indefinitely" by 2030 is not only attainable, but also affordable on a worldwide basis. At

least, assuming there exists global political support and the will to strive for this goal, which the United States certainly seems to have going for it.

According to the report, "Achieving 100% renewable energy would mean the building of about four million 5 MW wind turbines, 1.7 billion 3 kW roof-mounted solar photovoltaic systems, and around 90,000 300 MW solar power plants" (www.physorg.com). No one said it would be easy. The study focused on wind, solar, wave, and geothermal energy sources, leaving out fossil fuels, nuclear power, and biomass. Just imagine if biomass, which is currently one of the most widely used renewable energy sources, was added into the mix? The researchers purposely left it out over land-use and pollution concerns.

In the US, biomass power plants represent approximately 11,000 megawatts of capacity. Biomass provides the second largest amount of renewable energy in the nation, and is considered to be one of the most promising sources for transportation and waste management. Nearly 10% of the energy consumed in this country comes directly from garbage (yes, garbage), which might not seem like much; however, Americans throw away about 4.5 pounds of trash every day. Globally, some 140 billion tons of agricultural biomass waste is produced each year, most left to rot or burn, according to The United Nations Environment Programme (UNEP). This, of course, leads to pollution of its own in the form of greenhouse gas emissions—and, results in a lost resource that could, for all intents and purposes, be providing cleaner and more usable energy.

So, what is the solution? Is a nation dominated by clean energy possible by 2030, or by the President's goal of 2035? Should only some renewables be considered? Well, we've got to start somewhere. And, as the saying goes, it takes a village to raise a child. Just imagine what it takes to raise a nation.

This issue we bring you a diverse community of information, which includes an update on the Smart Grid (page 38) and a look at the key energy drivers that stand out so far this year (page 8). Plus, don't miss our 2011 Geothermal Buyers Guide and a display of some of the exhibitors from three upcoming shows: WINDPOWER 2011, PV America, and the International Biomass Conference & Expo. It's a busy couple of months. A good sign for the future of renewables.



news bites



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# **Clean Air Act will save lives**

The Environmental Protection Agency's report, "The Benefits and Costs of the Clean Air Act from 1990 to 2020" confirms the Clean Air Act's status as one of the strongest and most cost-effective public-health protection laws in US history, according to the Natural Resources Defense Council (NRDC). NRDC's own analysis of the agency's data shows that more than 2.2 million lives will be saved between 2010 and 2020, due to air pollution reductions achieved by 1990 amendments to the law.

View the EPA's full report by visiting: www.epa.gov/air/sect812/prospective2.html

NRDC | www.nrdc.org



# Reducing your carbon footprint

Gobi Carbon Management Solutions Inc. has announced the launch of GobiSOFT, a new webbased tool that enables small-to medium-sized businesses to easily and affordably measure, report, and reduce their carbon footprint.

GobiSOFT is based on international greenhouse gas (GHG) standards, making it one of the most credible and complete carbon management systems on the market. All a company needs is its utility and fuel bills, along with any travel records, waste, and recycling information. Once entered online, GobiSOFT then produces a range of reports and charts, letting the user analyze the company's footprint in terms of energy consumed, emissions produced, and cost of its environmental impact.

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# Renewable Market Growth: Key Drivers to Watch in 2011

By Eric Silverman *(left)* & Edward Kayukov *(right)* (with contributions from Jim Liles & Amy Turner) Milbank, Tweed, Hadley & McCloy, LLP



Renewable energy staged an impressive comeback in 2010, after a rebound from the financial crisis of 2008 and 2009. Though its recovery may not be complete. Key market drivers to watch in 2011 are highlighted as follows...

### **Electricity demand**

The economic recovery is bringing with it a modest increase in demand for electricity after a precipitous fall in 2008 and 2009. Demand for electricity fell by one percent in 2008 and by 3.4% in 2009—the largest decrease since 1938\*. Demand rebounded in 2010, with a 4.2% increase, putting consumption back at pre-recession levels. Although the US Energy Information Administration (EIA) expects electricity consumption to fall this year by a tenth of a percent from 2010 levels, it expects a larger increase (approximately 2.5%) in 2012, and electricity demand appears to be normalizing after a tumultuous couple of years. Moreover, strong growth in the manufacturing sector appears poised to increase industrial electricity demand at the predicted rates of 1.7% in 2011, and 2.3% in 2012.

### Shale gas

Increased production of shale gas in the US is adding to the gas glut at a time when demand is falling. Gas prices have fallen dramatically to around \$4.00/MCF from peak prices of nearly \$15.00 in 2008. The dramatic increase in shale gas supply has left domestic LNG import terminals sitting idle, especially considering the multi-billion dollar capital investments to export domestic gas to Asia and Europe—where prevailing market prices are higher. Lower gas prices put downward pressure on wholesale power markets and renewable developers seeking to develop competitive projects. On the other hand, the increased availability of natural gas may lead utilities to consider accelerating the retirement of up to 60,000 MV of obsolete coal-fired power plants facing substantial environmental compliance costs, opening the energy market for increased gas and renewables' participation.

# Project scale

Another factor at play in the renewable market is a trend toward major scale-ups in the size of renewables' projects to achieve efficiencies in capital and operating costs. December 2010 marked a watershed of sorts, as two of the largest solar and wind projects ever developed in the US, Abengoa Solana CSP and Shepherds Flat Wind, achieved financial

closing. As new and larger-scale technologies are tested and perfected, some of the obstacles to building and financing large-scale renewable projects may fall away. However, larger projects also put strain on equipment supply chains and the EPC sector. As projects are scaled up, so are the risks that accompany them including cost overruns, delays, foreign exchange, and currency risk. As billion dollar-plus renewable projects have only recently been seen, their impact on the EPC sector remains to be uncovered.

### Domestic supply chain pressures

In addition to the increasing scale of renewables' projects, renewable energy equipment/component producers are facing pressure due to other factors. First, fewer utilities are executing power purchase agreements at prices that make renewable deals feasible as compared to the height of the market in 2007 and early 2008. This diminishing demand may force equipment suppliers to cut prices to maintain adequate production volumes. As the volume of orders declines, large US manufacturers may begin to cut product lines altogether in order to cut costs. Deepening the potential negative impact on the domestic manufacturing base are the rockbottom prices for components offered by state-backed Chinese manufacturers, particularly in the solar photovoltaic market, with whom US producers are finding it increasingly difficult to compete. Finally, utility scale PV projects are bidding into markets previously occupied by solar-thermal projects, putting even more downward pressure on prices.

### Financial market recovery

Although the economy has rebounded since the lows of 2008, banks remain constrained in their lending, particularly for long-term debt. However, competition for short- and medium-term mini perm loans has increased. Moreover, liquidity is increasing in the capital markets, which is proving to be a good source of low-cost funding for investment-grade credits. Sub-investment grade credits will find financing to be more difficult, as the high-yield market tends to be volatile, though competitive pressures are driving down high-yield interest margins and financing terms are generally issuer favorable in the current market. On balance, liquidity is higher than it was in late 2008 and 2009, and there is more term lending. But, there may remain a limited appetite in the capital markets for complex construction projects such as billion dollar-plus renewables' deals. Those projects will continue to rely on government loan guaranty programs and federal and state tax credits.

# Tax credits & cash grant uncertainty

As in 2010, the domestic renewable market once again faces a fast-approaching sunset date for its popular Section 1603 cash grant program. The program was set to expire on December 31st, 2010, but was extended at the 11th hour through December 31st, 2011 by the Tax Relief, Unemployment Insurance Reauthorization, and Job Creation Act of 2010 (the "2010 Tax Act"). The extension is good news for developers, but the last-minute extension gave a preview of the rush developers will face to begin construction before the start of 2012. Section 1603 is particularly important in the current market as the tax equity market remains capacity constrained, with significantly more demand from developers than the limited number of tax equity investors can satisfy. Pricing has risen in the tax equity market and developers are increasingly dependent on the cash grant program to successfully raise needed equity capital. Renewable energy interests are lobbying for another extension of the December 2011 sunset date, as well as for an extension of the Section 1705 loan guarantee program from the US Department of Energy. The 2010 Tax Act brought another bonus for developers: 100% bonus depreciation for renewable energy projects during 2011.

# Absence of Federal RPS

The lack of a federally mandated renewable portfolio standard (RPS), combined with weak electricity demand and lower gas prices, continues to restrict the long-term off-take options for most renewable developers. There are, however, a few state-level RPS programs. California, for example, requires its retail electricity sellers to procure at least 20% of their electricity each year from renewable sources. New Jersey not only has an RPS program, but also a solarspecific RPS requiring a certain portion of electricity to come from solar sources. Both the RPS and the solar RPS have increases in the renewable energy requirement built in each year through 2026.

# Transmission upgrade cost

The high cost of transmission upgrades for interconnecting large-scale renewable projects has resulted in utility proposals for advance funding, subject to FERC review and approval on a case-by-case basis, resulting in significant administrative cost, delay, and uncertainty. In instances where FERC approves advance transmission funding and recovery of abandoned plant costs, problems may still arise at state level with necessary certificate and permitting issuances. Furthermore, even permitted transmission upgrades can take years to finish, which may limit capacity value of renewable projects for utilities' "resource adequacy" requirements under state law.

### Conclusion

Overall, there is reason for optimism in the renewables' market. The improving but ever-changing economic scene means there is room for growth and for positive trends in renewable development. The upswing in renewables' activity at the developer, financing, and government levels is good news, and the increased levels of liquidity in the project finance markets may bring more investment, particularly from private equity/infrastructure funds and foreign investors looking to gain a foothold in the sector. As the renewables' market matures technologically and financially, opportunities for investment in the sector are likely to increase.

\* References available upon request.

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# Five Criteria that Could Make (or Break) A Renewable Energy Project Developing & securing a land option By Blair Loftis

**MUCH LIKE THE CALIFORNIA GOLD RUSH**, renewable energy developers are scrambling to secure property and resources to construct landintensive wind and solar projects as utilities generate an increasing number of open solicitations. Yet, in the need for speed, many energy developers forget to identify obstacles that could significantly reduce a project's footprint and/or hinder the return on investment. Renewable energy projects can be real estate intensive. Often times, in areas of the country where the sun shines brightest and the wind is optimally constant, securing a land option is the developer's first priority. However, decisions made in haste can often offer unacceptable levels of risk and consequence. The developer is not really to blame; the competitive nature of the market rewards speed and efficiency.



### Play fast, but play smart

With this sense of urgency, a developer will sometimes establish control on the seemingly optimal piece of property only to later find it underlain by shallow bedrock, located in a floodplain, too steep to support the renewable solution, or is home to a protected plant or animal. Species of protected plants and animals, jurisdictional waters, and various cultural factors (e.g. burial grounds) can quickly turn what appeared to be sufficient land volume to meet capacity commitments at a competitive wholesale cost into a compromised polygon of real estate, where the price for energy sales no longer exceeds the cost of energy production. With a couple thousand dollars invested in the early phases of land development, however, such problems can be avoided long before wasting valuable time and money—all with a little help from a professional who has access to a desktop computer.

### Waterways, bugs & bunnies

Experienced developers are familiar with permitting challenges or unfavorable regulatory regimes that can preclude a property from development, or at least compromise the asset's financial *pro forma*. For those not as familiar, five very simple criteria to be considered in the early land-siting phase include: **1.** An evaluation of floodplains;

- The presence of potential jurisdictional waters;
- 3. Construction access roadways;
- **4.** Interconnection access; and,
- **5.** Topography consistent with development objectives.

A quick desktop land-constraints assessment of these five criteria, using publicly available resources reviewed by the appropriate experts, can help a developer make a more informed decision-one that exhibits a lower risk profile and higher likelihood of viability.

For instance, a property that might look great on the surface could be located within a 100-year floodplain, or could be traversed by drainage features potentially regulated under federal jurisdiction. If these drainage features were to fall under the regulatory authority of the United States Army Corps of Engineers (USACE), then permitting of the site for construction could be arduous and costly. There is also the binary risk USACE would not approve the permit for the site of preference once the requisite alternatives analysis had been performed. But, a quick desktop review by a trained professional can identify seasonal washes or arroyos with a high likelihood of regulation. As necessary, a wetlands biologist could visit the site ("boots on the ground") and perform a quick survey to determine if a wash, identified from the desk review, is connected to jurisdictional waters and would, therefore, fall under a more complex regulatorv nexus.

Similarly, using publicly available data, the land constraints report can evaluate threatened and endangered plants and animals in the area. The information is available from US Fish & Wildlife, as well as state fish and game resources, though it takes a trained professional (wildlife biologist) to distinguish between what is important and what is just trivia. For example, research might find the county where a developer is considering property control is known as a rich habitat for a federally protected plant species. But, this does not mean the protected plant species is actually on the site of interest—only that the potential exists. With this information, a developer might hire a field biologist to make a preliminary site assessment to determine the best option: either to proceed with mitigation or look for another site.

### Titles & topos

Site access or right-of-way seems like a simple discovery every experienced developer should evaluate prior to securing a property. However, an in-depth look at ownership records could find a site is landlocked or, as in the case of many western locations, surrounded by lands of public interest (e.g. land owned by the state or the Bureau of Land Management), which could make gaining roadway or interconnection access difficult. Interconnection access requiring the construction of power poles on BLM land inevitably invokes the National Environmental Policy Act (NEPA)—a long and tedious process.

Using publicly available information, a land constraints analysis report can also summarize the substrata conditions and offer an opinion about whether the geology is conducive to wind or solar generation. If, by chance, geological studies in the area find a high likelihood of karst or bedrock a few feet below ground surface, the developer might want to reconsider securing land elsewhere. Even the topography of a parcel is critical, particularly for solar developments (e.g. most developers do not build PV solar cells on slopes that exceed a two percent grade). A land constraints report can quickly compile a variety of information including local agency entitlement challenges, Federal Aviation Administration (FAA) instrument approach zones, as well as recommendations for other criteria to review depending upon the consultant's knowledge of the local or regional area.

### Know the possibilities

The desktop land-constraints evaluation is a decision-making tool that can help owners determine what sites to pursue. The price for this information is nominal in comparison to the risks of sinking precious development capital into a project that will never cross the consumer's meter. Typically, these reports can be completed in less than a week's time.

Blair Loftis is the vice president of renewable energy for Kleinfelder.





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WHEN VISITING WIND FARMS across the world, it becomes apparent that more and more of them are situated on hilltops or mountain ridges. The Grouse Mountain wind turbine in Vancouver, BC, Canada, the Hohentauern Wind Farm in the European Alps of Austria, and Project West Wind in Wellington, New Zealand are examples of highaltitude wind turbines. Due to the reduced influence of drag at higher altitudes, such regions worldwide hold the promise of having a higher wind potential than the surrounding areas. Wind data alone, however, is not sufficient for accurately choosing a site for a large wind project. Other factors can come into play to make a seemingly promising site unacceptable. It is these often, unfulfilled promises that make investments in such wind farms very risky for several reasons.

There is great variety of wind potential within a small area. Complex wind regimes exist that can threaten the lifetime of the turbine or individual parts. Often at higher and colder elevations, the risk of blade icing can threaten project financing even further.

Therefore, assessment of meteorological data becomes a key element of each project, along with evaluation and further simulation of the wind field for energy assessment and wind-load determination at each turbine site. As the terrain gets more complex, the wind resource assessment becomes more complicated in regards to locating the wind farm itself and determining the position of each turbine.

# Green field planning in complex regions

Screening larger areas for wind potential is usually not reliable and only used if no meteorological data is available or, as is more often the case, the available data is of bad quality. Numerical weather models for large areas, such as MM5, can be implemented into computational fluid dynamics (CFD) simulations for more detailed regions. Using MM5 for boundary conditions serves as a suitable input to determine areas of interest and to find locations for future meteorological towers. This will help prevent development of wind farms in unproductive areas. For example, a wind farm built in a low mountain range in southern Germany was eventually disassembled after several years of underperformance. To avoid a similar costly and unsuccessful undertaking, special care is now taken in assessing the best locales for turbine installation.

# Large-scale & High-resolution Wind Potential Analysis

By Thore Lapp & Thomas Zirngibl

### Ideal locations for individual turbines

After wind measurements have been executed over a longer period of at least 12 months, the planning of the wind farm should be optimized. As seen in mountainous regions in Europe, the combination of wind turbine wake and complex wind patterns within the wind farm area can lead to deviations in energy yield of up to 50%.

To guarantee ideal planning and, consecutively, a maximum energy yield, a short-sighted approach would be to optimize energy yield but to neglect that the intactness of the wind turbine is necessary to generate the predicated energy. In general, load calculations of main components ensure a lifetime of 20 years in terms of extreme and fatigue loading.

### Site-specific load calculations

If a wind turbine type is certified according to IEC 61400-1, then certain maximum flow conditions were assumed in load simulations for the whole turbine. Additionally, these simulations are compared with load measurements on the turbine according to IEC 61400-13. With the mentioned constrains of maximum flow conditions, a lifetime of 20 years is granted for fatigue and maximum loading of the turbine.

These flow conditions are:

- Long-term average wind speed at hub height;
- Maximum 10-minute average wind speed with a reoccurrence period of 50 years;
- Maximum three-seconds average wind speed with a reoccurrence period of 50 years;
- Ambient turbulence intensity;
- Maximum wind shear exponent over the rotor area; and,
- Maximum flow inclination angle.

Mountainous regions have the potential to exceed all of those load parameters. Wind parameters are used as input to load calculations for main components such as the blades, the drive train, and the tower. Currently, no data exists concerning what problems could arise in the last quarter of the lifetime of a modern multi-megawatt wind turbine.

# Results for a combined WAsP & WindSim approach

Analyzing the wind speed for larger regions is a common way to identify hot spots for developing wind farms. The combined use of the European Wind Atlas Method together with a CFD simulation program allow for higher quality in-



# Wind turbine cables

While the wiring requirements of wind turbine nacelles may call for tray cable, the testing protocols for Wind Turbine Tray Cables (WTTC) are significantly different from those for tray cables found in industrial-related applications. In response to the needs of the wind turbine marketplace, C&M Corporation has introduced the GreenLINX family of wind power cables. Made in America and fully recyclable, these cables carry the 1000V WTTC rating and are backed by a more stringent, high-voltage testing methodology than that used for standard TC-ER constructions. In addition to WTTC ratings, the GreenLINX cables also carry a formal 600V TC-ER rating that permits them to be used in more standard applications, outside of a nacelle, where electrical codes allow for TC-ER cable types. The C&M Duralon jacket material makes the GreenLINX cables abrasion-resistant and offers a high level of protection from oils, solvents, chemicals, and fuels. **C&M Corporation** | www.cmcorporation.com

put data, especially from low-level wind measurements such as from meteorological stations. This is done by creating virtual wind measurements with WAsP (Wind Atlas Analysis and Application Program), which then serve as meteorological input for the CFD simulation. This combination allows for shorter computational time and higher accuracy in the calculated wind field.

Data taken from wind measurements is prepared by determining obstacles and roughness in the vicinity of the measurement, including contours lines. The point of application for the generated wind atlas is the measurement site itself, which removes the RIX problematic since Delta-RIX values are zero for all sectors. The predominant stability of the atmospheric boundary layer should be considered by adjusting the site's heat flux. A virtual wind measurement can then be created at an arbitrary height (e.g. at 100m above ground level). This serves as input for the CFD simulation. This removes the constraint of having a large number of cells close to the ground where the wind measurement took place. This allows either for decreasing computational time or to increase the cell density in the area of interest, for example, at the turbines' hub height. Reproducing the initial measurement serves as a self-consistency check, while predicting available production data from running wind turbines close-by serves as validation of the model.

Thore Lapp was previously head of the Business Field of Manufacturing Industry at TÜV SÜD in Germany, and is currently the Strategic Business Development manager for TÜV SÜD America's Industry Service group.

For the past three years, Thomas Zirngibl has been working as a wind expert for TÜV SÜD in Europe, with a special focus on safety requirements for wind turbines, wind energy utilization in forests, and large-scale wind potential analysis.

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STRENGTH THROUGH COOPERATION

# Offshore Wind Initiatives Drive High-productivity Turbine Machining

By Brent Godfrey

Wind turbine components include (from right) the hub (with slewing ring) and the main frame. The main frame holds the main shaft and bearing housing, and the gearbox with its slewing ring. A connecting ring is shown inside the tower. (Source: Sandvik Coromant)

**EARLIER THIS YEAR**, the United States Departments of Interior and Energy announced a strategic plan to fund offshore wind energy projects with incentives that will add up to \$50.5 million over the next five years. These incentives (see sidebar), part of the US goal to access 80% of its electricity from clean energy sources by 2030, is an ambitious plan that will likely put strain on the wind turbine supply chain to produce sufficient machines in the appropriate timeframe. Part of the overall high-productivity solution must be productive and efficient machining of each part of the wind turbine.

Fortunately, recent developments in metal cutting tools allow machine shops making turbine components to reduce cutting times and achieve consistent quality using fewer types of tools. For instance, the main shaft in a wind turbine is a large, forged component where 40% of the material is commonly removed from a forging weighing several tons. A week-long process is not unusual to complete the various roughing, turning, and drilling operations in the main shaft (see image).

The machinist's selection of the best tool holders, insert geometry, and grades has a tremendous effect on the total number of hours the shaft is processed on the machine. The forged surface of the main shaft demands metal cutting inserts with secure performance and high-temperature resistance due to the long contact times. The industry has begun adopting wipers that are adept at performing heavy-duty turning operations at high removal rates—from forged skin to close-tolerance finishing.

# Machining inside the gearbox & hub

Machine shops that produce wind turbine parts, such as the hub, planetary carrier (part of the gearbox), and main frame face numerous challenges. For example, the complex shape of the hub makes workholding difficult and, as a result, vibration commonly becomes an issue. Fortunately, for most challenges, solutions do exist. In this case, a combination of Capto holders and Silent Tools dampening adaptors works to increase the application's stability and avoid vibration when using long tools to access awkward areas.

Inside the gearbox are planetary carriers, which are typically manufactured from nodular cast iron, and can be machined in different ways depending on the machine tool and machining strategy. While one machinist prefers turning for metal removal, another chooses milling. Helical interpolation, a flexible three-axis ramping technique, provides rough boring using long-edge indexable insert cutters for high efficiency. For fine-finish boring, a cutter that is capable of micrometer-level adjustments is recommended.

Machining inside the hub can be challenging and time consuming. A proven and cost-efficient solution is back facing with high precision using a multi-purpose side and face cutter. Similarly, a milling cutter that enables light cutting action, and uses eight cutting edges and shims to protect the cutter body can provide highly efficient face milling of hubs.

# Turbine towers & connecting rings

Most large wind turbine towers come with tubular steel sections that are 60 to 100 feet in length. The tube sections are bolted together using connecting rings—one at each end of the section. Each tower contains six to eight connecting rings, which are 10 to 30 feet in diameter. Machining the connecting rings typically involves drilling hundreds of thousands of holes per year because the rings are produced in large volumes. Bolt-hole productivity can be drastically improved by applying the latest indexable drills correctly, potentially halving drill times for many machine shops.

For example, in the drilling of connecting rings, one ring producer was experiencing a problem with vibration. By replacing the existing drill with an improved model, the manufacturer was able to balance the cutting forces for vibration control and reduce cycle time by 35%. Tools make the difference. The slewing ring connects the tower to the nacelle, causing it to rotate in response to the wind's direction. Three slewing rings connect the turbine blades with the hub to adjust the pitch angle of the blades. They start out as forged rings, up to 30 feet in diameter, and the gear teeth are machined using gear-milling tools. One of the most challenging machining operations is the production of ball tracks. Rather than employing expensive grinding operations, round cutting inserts can be used to rough out the grooves, providing optimal chipbreaking and high productivity, while round ceramic inserts can finish the grooves.

# Summary

Wind turbines contains a multitude of components—from slewing rings to planetary carriers and main shafts—each fabricated using highly efficient and productive machining operations. As the demand for offshore wind generation increases in the US and other parts of the world, the need to produce more wind turbines in a fast, cost-efficient manner will be of paramount importance.

Some of the most challenging components to machine on a wind turbine are the planetary carrier and inside the hub. For the planetary carrier, a flexible three-axis ramping technique called helical interpolation provides rough boring using long-edge indexable index cutters. This is followed up with fine-finish boring with a cutter capable of micrometer adjustments. Inside the hub, back face cutting with a multi-purpose side and face cutter is performed. In the production of connecting rings and slewing rings, a high-efficiency drill can expedite the hole-making process while minimizing vibration.

Brent Godfrey is a wind power application specialist with Sandvik Coromant in Fair Lawn, New Jersey,

Sandvik Coromant

www.sandvik.com

# Details of the strategic wind farm plan

On February 7th, 2011 Secretary of Energy Steven Chu and Secretary of the Interior Ken Salazar announced a new project to speed up offshore wind energy development in the United States. The plan commits up to \$50.5 million in research and development funding for projects that will support offshore wind power farms in high-priority areas including several sites off the coasts of Delaware, Maryland, New Jersey, and Virginia.

According to Global Wind Energy Council, global installations of wind energy reached 194 GW in 2010, a 22.5% increase over 2009 levels. In 2010, US installation of new wind energy capacity dropped to 5 GW, from 2009s level of 10 GW. European new capacity was down slightly from 10.7 GW to 9.9 GW, between 2009 and 2010. For the first time, more than half of the new wind power was added outside Europe and North America, primarily driven by China, which installed 16.5 GW of capacity in 2010.

The US Department of Energy set a goal of deploying enough offshore wind farms to generate 54 GW of electricity by 2030, at a cost of energy of 7 cents per kilowatt-hour (kWh), with an interim target of 10 GW of capacity deployed by 2020, at a cost of energy of 10 cents per kWh.

# The Strategic Work Plan includes three components:

- Technology development (\$25 million of the total budget);
- Studying and removing "market barriers," including environmental risk reduction and supply chain development (up to \$18 million in the next three years); and,
- Up to \$7.5 million to develop and refine next-generation turbine drive-trains.



# Wireless self-powered anemometer

Etesian Technologies flagship product is its patented wireless and self-powered anemometer. By incorporating a customdesigned permanent magnet generator inside the anemometer, it is able to broadcast its data back to the base station/logger. By utilizing the ISM 900 MHz band, no wires are necessary and there is never a battery to replace. Installers report that elimination of sensor wiring can cut installation time in half.

In addition to the basic wind speed sensor, two other wireless self-powered sensors are available. One incorporates a temperature sensor and the other a direction vane. Up to eight sensors can be utilized with a single base station. The logger combines a 900 MHz receiver, a low-powered logger, and the convenience of logging directly to a USB flash drive. If local access is possible, a simple flash drive swap is all that's necessary to retrieve the daily wind data files. For remote access, an optional cell network modem is available.

Etesian Technologies www.etesian-tech.com



# **CNC** router systems

Thermwood has introduced a new series of CNC router systems, the CBX Series, capable of machining flat and three-dimensional parts including wind turbine blades and much more using wood, composites, chip core, rigid foam, plastics, non-ferrous metals, and other various types of materials. It's a robust, highly flexible production system capable of operating 24 hours a day, seven days a week. It includes Thermwood's Gen2 SuperControl, which offers features, support, and advanced capabilities not available anywhere else. This machine is inspected and calibrated utilizing three-dimensional volumetric compensation, which measures the exact X, Y, and Z position of the cutting head within the working envelope and compensates all three linear axes. It also includes Thermwood's patented Impact Resistant Head, which eliminates the need to re-align the head after a crash. **Thermwood Corporation** www.thermwood.com



# **Offshore floating turbine**

Two-thirds of offshore wind energy is in water that is too deep for today's wind turbine towers. In contrast, Nautica Windpower LLC's patented Advanced Floating Turbine (AFT) is designed to access those favorable winds beyond sight from shore. Weighing in at about 25% the weight of floating oil platform designs yields significant cost savings. Further savings result from passive load mitigation and a single tether to the seafloor, as well as deployment without special ships and cranes. Initial tests of scale models in the Great Lakes are completed. A medium-scale test is being planned for 2012 in the US and Asia. A digital 5 MW wind turbine prototype is in development for manufacture and market entry in 2014. The AFT is anticipated to produce electricity at a cost competitive to the cost of energy generated by new fossil-fueled power plants.

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# Hybrid-drive Offshore Wind Turbines

Uniquely designed for corrosive ocean environment By Steven Cuevas

### Innovative design & technology required

Creating a quality, high-efficiency offshore wind turbine is far more complex than merely moving existing turbine technology from ground to water. The harsh, salt-corrosive ocean environment magnifies system weaknesses and presents unique challenges for operations, service, and maintenance. A reliable, next-generation hybrid-drive design coupled with a specialized air treatment process and redundant maintenance systems provide an optimized turbine solution for reliably generating significant power with minimal interruption.

### Compact & lightweight

A hybrid-drive turbine is an ultra-compact design harboring extensive technology in the smallest space. The specific configuration of technical components in a relatively small area of the nacelle is the result of extensive studies and adaptations of conventional turbines. The hybrid-drive's compact design is made possible by the integration of the rotor bearing, gearbox, and generator, dispensing with the need for plant component housings. The small dimensions lead to short paths for load transmission to the tower head, which is ideal for offshore wind turbines.



These component integrations and smaller dimensions result in a relatively low weight per megawatt, which facilitates transport and erection—crucial logistic and cost factors when working on the open sea. For example, the nacelle and rotor of a hybrid-drive 5 MW turbine together weigh less than 350 tons. Completing nacelle assembly on land simplifies transport and lifting the structure onto the tower ensures a higher degree of safety and, ultimately, saves time and costs. Additionally, the reduced top-weight of a hybrid-drive nacelle adds flexibility in selecting tower and foundation structures.

### Reliable & robust

Reliability, the decisive factor for successfully operating offshore wind turbines is an integral element of the hybrid-drive concept. The permanent magnet synchronous generator is directly installed in the machine housing. Since the generator's rotor is mounted on the output shaft of the gearbox, it needs no generator bearings. In combination with the frequency converter, the permanent magnet technology achieves a maximum rotation speed range, resulting in an ideal electrical and aerodynamic efficiency rate. The generator is connected to the grid via a 4Q converter, which allows maximum speed variability and compliance with all grid directives.



Additionally, all key auxiliary aggregates and operation sensors have redundant systems to ensure continued operation of the overall system.

The hybrid-drive's low rotational speed and small number of rotating parts and roller bearings reduce the risk of failure in the drivetrain to exceedingly low levels. In the singledrive gearbox, a double-tapered roller-bearing connects the rotor with the machine housing. The precise geometric assembly of the rotor bearing and gearbox is such that the dynamic rotor loads cannot generate a harmful impact on the gear meshing. The helical planetary gear train ensures the optimal lubrication of all shafts and wheels. Independent of this, the gearbox permanently supplies the rotor bearing with oil.

### **Proactive & protected**

Equipping offshore hybrid-drive turbines with two kinds of online condition monitoring systems (drivetrain and blades) helps ensure reliable and safe operation, and the highest levels of availability. With prompt and direct 24-hour online access to turbine controls, drivetrain and sub-systems via more than 1,200 sensors, a majority of error detection and status codes for temperatures, flow and switching rates, and parameters and component conditions can be monitored and rectified from onshore operations. In certain cases, the monitoring system can disconnect faulty components and reconnect to redundant systems. For example, one pilot project of six 5 MW hybrid-drive offshore wind turbines maintained a 97% technical availability rate since installation in 2009, and 86% of issues were resolved remotely. Extended blade service life is crucial for an offshore turbine's economic viability. By equipping the components with a rotor blade monitoring system, detecting damage at an early stage enables longer-term replacement scheduling.

Protecting the offshore wind turbine's hybrid-drive equipment from the salt-corrosive marine atmosphere is also vital to a long service life. One concept pulls in external air at the base of the above-water tower section, and then cleanses it of corrosive salt particles and moisture through several treatment stages. The pure, dry air is then blown into the tower, creating overpressure throughout the entire system and ensuring that no salty ambient air intrudes into the turbine or tower structure. This combination of internal environment integrity and robust hybrid-drive technology results in reduced maintenance and service frequency, and lower operation and maintenance costs compared with other technologies.

### Flying service truck

An obvious difference with offshore wind turbines when maintenance is needed is that one cannot hop into a service truck and drive out to the turbine. Instead, maintenance technicians arrive onsite after a 30-mile helicopter ride and are lowered down by cable to the nacelle's topside landing platform and rooftop access. To keep these trips to a minimum, the integrated condition monitoring systems provide a precise analysis of the turbine components to optimize and combine maintenance and service work over the turbine's 20-year lifespan. With accessibility to an offshore wind park heavily dependent on weather conditions, the hybrid-drive technology is intentionally designed for long periods between onsite maintenance.

As the North American offshore wind market strives to find its policy and market footing, turbine manufacturers and developers are continuing to create a foundation of reliable technology and relationships. The uniquely designed hybrid-drive offshore wind turbines provide a reliable, proven, and bankable approach to start tapping the estimated 54 GWs in offshore wind energy targeted in 2030 by the US Department of Energy.

Steven Cuevas is the Director of Offshore Wind Development for AREVA Renewables North America. AREVA offers a full portfolio of clean energy sources, including nuclear, concentrated solar thermal, offshore wind, biomass, and hydrogen energy storage and distribution.

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Hydroelectric Frank Groznik (503) 248-5600 fgroznik@ene.com

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**Transmission** Jim Thornton (503) 248-5600 Jthornton@ene.com

# Turbine Drivetrain Design & Optimization

By Chris Halse | Images courtesy of Romax Technology Inc.

**THE ARRANGEMENT OF THE ROTATING** mechanical parts of the wind turbine drivetrain—shafts, bearings, gears, generator moving parts, and their supporting structures—provide a variety of options and challenges for the wind turbine designer. These challenges must be addressed by looking at the system as a whole,



and by performing trade-off studies to optimize the selection of design parameters to meet the drivetrain design requirements.

There has been a trend amongst some wind turbine manufacturers away from a modular design, either by use of the larger diameter, lower-rpm generators in direct-drive or medium-speed designs, or by integrating the gearbox into the main bearing supporting structure.



Figure 1: Integrated gearbox design.

With closer integration of the gearbox with the main bearings, the total nacelle weight may be reduced; however, difficulties may be introduced such as access to gearbox components for maintenance or assembly. Direct-drive wind turbines may have a reduced number of components, but either a novel generator design or an extremely strong (and, therefore, heavy) nacelle structure may be required to maintain the generator airgap.

It is not yet possible to describe conclusive findings as to the optimal drivetrain layout for wind turbines as there are too many factors that may be weighted differently, depending on the overall concept. The driving factors for the design include rating, cost, weight, generator technology, required tower clearance, fatigue resistance, static strength, ease of maintenance and access (e.g. offshore vs. onshore), component availability, as well as ease of assembly. All of these factors depend on the selection of blades, control system, and the electrical system.

One important design area is bearing sizing and selection. The cost and availability of bearings is an important driver for drivetrain architecture selection. For instance, the cost of bearings increases exponentially with diameter, and the lead times for large bearings can currently be as much as 24 weeks. This may drive the design toward including two smaller bearings, increasing the number of parts and the complexity of assembly. The relative positioning of the bearings is then a trade-off with the load they will support and the weight of the shaft, the housing, and the mainframe. Figure 2 charts such machine weight and bearing fatigue against the span of supporting O-configured taper roller bearings—which is affected by the type of bearing chosen.



**Figure 2:** Machine weight and bearing fatigue against main bearing span for O-configured taper roller bearings.

Single- or double-row taper roller bearings, cylindrical bearings, and spherical roller bearings are all in use in the marketplace as wind turbine main bearings in various arrangements. Software tools can be used to rapidly size, compare, and optimize different bearing arrangements. For bearing design, the misalignment, load sharing, roller/raceway stresses, rib loads, and other factors are calculated in these tools (see Figure 3), and allow the strength and fatigue calculations to be performed. Load cases need to be considered to account for the high-bending moments and forces at the rotor hub. Moreover, tools need to be efficient enough to compute hundreds of non-linear static analysis to incorporate the complex loading conditions.



**Figure 3:** Calculated bearing rolling element contact stress for wind turbine main bearing.

The flexibility of the supporting structure of large, main bearings is important. This is an issue more obvious in the design of pitch and yaw bearing supports, but for larger main bearings it's often an important factor. There is a clear trade-off between the desire for a lightweight machine base and maintaining good contact conditions in the bearings—although some flexibility in bearing rings may be advantageous as it spreads the load over more rolling elements. Modern software tools allow the consideration of the flexibility of bearing raceways and supporting structure in the evaluation of bearing life and system deflections.



**Figure 4:** A detailed analysis model, incorporating flexible main bearing rings, flexible bed plates, and housings (gearbox housing hidden) to capture whole system deflections and influence on machine element stresses.

The bearing selection cannot be considered in isolation, and design drivers from other components must be incorporated. For instance, stress cycles leading to fatigue in the main shaft may be the limiting factor on the main bearing diameter. As well as the weight of the rotor causing stress cycles, there are additional cycles due to the load variation on the blades. Therefore, a larger bearing may be required than one that solely supports the loads, while a detailed load spectrum and careful fatigue analysis of finite element models is required to design the main shaft.

As illustrated by the variety of drivetrain architectures in the marketplace and in development, the mechanical design of wind turbines is an exciting area with many opportunities for innovation. Investing in thorough concept design and decision-making early in the design process pays off in cost savings and improved reliability. Engineering tools and improved understanding of factors critical for drivetrain reliability are shaping the future of the next generation of turbine technology.

Romax Technology has 20 years of experience in the design of drivetrain systems, and they are very active in the wind turbine sector. Their expertise lies in concept design and bearing selection, design of for pitch, yaw, and main bearing systems, gearbox upgrades, and more.

Romax Technology Inc. | www.romaxtech.com



# Gear grinding machine

American Wera Inc., a distributor of quality machine tools utilized in the global wind energy industry, introduces the Präwema XL Series of Gear Grinding Machinery. Präwema recognizes the market demands for higher quality gearing in the wind power industry, which translates into increased efficiency in operating wind machines. To this end, they have created the XL Line of Gear Grinders. The machinery, built on a solid granite base, is designed for thermal stability and vibration dampening. Built in flexibility includes using dressable or plated grinding wheels, and the choice to select profile grinding or generating grinding. The machines are equipped with a tailstock for shaft style parts, which is also a live spindle, making it possible to grind the gear faces and bores. This coupled with in-process measurement and advanced software solutions make the Präwema XL Series a serious contender. American-Wera Inc.

www.american-wera.com

# Eighty-meter tilt-up tower

In response to industry demand to measure the wind at taller heights, NRG Systems now offers an 80-meter tilt-up tower. Built on the same reliable platform as the company's 60-meter XHD system, the 80-meter tower incorporates bolted joints for a stiffer, stronger tower, while offering familiar installation and performance. The complete 80-meter XHD system includes a galvanized 10-inch diameter tilt-up tower with a steel baseplate, a SymphoniePLUS 15-channel datalogger, NRG Systems sensors to measure wind speed and direction, side-mount booms, and other accessories. The high-visibility package, required by the FAA in the US, includes an orange-and-white painted tower, a compliant lighting system, and marker balls. The 80-meter XHD system will ship via surface freight free of charge in its efficient Enivocrate packaging starting in February. NRG Systems | www.nrgsystems.com

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D-VAR installation at the 58 MW White Hill Wind Farm located in South Island, New Zealand. The wind farm generates enough electricity annually to power 30,000 homes.

# Dynamic Reactive Compensation Required for Grid Interconnection

A look at wind & solar power plants

By Tony Siebert & Perry Schugart | Photos courtesy of American Superconductor

y the end of 2010, the world's wind power installed base had grown to approximately 180,000 megawatts (MW). The Global Wind Energy Council expects this installed base to nearly double to 347,000 MW by the end of 2013. The rapidly expanding wind power market is helping countries around the world meet rising energy demands, while reducing pollution. Yet, the intermittent nature of wind-generated electricity results in variable voltage levels that must be mitigated when integrated into the greater power grid.

Unlike the dynamic voltage support provided by conventional power sources such as coalfired plants, reactive power derived from wind farms often cannot be provided dynamically or in continuously variable amounts. As a result, the variable power levels stemming from wind farms can cause voltage fluctuations.

To protect the integrity of the transmission grid, some countries such as Canada, Australia, and the United Kingdom have adopted interconnection standards requiring wind farms to provide dynamic reactive compensation, similar to traditional generation. Other countries are expected to follow suit as wind power markets continue their rapid rate of expansion worldwide. Grid interconnection requirements vary from country to country, and among individual provinces or states, depending on local grid characteristics and utility specific requirements.

# Systems for wind power plant interconnection

In addition to the provision of dynamic reactive compensation, wind farms today should maintain low-voltage ride-through (LVRT) capability to enable them to remain stable and connected during normally cleared electrical faults on a transmission grid. Like reactive compensation, fault ride-through requirements are defined in many regions of the world where a large number of utility scale wind farms are being installed. In some cases, these faults—which often result from natural causes such as lightning strikes—can cause a substantial transient voltage depression across large areas. Other common interconnection requirements call for wind turbines to operate continuously up to a rated output within normal grid voltage ranges, maintain a constant voltage, and remain connected during voltage step changes.

At larger wind farms, grid interconnection requires steady state voltage regulation, power factor correction, as well as LVRT capability for the entire wind farm. D-VAR STATCOM solutions have become the *de facto* standard for meeting local wind farm grid interconnection requirements around the world. A member of the FACTS (flexible AC transmission systems) family of power electronic solutions, these Intelligent Grid devices provide the essential reactive power capability needed to regulate the voltage output of wind farms. D-VAR systems provide voltage regulation and power factor correction, along with postcontingency assistance to stabilize voltage, relieve power grid congestion, improve electrical efficiency, and assist in preventing loss of generation. These solutions are able to detect and instantaneously compensate for voltage disturbances by dynamically injecting leading or lagging reactive power into the power grid.

D-VAR systems are sited at the substation connecting wind farms to the grid, stabilizing the voltage that is fed into it. These solutions provide the dynamic reactive power capability that allows wind farms to stay online and meet the interconnection standards. Unlike capacitor-based systems, this technology is not subject to the square of voltage de-rating factor at lower voltages. However, D-VAR systems can additionally "soft-switch" external



D-VAR solutions provide dynamic voltage control, power factor correction, and postcontingency reactive compensation to stabilize the power grid and prevent undesirable events such as voltage collapse. These solutions also augment the overall performance of wind farms and enable developers to meet grid interconnection requirements.

capacitors and, thereby, eliminate the voltage step changes experienced by a wind farm and a utility. These devices are based on an integrated array of PowerModule power converters and, as a result, are highly scalable ranging from two mega-volt ampere reactive (MVARs) to hundreds of MVARs to accommodate wind farms of any size. This scalability reduces the overall level of MVARs needed for some applications, which can reduce costs for the wind farm developer.

### Utility scale grid interconnection for solar farms

The utility scale solar power market is also growing. Industry research firm IMS Research expects annual shipments of solar PV inverters to quadruple from approximately 8 GW at the end of 2009, to 32 GW in 2014. During this period, the utility scale solar inverter market is expected to grow at a much faster pace than the commercial and residential solar inverter markets.

Like wind farms, solar power plants require reactive compensation to properly interconnect. Reactive compensation standards are also likely to become a reality for utility scale solar power plants in North America, Europe, and Asia. Specifically, solar power plants are being required to meet power factor requirements, provide voltage control, and meet lowand high-voltage ride-through requirements. Additionally, they must be "good utility citizens" as part of a growing renewable portfolio. This means they must be grid-friendly and not disconnect from the utility when most needed (such as during power system disturbances). Secondly, a grid-friendly solar power plant actively supports the grid such that when disturbances do occur, the plant is prepared to help the grid recover. Solar power





AMSC's SolarTie Grid Interconnection Solution—the industry's first fully optimized solution for utility scale PV power plant developers.

plants must also provide day-to-day voltage support to help keep the system voltages smooth and stable, even if the power output of the plant varies due to clouds or other factors during the course of the day.

Proprietary D-VAR technology is now being applied to solar power, creating the industry's first grid interconnection solution with fast enough response times to enable solar power plants to meet local interconnection requirements with a single device. Until now, the majority of solar inverters on the market were intended for residential or commercial use and, therefore, not targeted for utility scale plants or grid stability. However, by coupling power converter capabilities with D-VAR reactive compensation technology, the first fully optimized solution for utility scale PV power plant developers now exists. This technology is the most optimized to enable dynamic reactive power compensation capability/voltage stability directly within the solution; thereby, eliminating the need for additional costly equipment. In highly dynamic grid environments, the robustness of this technology can maximize power generation time. Less tolerant systems can trip offline during even minor grid disturbances.

As demand for clean energy continues to rise rapidly, there is an immediate need to increase the quality and reliability of power generated from renewable energy sources. Given the unique characteristics of large-scale wind and solar power generation, more projects will require dynamic reactive compensation as a condition of interconnection. Ultimately, the new interconnection standards are a win-win for all renewable market stakeholders including, most importantly, the consumers of electricity.

Tony Siebert is the director of FACTS and D-VAR Business at AMSC Power Systems, and Perry Schugart is the director of Power Converter Business at American Superconductor.

American Superconductor www.amsc.com



# Controlling wind turbines

SEPAC's newest innovation will allow for infinitely modulating control of torque for spring engaged clutches and brakes. SEPAC, Inc. has been designing and manufacturing electromagnetic, hydraulic, and pneumatic clutches and brakes since 1984. Their newest design is particularly unique. Ordinary spring-engaged brake designs only allow for one, two, or three levels of braking torque, which can induce a shock load causing damage in a large, rotating system. SEPAC's new, patent-pending design allows the armature to gradually engage; thereby, providing a soft stop when the brake is applied. Such control over torque modulation will allow for safer operation of high-inertia systems, such as wind turbines.

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# wind power



## Halogen-free cables

General Cable has added another halogenfree line of cables to its 17 FREE offering. The new NextGen Brand UL-Rated Type OFNR Tight Buffer Distribution Fiber Cables, which can be used as an OEM product in wind turbines, will be offered at a competitive price and feature substantiated green properties. With the removal of halogens, which fall into Group 17 of the Periodic Table, General Cable's revolutionary 17 FREE line does not contain any chlorine, fluorine, bromine, or iodine, reducing the overall toxicity of the cable, and truly resulting in a more environmentally friendly "green" product. NextGen's 17 FREE line of Type OFNR Tight Buffer Distribution cables also features a lightweight, flexible design that simplifies installation. The tight-buffered fibers are easy to handle and strip for field connectorization.

General Cable | www.generalcable.com



### On-site portable flange facers

Machinists can now select one of three configuration options that have been added to a new line of heavy-duty portable flange facers from Climax Portable Machine Tools. Specifically, machinists who repair and maintain flanges and seals at power plants and on wind towers can specify portable flange facers for single-point machining only, for milling only, or for both milling and single-point machining. This Climax grinding arm and head can provide nearly four times the metals removal capabilities and generate a finer surface finish compared to single point machining. An optional grinding head

is also available that allows users to achieve fine surface finishes of 0.32 ra or better. Because the new line of flange facers easily switch between facing and milling operations, machinists using the tools effectively get two machines in one, thereby saving time and money. The new configuration options ultimately give machinists greater flexibility in how they approach on-site machining projects.

Moreover, incorporated into the single-point flange facer models is an exclusive, patented safety feature that lets operators adjust the feed rate while the machine is still running—without having to reach into the machine. The machines can be mounted either on the inside or outside diameter of the flange, and achieve infinitely variable feed rates from 0.002 to 0.035-inches/rev (0.0508 to 0.889 mm/rev). Tool heads can be rotated a full 360°, providing the ability to machine angular surfaces as needed.

Climax Portable Machine Tools | www.cpmt.com | www.cpmt.com/products/flange-facers



# Medium intensity beacon for obstruction applications

Dialight announced the debut of its latest LED based L-864 Red Medium Intensity Beacon, featuring the most compact flash head on the market, to significantly reduce wind load on fixed obstructions such as wind turbines and towers. Operating at just 20 watts, the new Dialight D464 Series offers the lowest power consumption of any L-864 product on the market to help save energy and reduce operating costs. At just under 8.5 inches in vertical height, the shock- and vibration-

resistant D464 series offers the lowest profile available to reduce the impact of wind sheer on the structure, making it ideal for highaltitude applications and improved performance in inclement weather.

Its design delivers the most energy efficient operation with the most precise optics available to minimize ground scatter and virtually eliminate community light pollution. Dialight's patented LED optics feature the sharpest beam cutoff in the industry for a consistently lower level of scatter—below 0.1 millifootcandles—over the full distance of one mile, while delivering the FAA required 2,000 candelas to passing aircraft.

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NBC "Top States for Doing Business," July, 2009.



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# Next-generation Urban Integrated Solar Technologies By Peter Le Lievre

IF YOU ASK A PERSON off the street what "solar technology" means, he or she will likely point you to an array of panels on a roof. Silicon Photovoltaic (PV) modules have come a long way since first introduced by Bell Labs in 1954, and are now a common sight in many cities. Aside from the energy produced, these modules are easy to live with (no noise or emissions) and can retrofit on vernacular architecture. Over 20GW of panels have been reported as installed in 2010. Government incentives have played a large part in this spectacular growth and, looking beyond PV modules to the next generation of rooftop solar technologies, incentives and new research will continue to play an important part.

One area of interest is in the gradual rise of hybrid PV research, which not only aims to increase solar-to-electrical efficiencies but simultaneously looks at harvesting waste heat, as well. "Normal" silicon PV modules produce valuable electricity with efficiencies from about 10% up to 20%. However, these efficiencies mean that 80% to 90% of the sun's energy is wasted as heat. This thermal energy loss is unavoidable—even "ideal" monocrystalline silicon cannot exceed 29% efficiency (ie. 71% "inefficient"). To solve this problem, hybrid PV systems aim to capture the lost heat while still providing equal or better electrical output as PV. Typical total hybrid (electric/thermal) collection efficiencies can range from 50% to 75%. These efficiencies provide more usable energy from a rooftop than "normal PV," and research in the area has been strong.

In California, hybrid research is being partially stimulated by the Solar Thermal Handbook, which is funded by the California Solar Initiative (CSI). The "million roofs" program initially supported PV module installation by subsidizing rooftop installations at up to \$3.25 per Watt. However, response was strong and the PV program has now stepped down to far lower subsidy levels. Since then, the thermal component of CSI has been launched at \$12.80 per therm (100,000 BTU), which is attractive not only to traditional solar hot water installers but to Hybrid PV system developers, as well. Next-generation Hybrid PV modules producing electricity and hot water can benefit from this renewed CSI support, and are expected to increase their market share over the coming period.

But what are these technologies and what do they look like? In simple terms, there



**Figure 1:** ANU CHAPS (left), Absolicon covered Parabolic Trough Hybrid (center), and Heliodynamics Fresnel Reflector (right)



Figure 2: Wiosun water-cooled PV modules (right), and PVT air-cooled PV modules (left)



Figure 3: Brightphase (left) and Chromasun MCT (right)

are three main types: concentrating hybrid, flat plate hybrid, and flat panel hybrid. Here's a look at each one...

**Concentrating Hybrid** systems are essentially utility scale solar collectors that have been adapted for rooftop service. An example of this technology has been installed by the Australian National University, in their CHAPS demonstration in Canberra. The CHAPS system is based on a classic parabolic trough concentrator design, adapted for rooftop installation. The custom hybrid receiver contains PV cells for electric generation and a water pipe to extract hot water for the building's domestic hot system. Another example



is Absolicon, a Swedish company that is currently commercializing a similar parabolic trough-based hybrid technology. In addition to parabolic trough, linear Fresnel concentrating systems have also been developed in rooftop hybrid format such as those constructed by Heliodynamics and Entech.

Common problems with concentrating hybrid systems is they are fairly bulky, have externally moving parts, and are hard to mount on the roof. However, these systems demonstrate excellent system efficiencies, as well as the ability to produce higher temperature heat (up to 100°C).

**Flat Plate Hybrid** offers a simpler, alternative approach that "cools" traditional PV modules with air or water. These hybrid modules are far easier to mount on the rooftop, and can be stacked much closer together than concentrating systems for greater rooftop density. Several versions of this type of technology are in the marketplace today.

Air-cooled modules are marketed by PVT Solar; whereby, hot air trapped behind the PV module is gathered up in a heat exchanger that, then, generates hot water. Alternative direct water-cooled modules are also available from Wiosun, which route water pipes behind the PV module and capture *Continued on page 26...* 



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hot water directly. Water-cooled systems have the advantage in that they can mount on standard PV racking—but they do require proprietary modules. Air-cooled systems do mount on proprietary racking, but at least accept standard modules.

Flat panel hybrid systems are especially appealing in residential applications where domestic hot water (55C) loads are a significant part of the energy requirement. However, in commercial and industrial applications, hotter water is often required and hybrid systems are unable to meet these demands.

**Flat Panel Hybrid** are a new breed of hybrid solar collectors that retain the ease of mounting shown by flat plate systems, but also incorporate concentrating optics that allow the higher operating temperatures and greater system efficiencies of concentrating hybrid systems. BrightPhase Energy introduced a pioneering version of a Flat Panel Hybrid in 2006 and, more recently, Chromasun has unveiled the development of a hybrid product in partnership with The Australian National University.

Flat panel hybrid technologies already demonstrate collection efficiencies of around 65%, and operating temperatures exceed 100°C. These temperatures are expected to increase as research and development teams look for ways to maintain the electrical efficiency of PV cells at higher temperatures. Or, alternatively, harness the infra-red radiation before it reaches the PV.

With so many advantages, it's not surprising rooftop-mounted hybrid technologies are one space to watch in the next generation of urban integrated solar. It is fortunate in states like California, regulatory and policy support already exists to stimulate this emerging segment as products reach the marketplace. A small segment, for sure, but one with some definite advantages on the rooftop.

Peter Le Lievre was originally the co-founder and CEO of utility scale solar company, Ausra, and is now the founder and CEO of Chromasun.

Chromasun | www. chromasun.com





### **PV** ion implant system

Varian's Solion PV ion implant system offers solar panel manufacturers better cell efficiency and reduced production costs. Based on the production-proven VI-ISta semiconductor implant family and its installed base of over 1200 units, the Solion platform is an ideal tool for advanced junction engineering. It also offers far better uniformity and cleanliness than the PV sector's traditional diffusion doping process, while eliminating several process steps. Solion can also handle both doping and patterning in a single step, with proprietary Precision Patterned Implant (PPI) technology. Early users have responded enthusiastically to Solion, using it to achieve cell efficiencies of over 19%. In the longer term, Solion offers a clear roadmap to manufacturable 22% efficiency. **Solion** | www.vsea.com



# Optical inspection & measurement of solar modules

The KUKA String Test is particularly recommended for automated production, where it can enhance the quality and output of the modules produced. A camera system is used to measure the strings, check the position of the bus bars, and give the cells a final inspection. This ensures that the robot positions the string optimally, and that faulty parts are segregated for manual reworking. An optional EL (electroluminescence) test reveals cracks (known as micro cracks) and functionally inefficient areas of the solar cells. The procedure takes between eight and 20 seconds, depending on the scope of the test and the string size, at the end of which a clear quality analysis is available. In cell strings that have passed the test, the connecting strands are cut-to-size for the relevant deposition position in readiness for the subsequent process step, cross-soldering. **Kuka Systems** | www.kuka-systems.com



# PV monitoring solution with wirelessly communication

SMA's Sunny WebBox monitoring system is now capable of wireless operation via integrated Bluetooth technology. In addition to continuously gathering PV array data, the Sunny WebBox with Bluetooth gives solar system owners the freedom to install or house the device in a variety of flexible configurations. The Sunny WebBox with Bluetooth wirelessly receives, stores, and transmits data from up to 50 solar inverters to the SMA Sunny Portal, where users can then access this information remotely from any web-enabled PC in the world. The Sunny Portal can also be configured to send email or text message alerts to the system owner if a power deviation is detected by the Sunny WebBox. For more detailed performance analysis, users can also add the SMA Sunny SensorBox to collect irradiance data at the PV array. The Sunny WebBox with Bluetooth can withstand ambient temperatures of minus 4°F to more than 149°F, and can be mounted on DIN rail, wall-mounted indoors, or used as a tabletop device. **The SMA Group** | www.sma-america.com

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# Improving Photovoltaic Efficiency with Analytical Instrumentation

By Robert H Clifford, PhD

**MUCH DISCUSSION** in the alternative energy market has lent itself to how the photovoltaic industry can prosper in the years to come. The consensus is that to achieve mainstream acceptance, PV power must be more kilowatt-hour cost-competitive than traditional electricity. To accomplish this, PV companies must improve manufacturing, and research and development efficiencies through the evaluation of materials, cells, and modules.

Traditionally, there are four main types of PV cells: crystalline silicon cells; thin-film silicon cells; copper indium selenide, copper indium gallium selenide, and cadmium telluride thin-film cells; and, dye-sensitized cells. The manufacturing process for these PV cells comprises many steps, during which a variety of analytical and physical testing methods can be used for quality control and improving research and development efficiency.

**Table 1:** Manufacturing process of crystalline silicon and the available techniques for improving efficiency.

Step		Process	Analytical/Testing Technique			
			FTIR Spectroscopy: Organic contaminant measurements on surface after			
		Si substrate surface	cleaning			
	1	1 cleaning Hardness Testing: Si substrate hardness and strength measurer				
		Removing surface				
	2	damaged layer	ICPE Spectroscopy: Impurity measurements on etching solutions			
	3	Texturing to enhance light trapping effect				
		n-layer formation by P				
	4	diffusion	FTIR Spectroscopy: P quantification n-type Si substrate surface			
	5	PSG elimination				
	6	Forming anti-reflective film	UV-VIS-NIR Spectroscopy: Reflectance and transmission measurements FTIR Spectroscopy: Evaluation of Si-H bonds			
	7	Forming front and back	Electron Probe Microanalyzers: Foreign matter analysis in anti-reflective films UV-VIS-NIR Spectroscopy: Cell reflectance and transmission measurements X-ray Diffraction Spectroscopy: Evaluation of crystalline structure of silver electrode materials Micro Compression Testing: Surface electrode Capillary Elow Testing: Eluid properties of electrode			

Here's a look at some of the instrumentation scientists are using in modern laboratories for PV cell and materials testing.

### Spectrophotometric analysis

Although crystalline silicon cells are the most popular, they are also considered first generation. Newer thin-film silicon and amorphous silicon cells use less silicon material and reduce production costs. Thin-film metals are becoming popular because of the ability to mass-produce PV cells in a similar manner to that of a newspaper printing machine rolling out paper at high efficiency.

Of course, before the cells are manufactured, the raw material must be evaluated and spectrophotometry can be used for this analysis. For example, when manufacturing silicon cells, the silicon ingots, polisher, surface and backside contacts, as well as the gold (Au) and silver (Ag) electrodes, must be analyzed. Similarly, with thin films, the PV substrate of glass, plastic, or stainless steel must be evaluated. To evaluate the crystallographic structure of silver electrodes, researchers can use an X-ray diffractometer, while the cell and module strength can be evaluated using a tensile tester. It is also necessary to analyze the energy conversion materials SiH4 and CIGS (copper, indium, gallium, and disulfide), as well as the front and backside contacts of Mo, ZnO, GZO, and AZO. The final module product must be tested with respect to EVA films, back sheets, cover glass, and frames.

### Anti-reflective films

Various innovations are being implemented to raise the conversion efficiency of PV cells, and one of these is anti-reflective film. Anti-reflective film is formed on the top of the cell to increase the amount of sunlight reaching the cell. It suppresses the reflection of incidence light from the surface of a solar cell, preventing the loss of light energy.

Ultra-violet visible-near infrared (UV-VIS-NIR) spectrophotometry measures the reflectance of anti-reflective film, and is an effective means of evaluating the film's performance. Using this method, researchers can measure absolute reflectance while freely adjusting the angle of incident light—how the sun hits the cell at different angles throughout the day.

For example, at 0° the sun is directly over the solar panel; whereas, at 5° the sun is slightly shifted from the center. As the angle of degree increases, the distance from being directly over the panel increases and the percent reflection increases, ultimately reducing energy efficiency.

Figure 1 shows the absolute reflectance of anti-reflective film (SiN film) used on top of the silicon wafer of a solar cell. It is clear this film sample suppresses reflectance chiefly in the visible light region, showing extremely small reflectance values in the wavelengths of 500 nm to 600 nm. Ideally, a research and development team could manufacture an anti-reflective film in which 0° and 60° would yield equivalent energy efficiencies at all wavelengths.



**Figure 1:** Absolute Reflectance Spectra using s-Polarized Light at 5°, 15°, 30°, 45°, and 60° incidence.

### Glass plate analysis

Spectrophotometry can also be employed during glass plate analysis to determine visible light transmittance to meet JIS R3106 standards (Testing Method on Transmittance, Reflectance, and Emittance of Flat *Continued on page 30.* 

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# Not just for sunny days.



**Bright** Thinking in Solar

# solar energy

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Glasses and Evaluation of Solar Heat Gain Coefficient). To analyze visible transmittance and reflectance, manufacturers can use a UV-VIS-NIR spectrophotometer equipped with an integrating sphere. Solar transmittance and reflectance, as well as solar heat gain coefficient can be evaluated using this method.

To measure normal emittance, manufacturers can use an FTIR (Fourier Transform Infrared) spectrophotometer equipped with a specular reflectance attachment. FTIR and UV-VIS-NIR methods can be user to conduct all of the aforementioned tests on commercial opaque glass used for photovoltaics.

### UV deterioration of encapsulation material

Ethylene-vinyl acetate (EVA) film is widely used as encapsulation material for solar modules. It must provide weather-resistance and long-term reliability under long periods of exposure to the elements. FTIR spectrophotometry can be used to evaluate weatherability under UV irradiation.

In the example below, EVA film was illuminated by a Xenon lamp and the IR spectrum measured by single-reflection ATR. Figure 2a shows the overlaid spectra measured after 0, 2, and 5 hours' irradiation time. As the exposure time increases, the acetate C=O (1735 cm-1) peak decreases continuously; whereas, the aldehyde/ketone C=O (1716 cm-1) and O-H (near 3400 cm-1) peaks increase (Figure 2b). This results from decomposition of vinyl acetate in the EVA and the formation of aldehydes, ketones, and alcohols during this process.





Figure 2a: IR Spectra of EVA Film during UV irradiation.



**Figure 2b:** Changes in functional groups under UV Irradiation. (a) Acetone (b) Ketone/Aldehyde (c) O-H (n=2)

During this analysis, a universal testing machine can be employed to measure the amount of peeling on the EVA film and soldered tabs on solar cells. Universal testers can also be used to test module loading and bending testing.

# Nanoparticle analyzers

Nanoparticle analysis is used to measure particle dispersement when manufacturing dyesensitized solar cells. These cells consist of an iodide electrolyte solution and a transparent electrode coated with a thin layer of dye-absorbed titanium oxide dye that is affixed to a plate. The porous titanium oxide film is made by coating the plate with nanoparticles and, then, baking the coated plate. To ensure a uniform coating, the nanoparticles must be maintained in a well-dispersed state. So, particle size measurement is critical. Additionally, the indium tin oxide (ITO) film used to make the transparent electrode is usually created by sputtering or other semiconductor processing. The ITO nanoparticle coating and baking technique is expected to lower production costs. Therefore, controlling the particle size and distribution of indium used for this technique will help conserve this scarce material and reduce manufacturing expenses.

### Conclusion

While all of the analytical instruments mentioned need not be in a PV manufacturer's R&D line-up, each one helps improve a step of the manufacturing process to improve the final product. Manufacturers would be wise to continue evaluating all of these methods to see which ones come out on top with respect to decreasing production costs, maximizing efficiency and enhancing the lifespan of PV cells.

Robert H Clifford, PhD, is the Industrial Business Unit Manager for Shimadzu Scientific Instruments. He leads the Shimadzu groups with respect to atomic and molecular spectroscopy, as well as the physical testing machines.

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# Balance-of-System Improvements and Their Impact on Solar Power LCOE

By Michael Lamb

WHEN MAKING LONG-TERM COMPARISONS of solar to other methods of generating electricity, the most common economic metric is Levelized Cost of Electricity (LCOE): total system cost (including capital investment, fuel, maintenance, and a discount rate to account for the time value of production) divided by total lifetime power production, expressed in dollars per kilowatt hour (\$/kWh).

Many companies are working to reduce solar's LCOE, with cheaper, more-efficient modules, trackers, and pre-assembled modules and racking that reduce installation time and cost. The following analyzes how one solution, Parallel Solar architecture, impacts LCOE. Wiring solar arrays in parallel instead of series makes arrays more economical by reducing balance-of-system cost, while simultaneously increasing energy harvest. As a result, Parallel Solar improves both sides of the LCOE equation—fewer dollars produce more kilowatt-hours.

Another way to implement Parallel Solar is through parallel AC rather than DC, using micro-inverters. There are tradeoffs involved, such as balancing copper plant costs and dealing with a more complicated wiring scheme, especially for three-phase applications. On the pro side, parallel AC eliminates the cost of installing and maintaining a central inverter.



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For this analysis, a sense of the overall numbers involved can be achieved by looking at a larger-scale project using a parallel DC bus and central inverter—the best-case cost scenario.

### Why balance of systems (BoS) matters

As photovoltaic panel prices fall, balance-of-system costs become a larger factor in solar array costs. In a 2009 survey of over 78,000 installations totaling 874 MW, Lawrence Berkeley National Laboratory estimated that balance-of-system costs accounted for an average 58% of total system cost in 2009, up from 46% in 2008.

Looking at Parallel Solar, the technology utilizes vBoost DC-to-DC converters to boost the output voltage of PV solar modules, creating a constant-voltage power bus that allows 100 or more crystalline modules and over 400 thin-film modules to reside on a single cable run. In addition, distributed MPPT eliminates effects of panel mismatch, optimizing energy harvest over the system's lifetime. This would, of course, be the same in the parallel AC approach.

### The megawatt model

To evaluate Parallel Solar's impact on LCOE, consider a hypothetical one-megawatt array with ground-mounted First Solar 75-watt panels. This model incorporates multiple variables, including:

- Lower Installation Costs: Fewer combiner boxes, less wiring, and reduced labor hours;
- Reduced Annual Operations & Maintenance Costs;
- Increased Power Production: Distributed MMPT for increased energy harvest; and
- Reduced Discount Rates: More-reliable performance data reduces perceived risk.

# Installation cost savings | O&M improvements

A parallel-wired system allows designers to connect more panels on a single cable run, which means less wiring, fewer combiner boxes, and fewer labor hours. In a traditional series-string approach, wiring and combiner boxes would have a total installed cost of \$432,640.

By contrast, Parallel Solar does not require "home run" cabling, and can accommodate over 400 solar modules per cable run (assuming a #4 USE-2 trunk harness de-rated to 96 amp capacity), allowing for fewer terminations, less wiring, and a large reduction in combiner boxes. Therefore, Parallel System installation costs total \$15,320, a savings of \$417,320. On a dollar-per-watt basis, this saves \$0.42/Wp. Parallel AC will shake out differently on this point, with less-dramatic wiring and labor saving, and the need for some additional equipment to efficiently transport the AC power to the grid. Costs around the inverter would be eliminated but this would be, at least, partially offset by the micro-inverter costs.

### Table 1.1 – Electrical System Installation Costs in Parallel vs. Series

		Series System		Parallel System	
Component	Price	Quantity	Cost	Quantity	Cost
Wire	\$0.30/foot	800,000	\$ 240,000	22,400	\$ 6,720
Combiner box	\$1,200 unit	112	\$ 134,400	5	\$ 6,000
Labor (hours)	\$65/hr	896	\$ 58,240	40	\$ 2,600
Total			\$ 432,640		\$ 15,320

Operations and maintenance are usually estimated at about 5% of total system cost. Parallel Solar technology improves O&M costs by monitoring performance at the panel level, which greatly improves the ability to find and fix problems. With the 5% estimate as the baseline, 4% is used as the cautious, 3% as the moderate, and 2% as the ambitious calculation.

### Increased power production & reliable data

Once a system is operating, Parallel Solar increases power production because it distributes MPPT and eliminates power-sapping panel mismatch. Parallel architecture lets each module run at optimal efficiency, providing maximum power to the central inverter regardless of soiling, aging, shadowing, or other causes of panel mismatch. Unlike series-string set-ups, underperforming panels will not drag down the array. Improvement will vary depending on the mismatch forces (environmental and otherwise) acting on the array at any given time. For these calculations, assume the baseline de-rating for Continued on page 34...

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# Schneider Flectric

### ...continued from page 32.

a system is 80%, and that it's brought to 83% in the cautious, 86% in the moderate, and 89% in the ambitious model.

A subtle but possibly more important avenue of savings is provided by the monitoring capabilities of Parallel Solar. Because distributed electronics inside each vBoost module provide constant data on the panel(s) connected to it, array operators get outstanding granular visibility into panel performance and problems. This is superior to series installations where inverter-level monitoring only tracks the array as a whole. The monitoring and distributed-MPPT advantage would exist for parallel AC architectures, as well.

While Parallel Solar's data stream is helpful in maintenance and troubleshooting, it also provides a detailed track record of array performance over time. This documentation is very appealing to financiers, who are still building their understanding of solar power plants and their associated risks. When financiers can make a data-driven assessment of risk associated with a particular installation, the value is increased. This is reflected in the array's discount rate. The change can be dramatic—in the model array, a 9% discount rate yields an LCOE of \$0.245 kWh, while a 6% discount rate yields \$0.191 kWh LCOE.

### Final LCOE models

Parallel Solar can improve LCOE with lower installation costs, reduced O&M, increased production, and lower discount rates. The following table summarizes the three scenarios—cautious, moderate, and ambitious, based on a range of possible improvements in up-front costs, O&M, de-rating, and discount rate.

### Table 1.2 – Final LCOE Results

	Original	Cautious	Moderate	Ambitious
LCOE	\$0.245/kWh	\$0.189/kWh	\$0.162/kWh	\$0.139/kWh
Total System Cost	\$3,161,928	\$2,732,256	\$2,646,873	\$2,561,490

Traditional architectures yield a \$0.245 kWh LCOE, while Parallel Solar LCOE ranges from a cautious estimate of \$0.189 kWh to an ambitious \$0.139 kWh. After adjusting for vBoost converter module costs, Parallel Solar can remove approximately \$0.03 (12%) to \$0.085 (35%) from system LCOE—a clear net benefit even under the most cautious scenario, and a potentially game-changing improvement in best-case situations.

Michael Lamb is the vice president of Business Development at eIQ Energy. Note: Article derived from a detailed White Paper available online at the company website.

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I am pleased to announce on February 1, 2011, DC Power Systems and Solar Depot, two strong, trusted names in renewable energy, completed the first step in our consolidation. The boards of both companies, along with ITOCHU, our ultimate parent company, agreed to begin our journey toward full integration by placing both companies under common ownership and management. Our combined companies will be the largest, most diverse renewable energy distributor in the Americas, carrying more products, more technologies and offering more services than any other renewable energy distributor operating in this hemisphere.

Throughout the upcoming months, you'll gradually see changes as we integrate our operations. Until then, it's business as usual for you. In some ways we will continue to operate as two separate distributors under one holding company. You will continue to receive quotes and place your orders as you always have, speaking to the same sales and customer service people you have always relied upon. Simultaneously, we'll be working hard behind the scenes to integrate our policies and practices to create best-in-class warehousing, shipping and back-office operations.

Integrating two established distribution companies will take time. As we complete the process, we will stay true to the values that have shaped both DC Power and Solar Depot: focusing on the basics of great customer service, quality products, fair prices, abundant value-added services and a corporate culture built on working together. On behalf of all of my coworkers, thanks for choosing us today.

**Kevin Shimokobe** CEO DC Power Systems and Solar Depot LLC

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**Five-string, pre-wired combiner box** Tyco Electronics (TE) launches the UL 1741-listed pre-wired SOLARLOK combiner box for faster, error-free residential solar panel installations. The five-string combiner box offers 30-second error-proof terminations through factory pre-wired TE SO-LARLOK connectors, which have polarity keyed housing to help prevent mismating. Additionally, its lightweight, low-profile design, which includes four pre-drilled knock-out selections, offers installation flexibility in various residential solar applications.

The high-performance UL F1 UV-rated material protects the product from harsh impacts and environmental wear and tear extending its overall life in outdoor environments. Components included in the combiner box are TE threaded SOLARLOK grounding bolts to establish easy, reliable ground paths and TE solar identification labels, which meet NEC solar requirements. All components (grounding bolts, connectors, and identification labels) are established TE products that are UL-recognized.

# Tyco Electronics

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Delivering solar power to the grid cost-effectively is dependent upon an inverter being properly protected and, with inverter technology rapidly evolving, custom protection is becoming a necessity. With this thought in mind, Crenlo is now offering inverter enclosures built to meet the needs of individual customers. Crenlo provides everything from initial consulting through implementation in all areas important to inverter protection including environmental considerations—such as UL 1741 compliance, airflow, and cooling, NEMA-rated seals, anticorrosion, EMI/RFI shielding, snow load, and seismic considerations.

Crenlo's enclosures are built for ease-of-use and installation with considerations given to access control, accessibility, and finite element analysis for crane, helicopter, or forklift installations. Inverter enclosures can be built for any scale, including the most common 333 kW, 500 kW, and 1 MW sizes. In addition, Crenlo manufactures custom junction and combiner boxes, DC disconnect boxes, and inverter housings. Crenlo also offers eight standard enclosure lines under their Emcor brand of enclosures. **Crenlo** 

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# Smart Grid Update: Standards Development & Renewable Energy



By Dick DeBlasio

**THE SMART GRID'S** promise and ongoing standards development are intimately linked. Perhaps nowhere across the Smart Grid's sweeping technology landscape is this fact more clearly illuminated than in renewables.

The robust and reliable technologies that will enable transition to renewables, in large part, have been introduced. To accelerate that transition, today's imperative is to connect the dots among the technologies via development and adoption of interconnection and interoperability standards. Standards are establishing the pathways for the greater reliance on renewable energy sources that the Smart Grid proposes.

With its "Draft Guide for Smart Grid Interoperability of Energy Technology and Information Technology Operation With the Electric Power System (EPS), and End-Use Applications and Loads," scheduled to be released for sponsor balloting this month, the IEEE P2030 Working Group has brought together engineers from across the power, communications, and information technology (IT) industries. Their focus has been the standard interfaces that will be needed to enable the increased use of large- and smallscale renewables, higher penetration on the electrical-distribution system of distributedgeneration energy sources, and other revolutionary benefits promised by the Smart Grid.

#### **Connecting renewables**

Standards and regulations for renewables interconnection have developed over decades, and the horizon for ongoing innovation is rich.

Part of the US National Energy Act of 1978, the Public Utility Regulatory Policies Act (PURPA) established the foundational technical and business terms of interconnections and transactions among utilities, and independent power generators in the United States. Building on a recommended practice for interconnecting portable photovoltaic (PV)

systems to the grid, the IEEE 1547 "Standard for Distributed Resources Interconnected with Electric Power Systems" addressed the performance, operation, testing, safety considerations, and maintenance requirements with regard to grid interconnection for any distributed-generation technologies. Since its release in 2003, 80% of US state public utility commissions (PUCs) have adopted the standard, which was called out for interconnection services in the US Energy Policy Act of 2005.

Important development continues around and beyond these landmark interconnection standards. In 2010, IEEE 1547 was reaffirmed for five more years. Plus, extensions have been crafted to address emerging issues. IEEE P1547.8, targeted for ratification in 2012, will expand the applicability of the base standard to innovations in energy storage, hybrid generation-storage systems, intermittent renewables, inverters, and plug-in electric vehicles—technologies that all figure prominently in the emerging Smart Grid.

The IEEE P2030 Working Group in March 2009 started on the Smart Grid interoperability guide that is nearing completion. Now, work is underway on additional application-oriented guides. Electric-vehicle interoperability with the grid will be the focus of the P2030.1 guide, for example; electric storage systems, of P2030.2, and test procedures for verifying conformance of storage equipment and systems to interconnection standards, of P2030.3.

#### Standards coordination

Ultimately, the Smart Grid demands standards—some of system level, some granular to cover specific electrotechnology components—across communications and IT services and end use; power generation, transmission, distribution, and load serving; automobiles; cybersecurity; sensors, etc. About 100 of its standards as foundational to the Smart Grid's



development have been identified. Plenty of new and revised standards will be forthcoming over the next decades of implementation, too.

It's critical for the Smart Grid's consitutencies—businesses and consumers, manufacturers, utilities, governments, etc.—that the standards environment doesn't fragment itself into an incoherent and maddening array of unrelated island specifications with which to comply. For manufacturers to profitably produce enabling technologies on wide scale, for example, Smart Grid standards must apply commonly across geographic markets (so a plug-in electric vehicle made in one jurisdiction can be purchased by a consumer living in another and driven to a workplace in a third, with no hiccups in recharging, billing, etc.)

This requirement demands a level of coordination across and among standards-development organizations (SDOs) globally that is perhaps unprecedented. Many of the interface standards for which the IEEE P2030 guide documents need may demand input from SDOs and consortia serving the vertical industries that are horizontally integrated within the Smart Grid. The International Electrotechnical Commission (IEC) is contributing here, too, with development of a Smart Grid standardization roadmap in 2010.

Governments will also play a key role in ensuring standards coordination. In the United States, the Energy Independence and Security Act of 2007 charged the National Institute of Standards and Technology (NIST) with creating a framework of Smart Grid interoperability standards, and the American Reinvestment and Recovery Act (ARRA) of 2009 devoted \$10 million to the effort. IEEE P1547.8, in fact, is a response to a NIST Priority Action Plan recommending improved interconnection performance functionality.

#### Conclusion

Incentives are, of course, another valuable contribution that governments can offer the Smart Grid, particularly in regard to renewables integration, as certainly there remain technology gaps to be bridged. ARRA's allocation of \$4.5 billion to fund regional Smart Grid demonstrations, for example, is proving valuable in encouraging innovation in distributed generation (around wind power and photovoltaics, especially). Storage is one prime area for ongoing research and development.

Government could play another important role in spurring US Smart Grid rollout by requiring that a certain percentage of power is derived from renewable sources by a given year. President Obama, in January's "State of the Union" address, presented such a challenge: 80% of America's electrictity from clean energy sources by 2035. Renewable energy policy targets exist in dozens of countries around the world, but the vast majority of US states offer no such mandates.

These types of policital and economic questions will

figure prominently in the next decades of development and implementation around the Smart Grid. The great promise of the Smart Grid relies on distributed generation of renewable energy sources on unprecedented scale. Political/economic incentives, undergirded by widely adopted standards, will have to be in place for that promise to be realized. In addition to his role as chair of the IEEE P2030 Working Group (http:// grouper.ieee.org/groups/scc21/2030/2030\_index.html), Dick DeBlasio is a member of the IEEE Standards Association Board of Governors and chief engineer with the National Renewable Energy Laboratory.

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# Photovoltaic Lifetime & Financial Risks



**"Will it last for the expected 25 or 30 years or more?"** is a common question being asked of PV modules and systems. And, in terms of "bankability," are there independent third-party data supporting newer proprietary or established technologies?

So, what happens when modules or balance of system (BOS) components either fail prematurely; require frequent unanticipated maintenance, repair, or replacement; or suffer system yield decline and fail to meet the long-term production estimates on which the financial calculations were based? Early module or component failure, unanticipated maintenance costs, or unexpected poor power generation are all real costs (think: time and money)—whether or not covered by hardware or performance warranties.

#### Money at risk

Financial risks faced by PV start-ups and new technologies come from many sources. Key questions need to be answered prior to start-up, including:

- What technological hurdles, if any, will need to be overcome within the available time and given the available resources;
- Can the product or technology be successfully manufactured, sold, and deployed; and
- $\cdot$  Will any competing products or companies be of contention, or simply too overwhelming to bear?

Even if all of these points are satisfactorily addressed, the question of "will the product last and perform" should be a critical part of the financial analysis carried out by investors such as VC's.

Large-system installations, such as commercial and utility scale arrays, require substantial financing and need to produce revenue at projected levels over their lifetime. Although worst-case power-yield decline figures may be used, one also needs to estimate the potential for module or component failure over 25 or 30 years, without making every system appear financially impractical to a banker.

Manufacturing costs for wafer-based modules are rapidly decreasing with the now abundant supply of silicon and low-cost production lines. This affords successful manufacturers the opportunity to focus more on issues of quality, long-term durability, and overall reliability rather than trying to squeeze another fractional percentage point of conversion efficiency. However, just because crystalline silicon (and now CdTe) is well established doesn't automatically guarantee new entrants will have the same quality. To quote an investment prospectus, "Past performance is no guarantee of future results."



#### **Problems solved?**

Many on the business side of PV believe that durability issues are past history since PV modules have been successfully used for 30 years. But, it's important not to forget about the many failures of new technology during that time. Today's products are simply not yesterday's modules. In the current drive to reduce material and manufacturing costs, many traditional designs are being replaced by those with a limited history and a greater potential for risk. Risks (or problems), which may take 20 years or more to develop.

Newer PV technologies, such as thin films, have very different degradation mechanisms and environmental sensitivities when compared to crystalline silicon; yet, these products are tested in the same way and with the same basic IEC tests. While the IEC crystalline silicon standard was based on 30 years of field history and experience, the thinfilm standard was mostly taken verbatim from the former. Even when modules are durable, many of the historical and current field problems involve the durability and reliability of other system components, such as junction boxes, power transmission, and management components. These outdoor exposure problems can lead to system de-rating, electrical arcing, hot spots, or other failures and safety issues.

New PV form factors, including flexible roll or roofing shingle BIPV and PV solar glass windows, must act and perform functionally, and meet the same building product codes and standards as their non-PV counterparts. For example, it is possible for a module to perform well, but look bad after only a few years. This may be irrelevant for a utility scale generating facility in the Mojave, but it's a serious issue for a monumental building façade.

### Current qualification tests

An industry misconception is that passing qualification tests and certification to standards such as IEC 61625 for silicon modules, IEC 61646 for thin film technology, or UL-1703 for safety is a guarantee of durability and reliability. In fact, the standards specifically state that they do not imply long-term performance. They do, however, establish a basic minimum initial performance or safety level to weed out truly inferior products.

Some manufacturers perform these (IEC) tests for higher durations than the requirements to try to obtain some idea of long-term durability, but these tests do not always adequately or realistically stress products to anything similar to real-world conditions. Rather, they serve as screening tools to catch basic failures that may extend beyond infant mortality. They are not capable of predicting true, long-term outdoor performance, longevity, or safety. Various standard-setting organizations, including the IEC, are just now starting to address long-term durability and reliability issues, but they are still years away from implementation.

Module- and BOS-accelerated test techniques have emerged to help address long-term durability assessment. And, recently, newer multiple-stress, true weathering-test programs have been developed to better assess the long-term environmental durability aspects of modules and BOS components. These will continue to improve and be refined as more data is generated. Be forewarned, however, there is no single magic accelerated test that can guarantee 25 or more years of field use.

#### Conclusion

Financial models for estimating PV module and system economics can be challenging without reliable data. Since waiting for real-time *Continued on page 42...* 



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#### solar energy

#### ...continued from page 41.

field data on durability is not an option to factor into these analyses, it's necessary to rely on accelerated tests—despite their imperfection. Uncertainty associated with accelerated test results may be reduced by applying techniques and approaches specific to durability issues, rather than qualification testing. If financial projections are only as good as service life estimates, then the path of accelerated test customization and refinement must be taken. Allen Zielnik is a senior consultant with the Solar Energy Competence Center.

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GreenTow | www.greentow.com



# Solar charge controller

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#### **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 2kW 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.

Patriot Solar Group www.patriotsolargroup.com



# Materials for solar panel production

Morgan Technical Ceramics (MTC) introduces materials that significantly improve the performance of ceramic rollers in furnaces used to make silicon wafers for solar panels. The performance improvements associated with the materials are expected to lower costs by driving down the processing costs for each wafer produced. MTC's fused silica rollers provide a variety of benefits for thermal processing and chemical doping of silicon wafers and module glass. The rollers are inert and have high mechanical strength and good wear characteristics, leading to a long life in a challenging high-temperature environment.

For high temperature applications in aggressive atmospheres, MTC has developed HalSolar alumina/silica rollers, which have improved chemical resistance, excellent thermal shock resistance, and can be supplied with a smooth surface finish. Developed specifically for the solar market, the new rollers demonstrate MTC's commitment to providing application engineering support to this important emerging market segment.

Morgan Technical Ceramics www.morganplc.com



#### Next-generation thermal processing equipment

BTU International introduces its new TRITAN dual-lane metallization firing system. This state-of-the-art system features increased throughput at 3600 wafers per hour, an edge-grip transport system, and a temperature spike faster than three seconds. The 90 MW metallization firing system also features BTU's unique TriSpeed technology, allowing users to take advantage of superior ramp rates—up to 200°C per second—while not compromising the drying and cooling sections of the profile. The three-belt, three-speed system provides revolutionary control of profile development.

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# Public Policy Incentives for Solar Energy



By Robert E Jackson, PE



As global energy demand continues to grow, developing and implementing cost-effective, sustainable energy solutions—including solar power is essential. Financial incentives, through federal and state public policies, provide the means for an economically viable solar marketplace.

#### State policies

One of the most effective ways solar energy development is currently incentivized in the United States is through a stateregulated renewable portfolio standard (RPS). An RPS requires utilities to use renewable energy or renewable energy credits—including solar renewable energy certificates, or SRECs-to obtain a specified percentage of their electricity sales. Twenty-nine states have an established RPS to achieve greenhouse gas emissions goals, partially through solar or distributed generation (DG) set-asides. According to the Berkeley National Laboratory, approximately 250 MW of solar photovoltaic energy has been brought online in states with solar or DG set-asides.

As part of the 2008 Green Communities Act, utilities in Massachusetts are required to generate five percent of the overall energy supply through the utilization of renewable energy. Massachusetts RPS goals will increase by one percent of total utility energy sales annually to 15% by 2020 and 25% by 2030, and so on. Utilities may either generate renewable energy or purchase SRECs from renewable energy generators. These payments are classified as Alternative Compliance Payments, which have a floor price in Massachusetts of \$300/MWh and a ceiling price of \$600/MWh. The SREC trading prices are currently highest in New Jersey, where SRECs prices as of January 2011 were trading at \$640/MWh.

RPS policies stimulate solar development not only on rooftops and public lands, but also on Brownfields-to-Brightfields sites such as closed landfills and other environmentally distressed properties. For example, the first 2 MW solar installation on a closed landfill was recently permitted in Greenfield, Massachusetts, and is currently under construction. Also, several Brownfields sites have been identified as part of a 20 MW micro-grid planned in New Bedford. SREC programs provided the primary economic incentive for developers to own and operate solar installations by selling SRECs to utilities, who must satisfy RPS obligations.

As the demand for SRECs increase, the price of SREC allocations also increases,

furthering the economic incentive for developers and power purchase agreement providers to participate in solar development.

#### **Federal incentives**

While several state solar energy policy efforts are experiencing success, federal economic policies relating to solar energy development have historically been unreliable, as many have incentive structures that expire after a set time period. One of these federal solar energy policy measures is US Treasury Section 1603 Grant Program, funded by the 2009 American Reinvestment and Recovery Act (ARRA). This program provides federal grants equal to 30% of the qualified facility installation costs, and was set to expire in December 2010. According to solar developers, this grant program is currently essential to the economic viability of solar installations across the US. Fortunately, this solar policy measure was recently extended as a component of the tax-cut compromise bill.

Solar energy policy can be separated into two focus areas, those with a "technology push" and those with a "demand pull." The US Treasury grants act as a "demand pull" that promotes the market viability of solar development. Continued solar innovation will also need "technology push" to promote research that increases the efficiency of solar energy conversion to direct current. These increases in efficiency lower the cost of capital by reducing the land area required to produce solar energy output.

There are several other important federal incentives and policy programs for solar energy development:

- The Modified Accelerated Cost-Recovery System (MACRS) allows businesses to deduct the depreciation on capital investment during a five-year schedule.
- The Economic Stimulus Act of 2008 allowed an additional 50% bonus depreciation write-off in year one under the original MACRS federal policy, enacted in 1993.
- The Business Energy Investment Tax Credit program allows businesses to take



a 30% tax credit for solar expenditures until the year 2016.

- Qualified energy conservation bonds include federal funding instruments to finance renewable energy development. Under this program, developers may take out bonds on solar energy implementation and pay back only the principal, while bondholders receive tax credits rather than interest payments.
- The US Department of Energy Loan Guarantee Program was developed as part of the 2005 Energy Policy Act, and provides approximately \$10 billion in loans for projects that reduce greenhouse gas emissions. The loans must be repaid to the federal government over the useful life of the project and have been generally allocated for projects in excess of \$25 million.

# The future of solar incentives

Utility scale solar energy is at the threshold of generating clean electricity at prices that are competitive with fossil fuel energy production. The state level RPS programs are designed to increase in ambition over time. This will lead to declines in solar energy costs due to increasing demand, and will accelerate economies of scale by increasing the efficiency of solar panels. While capital costs of solar energy decline, subsidies and incentive programs responding to the challenges of policy instability and changes in political climate should become less necessary.

Given the economies of scale trend, solar may achieve economic viability without the presence of incentive programs in the near future. According to several solar energy policy analysts, the overall price of solar energy production is expected to decrease from the current cost of approximately \$0.16/kWh to \$0.06/kWh in 2020. The predicted time frame for this achievement is recommended for further research analysis. Once there is some level of predictability within the renewable energy market, financiers of these projects may provide the required investment capital to implement project at a diminished risk.

Robert E Jackson, PE is an environmental engineer with TRC Companies, a national engineering, consulting, and construction management firm that provides integrated services to the energy, environmental, and infrastructure markets.

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# Solar thermal collectors

SRCC OG 100 Certified EZINC Solar Thermal Collectors are available in 4ft x 6.5ft, 4ft x 8ft, and 4ft x 10ft. The EZINC collectors also now come with US-NPT threads. They are not manufactured as many collectors with straight copper on the edge, which eliminates all welding processes when building the collectors side by side. Another advantage is when the system needs to be relocated—by detaching the collectors from the intermediary unions, installers will be able to have the original collectors back. EZINC provides flush mounting brackets appropriate to EZINC collectors. Also, EZINC provides mounting racks and sets for installing EZINC Solar Collectors on rooftops or flat surfaces. EZINC | www.presolarnet.com



# Position sensors for solar trackers

For high-temperature solar-thermal systems, where an array of parabolic mirrors focuses the sun's energy on a collector (boiler), accurate tracking systems are extremely important. With these installations, the mirrors are required to reflect the sunlight directly toward the mirror, and even a small aiming error could sharply reduce the overall effectiveness of the system. Position sensors, such as POSITAL's OPTOCODE (OCD) rotary encoders and ACCELENS (ACS) inclinometers, play an important role in these tracking systems, providing the controller with instantaneous information on the exact orientation of the solar panel array. Accurate, reliable, and weatherproof, POSITAL sensors are available with instrument interfaces that connect easily to most programmable logic controllers (PLC's). FRABA Inc. | www.fraba.com



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http://us.ferrazshawmut.com/catalog/ special-purpose-fuses/photovoltaic-fuses/



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# Wind Turbine Market Outlook

By Wayne Song



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**THE AMERICAN WIND ENERGY ASSOCIATION** (AWEA) reported that 2010 came to a close with just half of the wind turbine installations (5,115 MW), compared to the record year of 2009. While the weaker economy and lower demand for electricity contributed to the decrease in installed wind capacity in 2010, the lack of a long-term federal renewable energy policy in the US has been a significant factor in the "boom-bust" cycles that have characterized the US wind energy market.

Tax benefits in the form of production tax credits (PTCs) and accelerated depreciation were the primary drivers of the US wind energy market up until several years ago. PTCs were allowed to lapse several times in the past. The last time was at the end of 2003, when Congress took 10 months to extend the PTCs. Even after that extension, due to the uncertainty of whether turbines could be installed by the new sunset date to qualify for the

PTCs, purchasers were able to obtain 100% vendor financing in certain instances at the height of the thenbuyers' market.

From 2005 and on, PTCs were extended and in place, continuously, without any breaks in effectiveness In the absence of long-term federal policies, state RPS programs are helping to drive the demand for wind energy.

(they are currently set to expire at the end of 2012). The relatively long period of federal regulatory certainty, along with the increase in states adopting renewable portfolio standards (RPS), contributed to the sustained growth in installed capacity from 2005 through 2009—wherein, turbine suppliers enjoyed a period of market strength when demand greatly exceeded supply. In light of the then-market imbalance, various Asian companies entered the sector, and several European vendors who had been absent from the US for several years, returned to the North American markets just as the economy began to slide. The emergence of new turbine manufacturing capacity, at a time of decreasing power demand, firmly swung the pendulum back to a buyers' market by 2010.

#### Stratification of turbine manufacturers

Three categories of turbine manufacturers emerged in the US in 2010. Turbines from the first-tier suppliers continued to be financeable by the debt and tax equity markets, and these suppliers didn't have to modify the terms of their supply agreements significantly. Many of the first-tier suppliers reported record numbers of megawatts under contract in 2010, with deliveries primarily scheduled for 2011 and beyond. The second tier of turbine suppliers, however, has had to provide some concessions with respect to the terms of their supply agreements. As an example, rather than requiring large payments be made upon turbine delivery as is customary, certain tier-two manufacturers were willing to accept deferred payments until the purchaser/developer achieved project commercial operations. They received payment from the US Treasury,

under the popular American Recovery and Reinvestment Act of 2009 (ARRA) Section 1603 program, which allows developers to receive cash grants in lieu of tax credits.

The third category of turbine manufacturers consists of new entrants in the US turbine market, such as those from China, Korea, and India. Notwithstanding the fact some of these manufacturers have a large number of operating turbines installed overseas, their turbines haven't been financeable in the US because they lack a track record in this market. As a result, these vendors are working to gain a foothold in the US market in various ways. A new entrant may look to buy a "shovel-ready" project to install its own turbines. In December 2010, for instance, Goldwind, China's second leading turbine manufacturer announced its purchase of a 106.5 MW late-stage wind project in Illinois that includes a 20-year power off-take agreement. The project will be built with equity from Goldwind Capital, and debt from the China Development Bank. New turbine manufacturers may also arrange financing for their prospective purchasers, most notably from the China Development Bank or from Ex-Im banks.

#### Industry outlook

Several key factors will likely impact the industry in 2011 and beyond. At the end of 2010, Congress extended the cash grant program under Section 1603 of ARRA by one year. Developers now have until the end of 2011 to begin construction of a project to maintain eligibility for this incentive. AWEA reported that the US wind industry started 2011 with over 5,600 MW under construction—largely a result of the rush by developers to meet the deadline under Section 1603, which was to commence construction by the end of 2010. There will, undoubtedly, be a scramble of activity again at the end of this year to commence construction of projects to qualify for the cash grants. This one-year extension of the cash grant program exemplifies the lack of long-term federal policies in the US.

In the absence of long-term federal policies, state RPS programs are helping to drive the demand for wind energy. These mandates, which require utilities to procure a certain percentage of their generation from renewable sources, exist in over half of the states. As of January 2011, 29 states and the District of Columbia have mandatory RPS programs and seven states have RPS goals.

Economic factors related to the domestic energy markets will also have an impact on the wind turbine market. AWEA indicates that wind power is now cost-competitive with natural gas and that utilities will be more willing to enter into long-term contracts with wind power producers to secure favorable rates. However, advances in technology point toward increased accessibility to shale gas; thereby, potentially expanding the natural gas supply in the US, and possibly tilting the economic scales back in favor of natural gas-fired projects in the future.

Although the one-year extension of the cash grant program under the ARRA will assist the wind energy industry in the immedi-

ate near-term, the lack of long-term federal policies suggests that if history is a guide, the wind energy industry will continue to see "boom-bust" cycles in the future.

Wayne Song is a partner in Morgan Lewis' Business and Finance Practice, resident in the Los Angeles office.

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# Federal Clean Energy Standard: Game-Changer or Game Over?

By Jennifer Owen & Craig Cornelius

MANY RENEWABLE ENERGY proponents

feared the November elections sounded the death knell for federal energy and climate legislation. Concerns over budget and health care dominated, with energy appearing as a footnote. But in his State of the Union address, President Obama catapulted energy back to the forefront, issuing a bold call to generate 80% of US electricity from clean sources by 2035. While carbon policy remains highly controversial, bipartisan consensus around some form of a federal clean energy standard (CES) appears marginally more obtainable.

That slowly evolving debate begs the question: what? Will a federal mandate move markets? Which State and regional power markets stand to be most influenced by the mandates? Will some generation technologies see accelerated demand for deployment while others see markets shrink? Must a mandate take a different form to leverage private investment and stimulate more business activity?

Prospects for a federal electricity mandate are somewhat better in the Senate than the House, although the path forward is murky in either case. Following the State of the Union, details on a CES from the White House have been limited. The President appears to favor the inclusion of nuclear, coal with carbon capture, and natural gas in a mandate, along with solar, wind, and other renewables. Whether some generation sources will be treated differently—a solar carve-out or a limit on natural gas, for exam-



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ple—is unclear. The mix of resources, the overall target, and the timeframe for the mandate all create very different coalitions and will require difficult compromises to achieve consensus. Historically, Senator Jeff Bingaman (D-NM),

Chair of the Senate Energy and Natural Resources Committee, has preferred a renewable mandate. In the last Congress, Chairman Bingaman championed a 15% renewable electricity standard. In recent weeks, Chairman Bingaman has expressed openness to working on a broader bill, consistent with the President's proposal.

On the Republican side, inclusion of nuclear, clean coal, and natural gas is essential. Senator Lisa Murkowski (R-AK), Ranking Member of the Senate Energy Committee, supported the 15% renewable mandate in the last Congress, but has indicated she prefers a CES going forward.

In the House, energy is taking a backseat to partisan wrangling over budget and health care. Rep. Fred Upton (R-MI), Chairman of the powerful House Energy and Commerce Committee, has prioritized rolling back health care mandates and limiting the ability of the Environmental Protection Agency (EPA) to regulate carbon. In the last Congress, Chairman Upton voted for a 20% renewable electricity mandate that ultimately passed the House. Recently, Chairman Upton has suggested he may link support for a CES to some limitation on EPA regulatory authority.

Given the contentious debates in Congress over federal spending and deficits, action on a CES proposal is hardly imminent. Opponents are seizing on the anti-government mood by tying a CES to cap-and-trade, suggesting both are taxes that raise electricity prices and redistribute wealth regionally.

The wild card catalyst may be gasoline prices. High gasoline prices often drive broad energy debates in Congress, giving CES proponents a slender window of opportunity. If Congressional leadership senses the public wants bipartisanship, rather than steadfast opposition to the Administration's proposals on health care and climate, then a CES may be the ripest ground for compromise.

Even if agreement on a CES were possible, the question remains: what impact might a federal mandate really have in the marketplace?

Nearly all of the non-hydro renewable generation that delivers into wholesale power markets in the US today was constructed as a result of state-level renewable portfolio standards (RPS). Reductions in the cost of wind and solar photovoltaic power generation, coupled with the federal tax incentives, have made these mandates less costly to state ratepayers in recent years. But, with the exception of a limited number of projects built after natural gas prices spiked during 2007/2008, very little new renewablepower generation has been built without mandates as a key financial driver.

Some solar PV power plants will be capable

of delivering competitively priced power at financial returns acceptable to private investors without depending on revenue from the sale of renewable energy certificates (RECs) to meet state RPS mandates. But, even those projects represent a small fraction of the wholesale solar PV generation that is built in California, Arizona, Nevada, and Colorado to satisfy RPS targets.

Similarly, nearly all new wind generation to be constructed during the next two to three years will depend on REC sales to deliver the returns required for financing. With off-peak wholesale power prices still down significantly from their 2008 highs, power markets will not allow for new wind projects to be profitable without the REC payments that RPS mandates facilitate. For certain states, the existence of a mandate has clearly been essential to renewable deployment.

Whether a federal clean energy standard will change that dynamic is unclear. The legislative proposals that were considered during the 111th Congress likely wouldn't have influenced renewable deployment beyond "business-asusual" trajectories predicted for 2012 to 2020, in most power markets, with the possible exception of accelerating biomass generation in the Southeast. The proposals were in most cases less aggressive and comprehensive than those already enacted across the country.

The impact of a federal mandate that significantly surpasses state thresholds will depend on the details. None of the major proposals from the 111th Congress included nuclear or natural gas generation; those provisions could shift the mix of new generation away from renewables in many states if federal eligibility supersedes state rules. At the same time, the effect of distributed generation "multipliers" may result in partial displacement of wind and other wholesale power sources with rooftop solar PV generation. The ability to trade RECs across states could motivate development of excess generation in certain states, particularly in the Midwest and Southwest. Setting a stretch goal of 80% by 2035 is only part of the process, and the value of that target will be largely shaped by the finer details often overlooked in the broad debate.

Jennifer Owen is an attorney at Van Ness Feldman PC in Washington, DC, where her practice focuses on energy matters, particularly those related to clean technologies, renewable fuels, and energy efficiency technologies.

Craig Cornelius is a managing director at Hudson Clean Energy Partners, a private equity firm that invests in companies that reduce the environmental impact of energy production and consumption.

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www.consarc.com

Photon solar module yield measurement results January-November 2010 in kWh/kW. High end is 1034.9, low end is 925.8. Trina Solar is 1011.8. Source: Photon International



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Trina Solar Limited | www.trinasolar.com





PV America 2011 Date: April 3<sup>rd</sup>-5<sup>th</sup>, 2011 Location: Pennsylvania Convention Center, Philadelphia, PA Booth Number: 309

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MECASOLAR | www.mecasolar.com



#### Solar energy products & solutions

BP Solar, part of BP Alternative Energy, is a global company that designs, manufactures, and markets solar energy products and provides complete solar energy solutions for the residential, commercial, industrial, and utility sectors. To date, over 10 million BP Solar modules have been sold in 160 countries with a cumulative installed capacity of over 1.3 gigawatts. BP Solar is a pioneer in developing crystalline silicon photovoltaic technologies, and continues to drive PV technology forward through its US-based research and development center. BP Solar | www.bpsolar.com



#### Crystalline PV modules & cells

Perlight Solar Co., Ltd is a manufacturer of high-quality crystalline PV modules and cells. They are a division of the privately held China Baolite Group, which was founded in 1982. PV module production began in 2006 with rapid growth leading to production capacity doubling every few years. The company's core line of products is a 60-cell polycrystalline series of modules at 230w, 235w, and 240w. These modules are all UL listed for the US and Canada, and CEC listed with PTC ratings at roughly 90% nameplate value. Perlight Solar uses black triple bus bar polycrystalline cells in their poly modules, and every step of the assembly process is strictly monitored for quality assurance. The Los Angeles distribution center stocks panels and coordinates all North American activities.

Perlight Solar Co. www.perlightusa.com

ww.perlightusa.com



# Solar training & education

Infinite Solar, Inc. is a school offering solar energy education in America and Canada. They provide high-quality renewable energy training programs and certificate programs, and provide the skills necessary for businesses and contractors to strengthen their capabilities and succeed in the rapidly growing green market. Their skilled instructors teach students about the design, installation, and maintenance of renewable energy systems. They are licensed by the Pennsylvania Department of Education, and offer ISPQ accreditation by the Interstate Renewable Energy Council, an approved provider by the North American Board of Certified Energy Practitioners. Infinite Solar. Inc. www.infinitesolar.com



#### Ballasted solar mounting system

The new low ballast AluLight System is designed for large commercial roofs with low excess capacity requiring a high concentration of modules. Easy and fast to install, the AluLight is an optimized ballasted solar mounting system offering a fixed tilt of 12 degrees. Modules are quickly connected using top-down clamps while rows are interconnected by the system's unique design. With the use of concrete pavers, the system ensures a well-distributed transfer of compressive forces to the roof. **Schletter** | www.schletter.us



# Next-generation thin-film PV modules

Abound Solar is a manufacturer of next-generation cadmium telluride thin-film photovoltaic modules. Built upon 15 years of development at Colorado State University, with support from the National Renewable Energy Laboratory and backed by the Department of Energy, Abound Solar is producing solar modules that significantly reduce the cost of generating solar electricity using a robust, commercial-scale, continuous manufacturing process. **Abound Solar** | www.abound.com



#### **Bio-based solar** modules

BioSolar, a developer of a breakthrough technology to produce bio-based materials from renewable plant sources that reduce the cost of PV solar modules, announced that production samples of its innovative BioBacksheet product have successfully completed all critical Underwriter's Laboratories (UL) initial material property tests and is expected to officially obtain full UL material certification soon. The initial material property UL certification tests included material identification, partial discharge test, resistance to catching fire, and a long list of other tests that are required before BioBacksheet can be used commercially in solar panels. The last remaining test for BioBacksheet is the measurement of relative thermal index (RTI), which is the temperature below which material will retain its desired electrical and mechanical properties and not be compromised via thermally induced chemical degradation. After that, commercial solar panels using BioBacksheet can be submitted for final panel certification or recertification under UL 1703 prior to sale in the general marketplace. BioSolar, Inc. | www.biosolar.com



#### Solar parking structures with visual appeal

Building on the success of its patented Premium PV canopy, Solaire Generation is proud to announce the launch of two new innovative and cost-effective products: The Vanguard and The Solairis. With these new structures Solaire continues to maintain its high standards in quality and aesthetics. All three designs elegantly and economically transform parking lots into beautiful solar power plants. The Vanguard solar carport shares the Premium's cutting-edge dualincline design, while the single-tilt Solairis is tailored for sites where snow/ice is not a concern. Solaire solar canopies produce high-energy yields and provide a highly visible commitment to renewable energy and sustainability. Each Solaire structure can easily integrate with commercially available EV charging stations.

**Solaire Generation** www.solairegeneration.com



#### Utility scale solar EPC solutions

American Capital Energy (ACE), a Massachusetts-based solar PV Engineering, Procurement, Construction (EPC) company, builds 20% of the largest utility scale solar PV projects in the US. A 20 MW, 44-acre utility scale ground-mounted array is under construction in Nevada. ACE also recently completed several utility scale solar projects in Massachusetts and New Jersey, including the Silver Lake project (1.86 MW) and two other utility scale solar projects. Another ACE project in Pennsylvania is currently the largest rooftop solar array in North America. With offices nationally, American Capital Energy is a highly experienced solar integrator able and ready to design a turnkey solar electric system to meet present and future business needs, while helping green the planet and a company's bottom line.

American Capital Energy | www.americancapitalenergy.com

# With more than 5 GW of Solar **Mounting Systems** installed worldwide, Schletter offers experience, quality and service.



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### Park@Sol™ Modular Carport System

Based on the Schletter **FS** open area mounting systems, Park@Sol offers an attractive enhancement to photovoltaic power generation.

- Quick and easy construction
- Optimizes utilization of surface area
- Suitable for multiple types of modules
- Variety of foundation types available upon request
- Made in the United States



### Visit www.schletter.us or call 520.289.8700 for more details!

#### pv america 2011



#### **Turnkey integration** provider

With over 100 module lines installed worldwide, Reis Robotics provides turnkey integration of PV module manufacturing lines with offices in Chicago, Los Angeles, Germany, and throughout the world. Reis offers some of the most advanced design and project services and support. With 5.2 GW of installed production line capacity, Reis has provided turnkey line integration on the largest line in the world, and on lines in the US, Europe, and Asia of up to 600 MW. From line layout in a factory space to handing off a fully operating line to a trained staff, maximize investment and minimize risk with Reis.

**Reis Robotics USA. Inc.** www.reisroboticsusa.com



#### Solar power systems

For more than a century, the Westinghouse name has stood for reliability and innovation. Westinghouse's Solar Power Systems are safer, powerful, and more reliable, while backed by the proven quality of Westinghouse. Westinghouse Solar Power Systems integrate the racking, wiring, grounding, and micro-inverter into the solar panel itself, enabling installers to reduce inventory hassles, and simplify design and engineering so they can spend more time selling and less time installing. Westinghouse Solar

www.westinghousesolar.com



#### Thin-film vacuum deposition equipment

Leybold Optics will be presenting its range of thin-film vacuum deposition equipment for solar applications using PVD and PECVD technology. Applications include sputter deposition of front and back contacts, and active layer deposition. For active layers, they manufacture custom systems incorporating specified hardware, built to precise customer specifications (e.g. for Se evaporation, CIGS precursor deposition, and CdTe). Their Phoebus PECVD "Linear Cluster" tool is offered for deposition of tandem thin-film silicon cells onto glass substrates of 1.4m x 1.1m. Leybold Optics also provides systems for rigid and flexible (metal and plastic) substrates in sizes ranging through R&D and pilot manufacturing to full-scale production. Their machines are rugged and field-proven and installed at major manufactures worldwide. Levbold Optics USA. Inc. www.leyboldoptics.com



**PV** backsheets

DUNMORE is a manufacturer of photovoltaic backsheets, offering various PV backsheet constructions such as FPE fluorinated products, DuPont Tedlar backsheets, and all polyester backsheet constructions. With three ISO 9001:2008 certified facilities in the US and Germany, DUNMORE is a global backsheet supplier for all types of crystalline and thin-film PV applications. In addition to their complete line of PV backsheets, an added benefit of DUNMORE is their proprietary FastCert program. DUNMORE FastCert is a solar module qualification program that assists module manufacturers deliver new and redesigned modules to the market faster by facilitating the module qualification process.

DUNMORE | www.dunmore.com



#### Solar mounting solutions

Applied Energy Technologies (AET) is featuring their innovative solar mounting solutions. 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 Technologies | www.aetenergy.com



#### **D**emand response inverter

The Demand Response Inverter (DRI) is a next-generation inverter for microgrid applications. The four-port bi-directional DRI functions as the electrical "mastermind" for utility integrated photovoltaic systems, and is capable of operating in various modes including distributed generation, demand response, power factor correction, and stand-alone/microgrid mode. Solar systems equipped with the DRI will be able to lower the Levelized Cost of Energy (LCOE) through higher balance-of-system efficiency, high reliability, and lower capital cost while providing value added ancillary services to both the utility and end users, including energy storage. Development of the DRI was partially funded by the United States Department of Energy and Sandia National Laboratories under the Solar Energy Grid Integration Systems (SEGIS) program. **Princeton Power** 

www.princetonpower.com

web: www.power-fab.com



#### Solar roofing

EagleView Technologies offers a new solar roofing report that is an innovative breakthrough for solar integrators, solar installers, and the overall roofing industry. With a technology that will continue to revolutionize the solar and roofing markets, EagleView's solar 3D roof measurement report offers everything needed to calculate solar exposure, roof square footage, and panel placement. EagleView continues to change the roofing industry, and now begins to change the solar industry with the most accurate roof measurements available for overall pitch, square footage, and lineal square feet. The solar industry will experience the benefits of a solar 3D roof measurement report that additionally offers solar exposure, rafter lengths, grid layout, and an overall roof orientation in degrees.

EagleView Technologies www.eagleview.com



# Solar mounting systems

Sollega simplifies and accelerates the adoption of solar energy technologies by reducing the mounting and installation costs associated with solar arrays. Their first product is the InstaRack. The current growth in the solar market is decreasing the cost of solar modules (aka, solar panels). Even if the modules were free, the total installation cost from current racking hardware and labor would still be too high to make solar power competitive with coal. Sollega's product holds solar panels to roofs. They manufacture the simplest solar mounting systems on the market, saving labor time and cutting project costs. This decreases the cost of solar energy and increases project ROI. Sollega is a founder-funded start-up manufacturer based at NYC ACRE, New York's Clean Tech Accelerator. Partners include: ITAC, NYU-Poly, NYSERDA, and NASA/SATOP. Sollega | www.sollega.com



#### **Transformerless grid-tied inverters**

KACO has launched their blueplanet 00xi series transformerless grid-tied inverters. With 96.5% CEC efficiency on all 00xi series inverters, this ensures the lowest energy losses. The *easy*install T-bracket minimizes mounting time to approximately 15 minutes. The inverters produce more kWhs than ever before, and they enhance efficiency numbers by using a single stage DC conversion process. The low component count makes this inverter series the most reliable and lightest in the world—KACO 00xi series inverters are up to 50% lighter than comparably sized inverters. 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

# American Capital Energy

## BOOTH 850 PV AMERICA

With many offices and 80+ MW of installed solar across North America, American Capital Energy is one of the largest solar engineering, procurement and solar /construction contractors in the United States. We help businesses adopt solar power as a viable cost-savings solution and work with utilities to achieve renewable energy portfolio standard requirements. Our strategic partnerships include solar photovoltaic (PV) module manufacturers and experienced installation companies. Considering a solar project for a convention center, warehouse, carport, strip mall, brownfield, wetland or large plot of land?

American Capital Energy will help you make all of the right decisions on a complete solar power system that will cut your carbon footprint, help improve the environment and improve your bottom line.

> See our website www.americancapitalenergy.com or call us at 866.307.5370

> Your source for Solar Power..... We capture the power of the Sun.



#### **Commercial grid-tie PV** inverters

Achieve higher, faster PV system ROI and better BoS optimization with Advanced Energy's latest Solaron inverter model. The durable, robust, 500 kW PV inverter is ideally suited for utility scale or large, commercial PV installations. In addition to innovative high-power, highefficiency technology, receive advanced monitoring and control capabilities to provide greater performance insight. An optional Remote PV Tie (RPT) accessory can cut BoS costs even further, and Advanced Energy's SafeGuard program offers proactive service that goes far beyond the standard warranty. **Advanced Energy** 

#### PV modules & solar solutions

A vertically integrated solar services provider, GreenBrilliance manufactures high-quality PV modules in their facility and delivers turnkey PV solutions (design, engineering, installation, and integration), services for residential, commercial, and government clients in the Mid-Atlantic region of US. Their vertical integration gives them the leverage to secure the entire supply chain, and pass down cost-savings directly to clients.

GreenBrilliance

www.greenbrilliance.com

#### Foundation for ground-mounted solar arrays

Cantsink is a manufacturer of helical piles, used as a foundation for ground-mounted solar arrays. They provide fast turn-around of material and competitive pricing, along with high-quality customer service. They're also proud to announce that their plant and company headquarters have been converted to solar power and are net-zero energy facilities. **Cantsink Manufacturing** 

www.cantsink.com



#### Mono & multi-crystalline modules

ET Solar is a vertically integrated downstream solar power product manufacturer and turnkey solution service provider. ET Solar produces mono- and multi-crystalline modules with over 140 specification numbers. The mono-crystalline module covers seven categories of M536, M572, M636, M648, M654, and M660/672 with 69 spec numbers, and the multi-crystalline module covers five categories of P636, P648, P654, P660, and P672 with 65 spec numbers. The black frame and ZEP frame modules are the featured products of ET Solar. ET Solar also introduces its new product Zero-rack module to the market for the first time. With Zep Campatible frame, this Zero-rack module can dramatically reduce time and simplify procedure for installation. ET Solar | www.etsolar.com

#### **PV** modules

renewables

www.advanced-energy.com/

Centrosolar America, Inc. is a wholly owned subsidiary of Centrosolar Group AG, headquartered in Germany. The C-Series is CentroSolar America's latest in its series of German-engineered and manufactured PV modules. The panels have triple-layer back sheets, high-impact low iron glass, and are coated with a patented nano-power anti-reflective coating. The C-Series looks sleeker and cleaner on the rooftop, and has the highest reliability available. Centrosolar America's C-Series includes a 10-year product warranty and a 26-year at 80% power-loss performance warranty, along with a best-in-class power tolerance rating of 0/+3%.

Centrosolar America, Inc. | www.centrosolaramerica.com

# 🎊 Solar Monkey™

A Solar Photovoltaics Project Developer and Investor Seeks a

#### **Director of Project Finance and Senior Finance Professional**

We are looking for a Director of Project Finance/Senior Finance Professional to assist our rapidly expanding business and become a key member of our demanding management team. This individual will aspire to be Chief Financial Officer and the position may evolve into a CFO. This individual will participate in the evolvement of company strategy over worldwide markets (primarily EU and US) as well as assuming direct responsibility for project finance but will also participate in cash flow planning, risk control and hedging, performance reporting, accounting, banking and counterparty relations. We are looking for an individual who is seeking to grow a company aggressively with our relaxed but intensely focused team. This individual can be located either in our southern California headquarters or in a European location. Compensation will be commensurate with experience and performance.

#### **Requirements:**

Motivated self-starter with a positive outlook University graduate, preferably with an MBA. Strong experience investing in the renewable energy sector. Fluency in English – additional language fluency a plus. Strong analytical, quantitative, and financial modeling skills. Relationships with local financing partners and banks

Please send your curriculum vitae and current remuneration to our recruitment coordinator at nace@solarmonkey.net

WWW.SOLARMONKEY.NET



#### Solar-friendly manufacturing region

A growing number of power producers, including the world's largest PV solar farm, are tapping into the industry friendly infrastructure of Sarnia-Lambton in the south-western Ontario region. Excellent manufacturing locations, which are suitable for the manufacture of solar panel components, are available adjacent to the Michigan border and central to the Great Lakes region—with easy access to international markets. Many solar energy related companies are taking advantage of cluster power in power generation, industrial chemicals, and manufacturing. The region's Lambton College provides three-year Alternative Energy Engineering Technology graduates, and research assistance is available at The Research Park in Sarnia-Lambton.

Sarnia-Lambton | www.sarnialambton.on.ca

#### **Residential & commercial** solar products

Suntech Power Holdings Co., Ltd. produces solar products for residential, commercial, industrial, and utility applications. With regional headquarters in the United States, Switzerland, and China, and gigawatt-scale manufacturing worldwide, Suntech has delivered more than 13,000,000 PV panels to thousands of customers in more than 80 countries. Suntech's pioneering R&D creates customer-centric innovations that are driving solar to grid parity against fossil fuels. Suntech's mission is to provide everyone with reliable access to nature's cleanest and most abundant energy source. Suntech Power Holdings Co., Ltd. www.suntech-power.com



#### Surge protector

CITEL'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. This 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. CITEL, Inc. | www.citel.us



#### 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 full decades of reassurance. The German-engineered MAGE POW-ERTEC PLUS modules meet maximum demands with regards to stability and corrosion resistance. Starting this spring, 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 U.S.A., LLC.

www.magesolar.com



#### Fasteners & industrial supplies

Tanner is a distributor of quality brand name fasteners and industrial supplies for the solar industry. Products offered include security and commercial fasteners, anchoring systems, mounting hardware, channel and fittings, roofing piers, fall protection equipment, shims, cable and wire management, adhesives, and sealants. Tanner has an experienced staff of customer service representatives with extensive product knowledge ready to help provide solutions.

Tanner | www.shoptanner.com



#### Solar mounting, engineering & manufacturering

Daetwyler – Clean Energy (DCE) is known throughout the world as a provider of engineering and manufacturing of the highest precision parts and equipment for the renewable energy market. DCE provides its clients with the greatest value by implementing a high degree of competency using the latest in materials and manufacturing processes to minimize costs and maintain reliability. DCE's innovative designs enable the successful installation of rooftop mount, pole mount, ground mount, and parking canopy systems. DCE's systems are simple to install with minimal tools and feature the patent pending Easy Lock security mounting design. Their unique design features selectable tiltangles and is designed to easily fit any panel type.

Daetwyler | www.daetwylerce.com





www.upsolar.com

Delivering safe solar

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#### Solar tracking system

PV Racking designs, manufactures, and distributes solar racking components that are used in roof and ground-mounted solar systems. PV Racking uses a revolutionary new solar racking system that eliminates the need for clamps and is, therefore, much easier to install, more secure, and offers a superior appearance. PV Racking simplifies the installation process by eliminating the need for clamps. This change in approach is a dramatic improvement. The company, founded and operated by certified solar installers, realized that by using its unique "gravity held, slide in place system" that it would eliminate the need for clamps. The PV Racking design team of mechanical engineers realized that in addition to a more secure placement over clamps, the new design would be faster and easier to install, especially on roofs. All of PV Racking materials and components are 'Made in the USA.'

**PV Racking** | www.pvracking.us



#### Bonding technology for PV cells

Adhesives Research, a developer and manufacturer of custom pressure-sensitive adhesive tapes (PSAs), specialty coatings, films, and laminates will be featuring sophisticated bonding technologies designed for bus bar, solar cell encapsulation, and junction box applications in crystalline and thin-film PV modules. As an alternative to traditional bonding methods such as soldering for electrical interconnects and liquid epoxies for encapsulation, the new PSA technologies from Adhesives Research advance the bonding technology options available to PV manufacturers for delivering enhanced product performance, stability and extended product lifespan. PSA tapes offer a number of manufacturing benefits and efficiencies including ease-of-handling, continuous roll formats, and no messy clean-up. In addition to these new technologies, Adhesives Research also offers a full range of electrically conductive, optically clear and electronically clean PSA technology to meet the specialized needs of PV manufacturers.

Adhesives Research www.adhesivesresearch.com



#### Turnkey solar solutions

RAI Contractors is a New Jersey based firm of engineers and solar providers that has been in business for more than 37 years. Their philosophy: to be the best commercial PV provider and installer of turnkey solar solutions, providing system design and integration that outperforms their client's expectations in energy production and return on investment. RAI has \$150 million dollars in bonding capacity and are licensed in New York, New Jersey, Pennsylvania, Delaware, Maryland, and the District of Columbia. They primarily operate in the six-state area, but have completed projects as far west as Alaska and Hawaii and as far east as Germany and Portugal. RAI is made up of seven separate divisions designated as follows: General Construction/Design Build/Construction Management; Commercial Electrical; Industrial Electrical; Transit/Signaling/Heavy Rail; Communications/Data-com; TRACE/ Energy Conservation & Maintenance Testing; and, Solar Energy & Alternative Power divisions.

**BAI Contractors** www.raiservices.com



#### Programmable AC/ **DC** power supplies

Genesys' AC/DC power supplies are the only complete family with identical features and interfaces. They provide highpower density, low ripple, and complete user-friendly interfaces, as well as excellent performance and flexibility. Platforms include 750W, 1500W, 3.3/5kW, and 10/15kW output. Outputs are available in ranges up to 600V and 1,000A. Standard features for all Genesys units' include reliable front panel encoders, built-in standard RS-232/485, last setting memory, user selectable auto/safe re-start, optional LAN, and IEEE or Isolated Analog Control. Power-factor corrected AC Input options assures worldwide operation, and a five-year warranty. TDK-Lambda Americas is ISO 9001:2000 and ISO 14001 certified. Genesys 750W to 5000W are also RoHS compliant. **TDK-Lambda Americas** 

www.us.tdk-lambda.com/hp

#### **PV** mounting svstems

Sunmodo provides one of the best value solutions of solar PV mounting systems in terms of quality, efficiency, and price. They offer a broad range of solar PV mounting ground and roof systems. Sunmodo Corp.

www.sunmodo.com



#### **Cost-efficient solar** modules

Renogy develops and delivers the most reliable and cost-effective solar energy solutions. Their production of high-quality solar cells and use of high-end accessories enable them to produce high-performance solar modules that maximize the energy yield of the solar system per unit area—and, most importantly, reduce the system cost per watt.

Renogy | www.renogy.com

#### Solar mounting solutions

TerraSmart's time-saving solar mounting solutions are redefining progress in the solar industry. TerraSmart offers solar roof flashings, ground screws, and other innovative products, as their one-source solar racking provider. TerraSmart | www.terrasmart.com





# panels

SolarWorld is America's largest solar manufacturer, operating since 1975. Vertically integrated from silicon to systems, SolarWorld manufactures wafers and cells, and assembles panels, kits, and systems in the US. Highperformance SolarWorld Sunmodule panels are independently tested and proven to produce more energy per dollar than other major brands. Solar-World Sunkits are factory customized to make installation easy.

SolarWorld | www.solarworld.com



#### Show in Print

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



#### Laser wind sensor

Catch the Wind Ltd. is a high-growth technology company that develops and produces forward-looking laser wind sensors and control systems. The company manufactures products for new and existing wind farms, as well as applications for wind resource assessment. Their breakthrough technology enables utility scale wind turbines to use advanced wind velocity information to make intelligent control decisions to significantly increase power output while dramatically reducing wind turbine stress loading. Better wind information significantly reduces the capital risks while improving the ROI to the wind industry. Catch the Wind will demonstrate their Vindicator laser wind sensor and present data collected from over 20 months of trial programs that validates the use of remote laser wind sensors for better wind turbine control. Headquartered in Virginia, the company is focused on making clean renewable wind energy more affordable and profitable. **Catch the Wind Ltd.** www.catchthewindinc.com Booth 933 (indoor) & 6831 (outdoor)

# WINDPOWER 2011

#### May 22nd to 25th, 2011 • Anaheim Convention Center • Anaheim, California

Organized by the American Wind Energy Association (AWEA), WINDPOWER brings together thought leaders, industry experts, and investors, and is like no other wind industry trade show in the world. WINDPOWER combines education, exhibition, and networking to capture the energy of the rapidly expanding wind market, creating a venue for business, and bold, forward-looking action.

#### www.windpowerexpo.com



#### Narrow tang connectors

SureCrimp narrow tang compression connectors from ILSCO are designed for tight fitting applications, reducing required mounting plate surface area by approximately 30%—which can save space on bus bars and may decrease bus bar enclosure size, resulting in overall material savings. They are made from high-grade copper, providing a reliable, highly conductive, low-heat connection. The seamless copper tubing provides improved connector endurance. Electrotin plating offers protection against corrosion. SureCrimp connectors are die-stamped with wire size and die index number, as well as a part number identifier. Each lug is color-coded with permanent ink stamping for easy identification of proper die number and proper crimp positioning. UL Listed and CSA certified for AWG and Flex Wire. RoHS compliant and meet "Made In USA" and American Recovery and Reinvestment Act (ARRA) criteria. ILSCO | www.ilsco.com Booth 4654



#### Slip rings for high-reliability applications

DEUBLIN Company introduces slip rings for a wide variety of industrial applications. An electrical device that allows the transmission of power and electrical signals from a stationary to a rotating structure, slip rings can be used in any electromechanical system that requires unrestrained, intermittent, or continuous rotation while transmitting power and/ or data. DEUBLIN Slip Rings can be easily configured for both power connections and signal connections. The signal portion of the slip rings is designed for compatibility to Ethernet, Profinet, RS-232, RS-485, RS-422, CAN, as well as generic analog or digital sensing and 24V control signals. DEUBLIN Slip Rings are ideally suited for a variety of demanding applications, including wind turbines. DEUBLIN Company has utilized the same high-quality standards in the development of the new slip ring product line as they have established in their rotary union designs for over 60 years. DEUBLIN Company | www.deublin.com Booth 691



# Wind farm construction

White Construction specializes in renewable energy power generation projects by utilizing the strengths of their long-standing history of heavy industrial construction. White Construction was one of the pioneering companies in the early days of wind farm construction across North America. Currently, they have installed more than 4,000 MW in the United States and Canada. White Construction is distinctive in their ability to provide the Engineering, Procurement, and Construction (EPC) necessary to provide a turnkey approach to any renewable energy project. They have the knowledge, experience, equipment, and management to ensure a project is on time and within budget. This philosophy has led them to many repeat customers in the wind power industry. White Construction

www.whiteconstruction.com **Booth 3033** 



#### Wind turbine tower manufacturing

For more than 30 years, DMI Industries has built a solid reputation in heavy steel manufacturing, and since 1999 exclusively in wind towers. Wind turbine manufacturers rely on DMI for a best-in-class product built to their exact specifications, delivered on time, every time. Strategically located facilities are fully integrated to take every tower section through every stage of production without leaving the location, and DMI begins every project with the raw materials and processes that offer a superior product.

DMI Industries | www.dmiindustries.com Booth 2967



#### Renewable energy consultancy

GL Garrad Hassan is one of the world's largest dedicated renewable energy consultancy and a recognized technical authority on the subject. It offers independent technical and engineering services, products, and training courses to the onshore and offshore wind, wave, tidal, and solar sectors. Although the GL Garrad Hassan name is new, the company has a rich heritage. It is borne of the integration of specialist companies that, united, form the renewable energy consulting division of the GL Group. GL Garrad Hassan is a consulting company; it has no equity stake in any device or project. This rule of operation is central to its philosophy, something that sets it apart from many of its competitors.

GL Garrad Hassan | www.gl-garradhassan.com Booth 4133

#### windpower 2011



#### Thermal management products

Since 1980, STEGO has been developing and manufacturing innovative products that heat, cool, ventilate, illuminate, and control temperature and humidity of enclosed electrical and electronic control systems. STEGO products include: PTC based convection heaters; fan heaters with PTC and resistance heating elements; explosion-proof heaters and thermostats; temperature and humidity controls; filter fans and exhaust vents; enclosure lights; receptacles; and, vent plugs. These products are renowned for reliability, longevity, simplicity of use, and high quality. The company strives to solve electrical and electronic control packaging problems for customers, and serves customers in over 52 countries around the world. STEGO Inc. | www.stegousa.com

Booth 2199C



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5356 at the **AWEA Windpower Conference & Exhibition** May 22-25, 2011



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#### Metals fabricating & processing

Elixir Industries, founded in 1948, is a privately held company concentrating efforts to broaden their focus in the renewable energy market sectors. The company has undertaken extensive manufacturing equipment upgrades over the past several months at many of their key manufacturing facilities across the US. They offer full-service metals fabricating and processing, including: advanced CNC laser/plasma cutting, plate cutting, CNC punching and forming, CNC press braking, roll forming, MIG and TIG welding, primer, powder coating, aluminum extrusion, aluminum fabrication, robotic welding, and advanced CNC water-jet fabrication. Elixir Industries continues to offer new and existing customers lasting relationships based on quality, service, and adaptability. Their restructuring efforts, combined with stateof-the-art equipment upgrades and a strong financial position, provides Elixir Industries with a solid foundation to support customer success. **Elixir Industries** www.elixirind.com Booth 2105



#### Abrasive belt machines

Dynastraight Series of portable air-powered abrasive tools feature an ergonomically designed, lightweight composite housing that reduces tool vibration and is thermal-insulated to prevent cold-air transmission to the operator. Specific applications of Dynastraight tools include paint and rust removal, refining before final finishing, medium- and fine-grain finishing, and final finishing. Available in horsepower's ranging from .4 - 1, the tools are ideal for use with abrasive, impregnated non-woven nylon products, coated abrasive flap wheels, buffs, and non-woven nylon belts mounted on Dynacushion inflatable pneumatic wheels. Use the inflatable pneumatic wheel for finishing work surfaces of virtually any shape, contour, or material—excellent for finishing stainless steel and other metals. Work on a variety of materials including stainless steel, aluminum, carbon steel, copper, brass, plastic, fiberglass, composites, wood, and much more. The straight-line tools feature high-quality air motors ranging from 950 up to 18,000 RPM. Dynabrade, Inc. www.dynabrade.com

Booth 590

#### Medium-intensity LED obstacle lights

The new L450 product range of red and red/white, medium-intensity LED obstacle lights incorporate the most advanced optical engineering design and LED technology—providing cost-effective solutions for the medium-intensity obstruction light market. The new L450 products are focused on minimizing the visual impact obstacle lights can have on the surrounding environment while, at the same time, reducing power consumption. The L450's "All-in-One" concept follows the designs successfully adopted over the past 10 years in the L350 product, so the light includes a built-in power module, controller, and GPS synchronizer. This product design makes the lights simple to install, enables them to operate reliably under the harshest conditions, and minimizes the capital costs and cost of ownership. TWR Lighting / Orga Aviation | www.twrlighting.com

**Booth 2810** 



### Wind Generator to Grid Power Infrastructure Product Solutions, with Full Service & Support Before, During and After Installation.





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#### Halogen-free flame-retardant power cords & cables

Northwire Technical Cable, a solutions provider in the marketing, design, and manufacture of technical and retractile cables, has introduced EcoPower, an environmentally friendly power cord that is halogen-free flame-retardant (HFFR) (PVC-free), and UL listed. It is the industry's first HFFR power cord that is UL 62 approved. EcoPower is flexible, durable, and guaranteed to perform in harsh environments. Custom EcoPower cords and cables can be designed to ship in five days or less, with no minimum order length or quantity requirements. EcoPower Halogen-free Flame-retardant cables and UL-approved power cords are engineered to withstand abrasion and extreme temperatures (-50°C to 105°C). They resist oil, abrasion, kinks, and marring. They also pass 850 cycles when tested to UL abrasion test 1510, and are VW-1 and FT-2 rated for finished cable. **Northwire Technical Cable** www.northwire.com/eco Booth 1690



#### Economic development region

Abilene is a business-friendly city with a pro-business attitude. The DevelopAbilene team is committed to creating a healthy economic climate, finding the best way to strengthen its businesses, building a better, more diverse economic base, and creating jobs for its residents—including those in the wind power industry. Abilene solicits such industries with aggressive incentives and opportunities, as well as assisting existing industries with their expansion plans. In addition to helping companies through incentives, Abilene also offers an outstanding quality of life, proximity to ground, rail, and air transportation, and an incredible workforce. Whether it's site selection assistance, marketing, or existing business retention and expansion, they are a source of comprehensive information for expanding the relocating business. **Develop Abilene** www.developabilene.com Booth 1711



# Advanced clamp-on ground testers

The new DET14C and DET24C ground testers are designed with flat core ends, preventing dirt build-up and ensuring measurement integrity and improved reliability over previous products with interlocking teeth. Other enhancements include improved accuracy, ultra-high battery life, safety to CAT IV 600V, and a built-in filter function for electrically noisy environments. These ground testers offer excellent access and safety with their unique elliptical, low-profile head shape, and an automatic current warning to reduce risk of user disconnecting electrode with a hazardous current flowing. The excellent access is also enhanced with the instruments' short body length, a unique pre-test hold function, and display backlight for low-light environments. The elliptical head shape greatly improves capacity, enabling round cables up to 37mm diameter and earth tapes up to 50mm wide to be clamped. Megger | www.megger.com Booth 4611



#### Engineering services & consulting

SEL Engineering Services offers cost-effective engineered systems and consulting services for renewable energy. They support the application and operation of SEL equipment and other intelligent electronic devices applied on electric power systems. Their engineering services provide solutions for complete power system protection, automation, integration, and security. Many SEL projects are installed and commissioned in facilities worldwide. SEL has contracted over 150 complete turnkey control buildings and thousands of engineering projects for electric utilities, independent power producers, and industrial customers. Schweitzer Engineering Laboratories, Inc. www.selinc.com/wind Booth 1310





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ENVIRONMENTAL STUDIES & PERMITTING Over the past decade, Tetra Tech has provided environmental, engineering, and construction services to develop, construct, and operate more than 350 wind projects representing 20,000 MW of power. Tetra Tech is the only North American company to provide this integrated service offering. Since 2005, Tetra Tech has worked on the EPC and BOP construction of 21 wind projects representing 2,000 MW of power. Our construction services are provided by our wholly owned subsidiary The Delaney Group in the United States, and by Tetra Tech Canada Construction in Canada. Tetra Tech (NASDAQ: TTEK) is a \$2.3 billion company with a strong balance sheet and a commitment to quality performance and safety.







#### Wind-power developer support services

Idaho continues to grow its wind industry, in part by offering a welcoming business climate, a low-cost environment, and companies that support the renewables' industry. Idaho already has a number of companies that make launching a wind project easy, including those that design small- and medium-scale distributed power generation projects; offer new product design and R&D; provide consulting services, ranging from engineering, designing, implementation, construction; and, offer legal services. The state's universities, colleges, and the Idaho National Laboratory also provide training, research and development (R&D), and cooperative services. **Idaho Department of Commerce** www.renewable.idaho.gov **Booth 2901** 



#### Multi-jackbolt tensioners

Superbolt's Multi-Jackbolt Tensioners provide an effective bolting alternative for difficult wind turbine applications. Superbolt tensioners dramatically reduce the torque required to tighten and loosen large nuts by using a ring of jackbolts around the nut or bolt head that thrust against a hardened washer and generate clamping force. Only hand/air tools are required to install or remove any size tensioner. Because of this, Superbolt tensioners are extremely safe, fast, and easy to install, as well as cost-efficient. Joint integrity is also maintained because they are loaded in pure tension (without twisting), greatly reducing the likelihood of joints vibrating loose and eliminating thread galling and seizing of mating parts. Superbolt | www.superbolt.com Booth 5415



#### Green transportation & logistics solutions

Union Pacific Railroad, one of the largest railroads in North America, in conjunction with Union Pacific Distribution Services (UPDS), specializes in providing rail-based logistics solutions for the wind and solar industries. They offer customers a total logistics solution with shipment visibility to support efficient supply chains. Union Pacific Railroad is dedicated to the wind industry and transports virtually all wind project components—from the sand and steel at the site, to the complete turbine. Shipping by rail is inherently more economical and greener than truck, and Union Pacific can move a ton of freight 830 miles on a single gallon of diesel fuel, the equivalent to 400 mpg in an automobile. **Union Pacific Railroad** www.up.com/wind | www.upds.com Booth 4411

# Renewable energy law firm

As one of Canada's business and litigation law firms, Fraser Milner Casgrain LLP (FMC) has more than 500 lawyers in offices throughout the country. FMC has a multidisciplinary national energy practice, which includes a clean and renewable energy team that advises developers, investors, and lenders. Recognized for their expertise by Canadian, US, and international publications, FMC's energy lawyers have an understanding of their clients' businesses, objectives, and challenges. Their proven track record of working with project developers to develop and finance renewable energy projects—both timeand cost-efficiently—makes FMC highly sought-after by clean and renewable energy clients. **Fraser Milner Casgrain LLP** www.fmc-law.com/energy Booth 2290



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#### **Community wind turbines**

Seizing the need for a community sized wind turbine, Polaris America has turned their capabilities loose on a whole class of innovative wind turbine designs that feature exclusive technologies and superior engineering. In introducing this new line of community wind turbines, Polaris will be addressing the needs of homeowners, businesses, schools and universities, governmental institutions, and other applications often overlooked by other turbine suppliers. From 20 kW to 1 MW, Polaris has a size that fits any requirements with a proven technology that delivers the next-generation of wind power needed for diverse energy applications. Polaris wind turbines are designed to meet the IEC 61400 -2 and 1 standards. They are also participating in the new Small Wind Certification Council (SWCC) certification program for their 20kW and 50kW units. This program will certify their turbines against the new AWEA Small Wind Turbine Performance and Safety Standard (both units are listed on the SWCC web site). **Polaris America** | www.polarisamerica.com | www.smallwindcertification.org/certified\_turbines.html **Booth 911** 







#### Utility scale inverter

Magnetek Renewable Energy's E-FORCE Wind Inverter can "Harvest More Green." A three-phase, utility scale commercial wind power inverter, E-FORCE maximizes the full potential of a wind turbine. E-FORCE is available in both air-cooled and liquid-cooled models for use with permanent magnet generator technology. The modular design allows wind turbine designers to develop scalable products from 500 kW to 2.5 MW.

Magnetek Renewable Energy www.magnetekrenewableenergy.com Booth 1311



#### Wind power equipment solutions

Ingeteam wind power products offering includes a wide range of possibilities, allowing customers to select just the right equipment for each particular case, and always with the guarantee of maximum inter-part compatibility and the provision of an integrated expert service. Ingeteam offers solutions for PMG+FC and DFM topologies, in low and medium voltage, and in the whole speed range for the generators (direct drive, both medium and high speed).

Ingeteam is an independent supplier of power converters, electric generators, control electronics, pitch control systems, wind farm holistic management systems, in addition to a comprehensive range of services onshore and offshore. Currently, more than 14,000 wind turbines are fitted with Ingeteam converters and generators, which account for more than 17 GW of installed capacity. **Ingeteam** | www.ingeteam.com **Booth 4031**


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#### windpower 2011



#### Electronic torque tool

New World Technologies Inc., manufacturer of the E-RAD electronic torque tools, has introduced the new E-RAD Touch—a user-friendly control case with advanced capabilities. The E-RAD Touch features a 2 x 3-inch touch screen, which comes standard with torque and angle sequence, field calibration, easily selectable pre-sets, and optional password protection. With advanced data collection, store each job by individual name or number, and then easily upload onto a computer for complete traceability. Compared to hydraulic wrenches, the E-RAD electronic torque tool decreased tightening times by up to 300%. With an accuracy of +/- 3% and +/- 2% repeatability, the E-RAD is the most accurate and advanced torque system available today. It is also available in 18-Volt battery pistol grip with pneumatic design. **New World Technologies Inc.** | www.eradtorque.com **Booth 4783** 

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#### Engineering & turnkey wind services

CG Power Solutions (formerly MSE Power Systems) is a highly focused solution provider specializing in engineering and full design/build turnkey services for the electrical system of wind plants. Responsible for interconnecting approximately 22% of all wind energy in the US and 8% in Canada, CG Power Solutions has proven they consistently complete wind projects in up to 50% less time than other EPC companies. Their extensive experience includes projects with voltage levels ranging from 2.4 kV to 765 kV. Their subsidiary CG Automation offers wind farm management tools to maximize facility performance. CG Automation recently acquired ADMS Wind SCADA technology, a system that monitors the operating conditions of all wind turbines and the entire facility at a wind generation plant.

CG Power Solutions

www.cgpowersolutions.com Booth 3353



# **C**oncrete wind tower base system

The Atlas CTB Concrete Tower Base for hybrid wind towers answers the need for higher efficiency turbine output, economical tower/foundation installation, and low-cost life-cycle maintenance. The Atlas CTB enables wind farm developers to raise hub heights beyond 80m to 100m-plus into stronger, steadier winds that generate more power. Erection takes place rapidly on a simple ring foundation requiring one-quarter to one-third of the concrete found in conventional tower footings. A typical Atlas hybrid tower base diameter is 15m to 18m, with a height of 32m. A steel monopole upper section extends hub heights to 100m to 130m. The base requires no painting or bolt torquing, and the anticipated service life is 50 years.

Tindall | www.atlasctb.com Booth 3034

# KR Wind - Your World Wide Partner in Wind

KR Wind is an international turn-key and single service solution supplier for the wind energy industry. With over 10 years of experience in wind turbine installation and maintenance and having installed over 4000 turbines in all corners of the globe, we have become a worldwide market leader. Our sole focus is the wind energy industry and we are committed to uncompromising safety and quality.

KR Wind provides:

- Full logistical and transportation solutions
- Ownership of a specialized fleet of cranes for the wind industry allowing us to mobilize quickly and efficiently
- Electrical and mechanical installation of wind farms of any size and any turbine type
- Partnerships supporting EPC and BOP solutions

KR Wind also provides a vast range of service solutions ranging from:

- Scheduled and unscheduled maintenance
- Quality Control Services and end of warranty inspections
- Major component exchange and repair
- Operations and site surveillance

Please come visit us at booth 4283 during the WINDPOWER Conference & Exhibition 2011 in Anaheim for more information. "Don't be surprised if we exceed your expectations."



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# Color display fast vibration analyzer

VIBXPERT II vibration analyzer is rugged and lightweight, and combines the advantages of a rapid processor with a brilliant energy efficient color VGA display. Enhanced with an Fmax of 51KHz, and up to 102,400 lines of resolution, all machinery problems can be captured and easily analyzed on the VIBXPERT II large color screen. The VIBXPERT records all forms of machine vibrations, bearing conditions, structural noise, process data, and visual inspection information—ideal for condition assessment on constant or variable speed wind turbines. VIBXPERT II features customized vibration measurement templates for all wind turbines manufacturers, and built-in threshold values based on VDI 3834.

LUDECAwind www.ludecawind.com Booth 1068



#### Developing & operating wind power plants

Established in 1993, Volkswind has since become an Independent Power Producer in Europe and, in 2008, entered the market in North America. Projects are currently under development in Montana, Iowa, Nebraska, and Pennsylvania. For each of its projects, Volkswind is eager to establish trustworthy and consistent partnerships with the landowners and the local municipalities. In addition to its knowledgeable international workforce, whenever possible Volkswind employs local people to establish local expertise. Volkswind's core business is to develop, build, and operate its own wind power plants. Volkswind's focus is on achieving the highest quality standards, which ensure a high-energy output. With its wind farms, Volkswind delivers clean and reliable energy to almost one million people, and is steadily expanding its capacity. Volkswind | www.volkswind.com

Booth 5013



# Wire, cable & copper

Coleman Cable Inc., a copper fabricator and manufacturer of wire and cable, is the company that brought innovative solutions to electrical vehicle EV charging cables. Now CCI brings that same innovation to support green products in wind and solar energy. Coleman Cable designs and manufacturers products that are both ROHS & REACH compliant, and uses the latest process technologies with compounds that include low smoke and zero halogen products. In addition, CCI products are recyclable and ecologically preferable. From EV's to wind/solar renewable energy, Coleman Cable is ready to power any green applications.

Coleman Cable Inc. www.colemancable.com Booth 5114



#### EPC, design & operation of wind power projects

For more than a decade, Renewable Energy Systems Americas Inc. (RES Americas) has developed, constructed, owned, and operated renewable energy projects. RES Americas has constructed over 4,200 MW, has another 1,000 MW under construction, and has more than 10,000 MW under development. It offers in-house expertise in resource analysis, development, site design, procurement, engineering, construction, through to operations. This in-house accessibility ensures a smooth transition from one phase to the next, that budgeted costs are met, and the project is completed on time. RES Americas can sell its developed and constructed projects to others, construct projects developed by others, and own and operate projects. The company is headquartered in Colorado, with Canadian projects managed from Québec by RES Canada. **RES Americas** 

www.res-americas.com **Booth 4101** 





#### Safety tool specialist

Cementex manufactures Americanmade double-insulated 1000V safety tools designed and engineered for maximum safety between the worker and the danger of the job. Safe tools are the most important part of doing the job right—Cementex's complete offering of safety tools and personal protective equipment help meet the requirements of OSHA, NFPA 70E, and CSA Z462 standards. **Cementex** 

www.cementexusa.com
Booth 2499E



# Turnkey shipping for wind power

As one of the nation's largest railroads, BNSF Railway offers customized turnkey shipping solutions for the wind energy industry. Count on BNSF to be a collaborative partner through all stages of the transportation process—from preplanning to final delivery. Their decade worth of experience in the wind market qualifies them to ship components safely and efficiently. BNSF has a new transload site in Pasco, Washington, near 29 developing wind farm projects including Shepherds Flat, the world's largest wind farm. **BNSF Railway** | www.bnsf.com/wind **Booth 2988** 



#### Foundation solutions for wind turbines & solar collectors

Con-Tech Systems' time saving, single step CTS/TITAN Hollow Bar IBO Injection Bore Micropile System is very well suited for anchoring wind turbines. Their system has inherent advantages over conventional driven pile and helical pile systems, and has proven results in exhibiting more economical, and technically more reliable, foundation solutions for all types of soil conditions—in particular: collapsing soils such as sand and gravel. With the CTS-TITAN micropile system, while drilling, grout is simultaneously injected. Therefore, this innovative system also provides highly improved grout/ground adhesion all along the embedded length of the micropile. As a result, the IBO piles can be shorter in length, which reduces the over-all cost compared to other systems. Con-Tech Systems can also suggest more efficient designs that allow for higher production rates. Con-Tech Systems also offers efficient anchoring solutions for transmission towers.

Con-Tech Systems www.contechsystems.com Booth 671



#### Turnkey solutions & services for wind industry

KR Wind provides turnkey and single service solutions for the wind energy industry, and has many years of experience and knowledge. As wind energy is their sole focus, they are committed to uncompromising safety and quality. KR Wind provides: full logistical and transportation solutions; their own own fleet of cranes specialized for the wind industry; erection and installation of wind farms of any size, which also includes mechanical and electrical completion; a vast range of services and maintenance solutions; as well as, a partnership solutions that allow them to support customers and offer EPC, BOP, and door-to-door solutions.

KR Wind | www.krwind.com Booth 4283

# "For hub-height wind measurements, we trust Second Wind and Triton."



**Euan Cameron** Cofounder + Group CEO, Wind Prospect

"Second Wind's Triton is a key part of Wind Prospect's global wind resource assessment activities. Our teams have been measuring wind yield across the world for almost two decades and understand the need for accurate, reliable data. This is exactly what Triton delivers. Units are easy to deploy and help us reduce project risk at an early stage of development."

# <image>

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#### windpower 2011



#### Environmental, engineering & construction

Tetra Tech has provided environmental, engineering, and construction services to the development, construction and operation of more than 250 wind projects, representing over 20,000 MW of power. Tetra Tech has worked on the construction of 19 wind projects. In the United States, construction services are provided by their subsidiary, The Delaney Group; and, in Canada, they are provided by Tetra Tech Canada Construction.

Tetra Tech | www.tetratech.com Booth 1925



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Booth 5338

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Michels Corporation is one of the leading utility contractors in North America and ranked as the 45th largest contractor on ENR's Top 400 Contractors. Our team of 5,000 employees and 9,000 pieces of equipment provides engineering and construction services in the energy, transportation, communications and utility industries.





#### Wind farm construction & contracting

Mortenson Construction has built safe, quality construction projects since 1954. Mortenson is a US-based, family owned construction company that provides a complete range of services including planning, program management, pre-construction, general contracting, design-build, and turnkey development. The company's Renewable Energy Groups provide EPC and BOP construction services for customers in wind, solar, and next-generation biofuels. Mortenson has been involved in the construction of 100 wind power projects, totaling nearly 10,000 MW across the US and Canada. The company currently employs more than 2,200 people nationwide with dedicated teams to help deliver renewable energy to its growing list of customers. **Mortenson Construction** www.mortenson.com

Booth 1933



#### Analytical services

Herguth Laboratories is an ISO 9001:2008 and ISO 17025 quality supplier of analytical services with proven competencies in analyzing oil (with emphasis in wind turbine gearboxes, fuel, and grease, tribological, and special investigations). Quality programs include: 10CFR50 Part 21 Appendix B, Radioactive Licensed, PhD Research Associates, CLS, OMA I and II Certified. Their services provide needed information for continuous use and/or extended oil drain intervals. With extended oil drain intervals in machinery, vehicles, and equipment, Herguth Labs is providing clients what information they need to think green and help the environment along with time and cost savings. Data is accessible via the Internet. Herguth also offers customized training and training courses to enhance knowledge of predictive and preventative maintenance. Herguth is courier accessible from anywhere in the world. **Herguth Laboratories** www.herauth.com Booth 5009



#### Transmission insulator products & systems

MacLean Power Systems' family of silicone rubber transmission insulator products and APEX Insulator Systems are designed to meet growing customer needs by providing the equipment and value-added services from the wind turbine to the conductor. With over 25 years of field-tested performance, APEX Insulator Systems family of products and services include transmission suspension and post insulators, insulator assemblies, and services manufactured in South Carolina. MacLean Power Systems is a manufacturer of products used by utilities for building transmission and distribution lines and substations. MPS product families include hardware and connection products, as well as insulation and protection products.

MacLean Power Systems www.macleanpower.com Booth 5356



#### Submerged arc welder

Lincoln Electric features its Power Wave AC/DC 1000, which is ideal for rugged work environments and applications, including bridge decking and pressure vessels. The machine has a 380-575 VAC, 50/60Hz input voltage capability, and multiple machine configurations with easy setup. It is rated at 1000 amps at 100% duty cycle, and housed in a protective, stainless steel case with a severe-duty IP23 rating. The unit's Waveform Control Technology allows users to control the deposition rate and penetration for increased weld speeds, higher quality welds, and improved efficiencies. iARC digital controls deliver faster processing speeds for a faster arc response. ArcLink, ethernet, and DeviceNet communication offer users remote process monitoring, control, and troubleshooting. It also features Production Monitoring software for tracking equipment usage and data storage, and has True Energy capabilities for measuring and displaying energy for critical heat input calculations.

**Lincoln Electric** 

www.lincolnelectric.com
Booth 3001

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# Turbine design & technology

As the third largest wind turbine manufacturer in the world, Suzlon wind turbine technology transforms wind as a valuable asset into clean energy that's competitive and local. Boasting 2500 MW installed in the US, and 10,000 MW globally, the company's new S9X – 2.1 MW platform builds upon the success of Suzlon's S88-2.1 MW turbine with engineering philosophy focused on robust design, industry standard components, and simple operation for overall reliability. Suzlon pulls on talent and resources from around the world to provide high-quality products, and houses its engineering team in Germany, the blade design team in The Netherlands, overall system management in Denmark, and manufacturing facilities in US, China, and India. Combined these teams are working to provide customers with optimal solutions to meet wind power needs.

Suzion Wind Energy Corporation www.suzion.com Booth 3219



#### Managing wind energy project risk

DNV has been involved in the wind energy industry, and its employees have been providing services, for more than 25 years. They provide comprehensive services to help understand and manage wind energy project risk. DNV's experience includes both utility-scale and small-scale applications of wind energy technologies for onshore and offshore projects around the world. With the recent acquisition of BEW Engineering, DNV has further strengthened its service lines to the renewable energy market, allowing them to provide a more complete service portfolio for renewable energy developments in North America. DNV | www.dnv.com/windenergy Booth 2009

MULL:



#### **Guide posts**

Concast, Inc. manufactures concretefilled bollards or guide posts to help protect below or at-grade equipment. The HDPE shell is impact-resistant with excellent weather and UV-resistance—there is no need for repainting or to worry about corrosion. They can be ordered hollow for a lightweight visual barrier or, as recommended, filled for an added physical barrier. The high-visibility OSHA yellow is standard, but can be purchased in an assortment of colors. Each post is equipped with a 3/8" threaded insert in the top surface for mounting a safety chain between posts if needed. Standard post sizes are 4" to 7.5" in diameter by 7'4" long. Concast, Inc. has been supplying precast products to the electrical and wind industry for over 42 years.

Concast, Inc. | www.concastinc.com Booth 5401



#### Business insurance for renewable energy

CNA is one of the largest business insurance providers to construction companies across America, with the industry expertise to offer specialized coverages for the renewable energy industry. CNA works with independent agents to customize flexible insurance portfolios that provide the optimal protection for a company's specific level of risk. Available lines of coverage include, but are not limited to: General Liability, Commercial Automobile, Workers' Compensation, Umbrella Liability, Inland Marine, Ocean Cargo, Surety, Technology, Manufacturing, International, and Professional Liability. For more than 100 years, companies have looked to the longevity and financial stability of CNA to help protect their businesses and their reputations.

**CNA** | www.cna.com/construction **Booth 5102** 



#### Wind turbine developer

Northern Power Systems has over 30 years of experience developing advanced, innovative wind turbines. The company's next-generation technology is based on a vastly simplified architecture that utilizes a unique combination of permanent magnet generators and direct-drive technology. Their Northern Power 100 delivers high-energy capture, eliminates drive-train noise, and significantly reduces maintenance and downtime costs for community wind projects. In the near future, the company will be adding a utility scale permanent magnet direct-drive wind turbine to its product line. Northern Power Systems is a fully integrated company that designs, manufactures, and sells wind turbines into the global marketplace from its headquarters in Vermont.

Northern Power Systems | www.northernpower.com Booth 3129



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# **Turnkey Wind Energy Solutions**

Environmental | Engineering | Procurement | Construction



The AMEC Black & McDonald Joint Venture offers engineering, procurement and construction solutions for your wind energy development.

With 20 years of wind energy experience, we can help make your project a success from initial concept through to commissioning and on to operation and maintenance.

Contact our North American Headquarters:

AMEC Black & McDonald Joint Venture 2020 Winston Park Drive, Oakville ON L6H 6X7 Tel. 905-829-5400

#### www.amec.com/wind | www.blackandmcdonald.com/wind-power

#### windpower 2011



#### Bolt tensioning tools

TorcUP, a designer and manufacturer of bolt torque and tension equipment, has launched a new series of bolt tensioning tools for the wind power generation industry. The tool range is suitable for complete wind turbine erection or maintenance programs on a variety of wind turbine models. The products feature quick-release swivel fittings, automatic piston reset, and hands-free operation. The products are manufactured from aircraft-quality, high-strength tensile steel, and are compact and lightweight for ease of handling. The new range is designed for manufacturers of wind turbines, installation companies, and subcontractors. From hydraulic torque wrenches to pneumatic torque wrenches to hydraulic tensioners, TorcUP has it all.

TorcUP | www.torcup.com Booth 519

## SafAscent Turbine Maintenance Platform

## Any turbine, anywhere

Designed specifically for wind turbines, the SafAscent<sup>™</sup> Turbine Maintenance Platform enables unrestricted access to the tower and blades. With more than 85 branches throughout North America, Safway and SafAscent can reach any project, in any location.

For more information and a list of locations in the United States and Canada, please visit **www.safway.com/wind**.



Visit us at WINDPOWER 2011 Booth #3200.





**Scaffolding & Access Solutions** 



# Pre-fabricated structures

Trachte preassembled control buildings are available in custom sizes and configurations for wind farms and utilities, and shipped pre-erected with wall and ceiling-mounted electrical gear and cable tray pre-installed. Buildings are available with or without a structural steel floor. Trachte's detailed design and drawing support and factory preassembly provide clients with tremendous project management efficiencies, convenience, and a consistent, exceptional level of quality.

With more than 90 years of experience, Trachte bases its success on mutually beneficial relationships and strategic partnerships with end users, consulting engineers, contractors, OEMs, and value-added resellers. A large percentage of current company growth comes from repeat customers who indicate that they return because of unsurpassed product quality and overall satisfaction.

Trachte, Inc.

www.trachteusa.com | www.t-rams.com Booth 1709



# Bonding, sealing & protecting solutions

For more than 15 years, Sika has globally offered the wind industry a full system of high-performing sealing, bonding, protecting, and reinforcing solutions from the foundation base to the tip of each blade. Sika strives to exceed the standards of innovation that customers expect from their products that allow for rapid, reliable, and the most cost-efficient solutions for manufacturing, installation, and repair applications.

Sika Corporation

www.sikausa.com Booth 554



# Gearbox & drivetrain technical consultancy

Romax Technology is an independent drivetrain consultancy offering technical consulting, design services, and software tools for gearboxes, drivetrains, and bearings for the wind energy industry. Recognized for its engineering capabilities, Romax provides innovative engineering solutions to world leading OEM's, transmission, and engineering companies within the energy industry from its offices in Colorado, and across the rest of the world. Romax's showcase includes gearbox and drivetrain life-cycle management offerings, as well as drivetrain assessment, SCADA data analysis, and forensic analysis.

Romax Technology www.romaxtech.com Booth 1294



#### Custom extrusions for renewable energy market

Sapa Extrusions, a global manufacturer of aluminum profiles, is a key supplier to the renewable energy industry. Sapa's Renewable Energy Organization provides solutions to all wind power market segments including: nacelle support structures, turbine mounting brackets and frames, profiles for ladders and lifts, platform/stairway/railing and elevator components, bus bar, aluminum hydraulic manifolds, rigid aluminum conduit, inverter housings and components, and thermal management systems. 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 wind power applications that help customers optimize the value of their products. Sapa Renewable Energy www.sapagroup.com Booth 5125



#### Wind energy legal services

Harnessing and supplying one of the fastest growing fuel sources? Look to Foley & Lardner LLP—one of the top wind energy legal practices. Foley's wind energy attorneys can help develop comprehensive solutions for all business needs. From assisting with joint ventures, acquisitions, investments, turbine supply, power purchase, and construction contracts to project financings—including Section 45 Production Tax Credit financing structures, Treasury grants, DOE programs, and new issues involving offshore wind—Foley has offered reliable experience in the field of renewable energy for over 20 years. (Image courtesy of Acciona.)

Foley & Lardner | www.windenergyattorneys.com Booth 1595

# A fastener that stays tight until YOU remove it.



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#### windpower 2011



#### **Electricity & grid connections**

S&C, headquartered in Illinois, is applying its 100 years of innovation to address challenges facing the world's power grids, and is shaping the future of reliable electricity delivery. The mission is to continually develop new solutions for electricity delivery, fostering the improved efficiency and reliability required for the intelligent grid. S&C provides grid connections and turnkey installations for wind farms across the US, having experience in working with electric utilities, wind farm developers, European turbine manufacturers, independent system operators, and transmission service providers. S&C has knowledge of wind farm design, system protection, coordination, and reactive power compensation requirements. S&C can also integrate wind, solar, and other renewableenergy sources into the grid, provide energy storage, and maximize power assets and their efficiencies. S&C's maintains operations around the globe.

**S&C Electric Company** www.sandc.com

Booth 4067



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# Industrial-rated security devices

Phoenix Contact introduces the FL mGuard series of industrial-rated security devices. The FL mGuard products provide firewall, router, and VPN functionalities in a single, rugged device. The line is available in two hardware styles for industrial Ethernet: the FL mGuard RS DIN rail-mount devices and PCI card versions for integration into industrial PCs. The FL mGuard solution has dedicated hardware providing security functions, which allows higher data throughput rates than software-based solutions. There are no limitations to the operating system, or the type of devices connected to the FL mGuard. It can protect PCs running all versions of Windows, as well as PLCs, I/O units, bus couplers, and other industrial Ethernet devices. The PCI version of the FL mGuard is currently the only PCI form factor security device that combines firewall, routing, and VPN in a single device. It integrates quickly and easily, without modifications to the system settings or driver installation.

Phoenix Contact www.phoenixcontact.com Booth 2156



#### Turbine O&M

SSB Service is now Availon. Finding a team of experts to entrust turbines to is vital. Availon specializes in wind turbine spare parts supply, inspections, upgrades, remote monitoring, operations and maintenance, and field service. By listening to issues and concerns, Availon is able to excel. They understand that availability and efficiency are key drivers of financial success, and that having a partner is preferable to simply having a vendor. **Availon** | www.availon.com **Booth 1277** 



#### Transmission & distribution engineering

Worldwide Integrated Rating Enhancement (W.I.R.E.) Services began operations in 2001, using the experience and expertise developed in applying LiDAR data to transmission line analysis and upgrade engineering solutions. W.I.R.E. Services was the first utility based company to combine LiDAR surveys with utility applications, and provide thirdparty electric utilities with a full-service solution package for their transmission line needs. W.I.R.E. Services' expertise and service offerings allow a client the ability to design and interconnect wind farms to new or existing transmission lines. W.I.R.E. Services' knowledge and experience in using LiDAR technology, coupled with extensive utility experience in transmission line design, enables them to provide meaningful information on utility transmission assets.

W.I.R.E. Services | www.wireservices.ca Booth 555a



# Track conversion systems

Mattracks manufactures rubber track conversion systems for four-wheel drive ATVs, SUVs, midsize tractors, and trucks up to 20,500lbs gross vehicle weight (9290 kg). Mattracks track conversions provide mobility and traction in mud, sand, snow, swamp, and muskeg, giving users access to roads that can no longer be traveled by tires, with decreased impact to the vehicles and the environment. **Mattracks. Inc.** 

www.mattracks.com Booth 5233

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#### Standard & custom enclosure manufacturer

FIBOX is a global enclosure manufacturer. They are partnering with top wind and solar industry manufacturers all over the world to provide a selection of enclosures, ranging from standard off-the-shelf to customized housings to protect the components. FIBOX has the knowledge and technology, a strong material and electrical engineering expertise, rapid prototyping processes, as well as a wide enclosure range for protecting electrical and electronic components and systems for all aspects of the renewable energy market. With over 1500 off-the-shelf sizes to choose from, FIBOX can help get a product to market quickly.

FIBOX USA | www.fiboxusa.com Booth 1511



Rail is the most environmentally friendly mode of surface transportation. And that's only one reason shipping wind energy components with BNSF will make you breathe easier. We've been creating turn-key, customized solutions for the wind energy industry for nearly a decade. We give you support and online tools that make it easy to ship with BNSF. Plus we have transload facilities less than 300 miles from most U.S. wind farms, and access to major U.S. ports.

Learn more at www.bnsf.com/wind.



#### Providing field workforce

At PTS, they work with some of the nation's largest developers of wind energy. They know a renewable energy project relies on having a qualified, experienced field workforce, precisely when and where required. PTS has specialized industry knowledge in: recruiting specialized tradespeople with experience in renewable energy projects; phasing a project workforce to eliminate delays and keep every project on track; and, responding quickly to each customer's needs. From one man to an entire crew, CLP can provide the skilled tradespeople who will complete projects on time, every time, including: installers; concrete/ mortar framers; electricians; equipment operators; high-voltage electricians; laborers/assemblers; linesmen; pipefitters; pole pounders; and, welders. **PTS** | www.ptstravelers.com Booth 3693



# Transformers, wire & connectors

Legrand offers various products for wind turbines. Their Cablofil Wire Mesh Tray supports heavy vertical power feeds in wind turbine towers, and organizes large numbers of cables in tight nacelle installations. Cablofil is UL-listed, features low electrical resistance for grounding, and is available in hot-dipped galvanized or stainless finishes. Legrand's Cast Resin Medium Voltage Transformers are safer and 10% lighter than oil-cooled transformers. They are compact and can be installed in the nacelle and close to the load. Legrand Cast Resin Transformers are designed to accommodate fluctuating loads and are available in 5 kVA up to 16.000 kVA ratings. Their Pass & Seymour Watertight Pin and Sleeve Connectors feature chemical-resistant thermoplastic construction with shrouded, nickel-plated, solid-brass pins for corrosion protection and excellent conductivity. Each connector is ready to wire and feature an exclusive, hinged cord grip eliminating lost parts. Legrand Cablofil

www.legrand.us/cablofil

Booth 3209



# Wind power supply chain location

Ranked among the top states for wind generation potential, Nebraska is one of the best locations for renewable equipment manufacturers. Proximity to regional markets makes the state a strategic supply chain location and hub for timely delivery throughout America. Shipped by truck or rail, equipment can be delivered within hours, if not days. In addition, Nebraska offers competitive industrial electric rates and ample location possibilities. Renewable equipment manufacturers will find a partner in Nebraska Public Power District. The utility's economic development team has assisted hundreds of companies find productive and profitable locations in Nebraska by offering personal service and a comprehensive online database.

Nebraska Public Power District www.sites.nppd.com Booth 3101



#### Wind turbine rescue

Fall protection and rescue specialist, Gravitec Systems, Inc., presents its G4 Wind Turbine Rescue and Evacuation System. Designed to facilitate the rapid evacuation of personnel from high-angle environments, the G4 is an assembly of rescue equipment specifically selected to handle the four basic rescue functions on wind turbines: lifting, hauling, evacuation, and assisted rescue. This easy-to-use and versatile system requires minimal set-up time to perform oneand two-person evacuations, and can be rigged for a 1:1, 3:1, and 5:1 mechanical advantage, depending on the rescue worker's needs. The G4 is individually serialized and comes standard with a 5:1 mechanical advantage lifting rig, a 3:1 drag/short lift rig, an evacuation/descent device, a pick-off strap for two-person rescue, a re-direct pulley set-up, 300' of rescue rope, a PVC weatherproof storage/haul bag, a waterproof rope log, and plasticized, quick-view instruction cards. Customization options are available. Gravitec Systems, Inc. www.gravitec.com Booth 3407



#### High-density IGBT stack

INFINEON'S HIGH-POWER IGBT stacks are used by well-known manufacturers in countless applications all over the world. Under permanent load in daily demanding use in rough environments such as wind mills, pumps, and industrial and auxiliary drive applications, Infineon's IGBT ModSTACKs provide high reliability and robustness. General features include: modular stack system designed for industrial approved cabinets; optimized high-efficiency heatsinks; low inductance DC link with polypropylene or electrolytic capacitors; integrated IGBT EiceDRIVER, voltage signals for control and monitoring (currents, voltages, short circuit, heat sink temperature, failure signals); simulated chip temperature available as voltage signal, up to four units can be operated in parallel; and, electrical or optical interface for digital control signals are available.

#### Infineon Technologies Industrial Power

www.infineon.com/highpower Booth 5501



# Vertical turn-mill machinery

American Wera Inc., a manufacturer and distributor of quality machine tools utilized in the global wind energy industry, introduces the Pittler PV Series multi-functional Vertical Turn-Mill Machines, Pittler identified the market demand for increased throughput in the wind energy market without adding capital. No longer is it acceptable to have a large, expensive machine only capable of performing one operation. In response to this demand, Pittler has brought the PV Series to the forefront of the market maximizing the number of operations that one can complete in a single clamping. The PV Series of machines is able to turn, mill, drill, grind, and measure parts in one clamping. Soft or hard, the PV Series of Turn-Mill machines provide the ultimate in flexibility with the robustness of a turning machine. The PV Series can accommodate parts up to 5000mm.

American-Wera Inc. www.american-wera.com Booth 5201





Making difficult bolting obsolete all over the world. Superbolt<sup>®</sup> Multi-Jackbolt Tensioners provide a safe, fast & easy bolting alternative. Benefits include:

Only hand/air tools requiredTightens in pure tension

Reduces install/removal times
 A better bolted connection





#### Reel & cable handling equipment

Reel-O-Matic, a manufacturer of reel and cable handling equipment for the wind power industry, will exhibit its HJ Series powered pay-out machinery, as well as its Penthouse Series measuring and coiling equipment utilized in cable kit assembly operations. **Reel-O-Matic** 

www.reelomatic.com Booth 2600

#### Radar system for offshore wind

DeTect is the developer and manufacturer of the MERLIN Avian Radar System, the most advanced, proven, and widely used bird radar system for terrestrial and offshore wind energy project bird and bat survey, mortality risk assessment, and operational monitoring. DeTect has over 60 systems operating worldwide since 2003. With the MERLIN SCADA software, the system provides real-time mortality risk mitigation for birds and bat. MERLIN is the only technology in operational use for real-time bird mortality risk mitigation at wind farms.

DeTect | www.detect-inc.com Booth 1509



#### Intelligent weather-station measures

In today's strict regulatory environment, investor-owned utilities are stepping up requirements for accurate performance reporting for renewable energy projects. As the finite power grid gets more and more crowded, all energy projects are vying for limited space. To know the precise potential of project production and having ability to report efficiency of production is critical for all developing and operating renewable energy projects. Lufft WS line of intelligent weather stations measures the climate in extreme conditions. The newest sensors to the Lufft WS family are the WS301 and WS501. These sensors measure temperature, relative humidity, wind speed, wind direction, and solar radiation by incorporating and integrated Kipp and Zonen CMP3 pyranometer. Lufft sensors are used worldwide in a wide range of renewable energy applications. Flexible communication protocols (including MODBUS) make them a good choice when less hardware is preferred.

Lufft USA

(distributed by Abbeon Cal, Inc.) www.lufftusa.com

Booth 1596



#### **EPC** services

Engineering applies to every facet of renewable power infrastructure—from wind turbines through the transmission and distribution electric infrastructure. As the wholly owned engineering affiliate of Pike Electric Corporation, Pike Energy Solutions has amassed decades of experience in the siting, engineering, design, procurement, and construction of electric power infrastructure. They serve clients from coast-to-coast, and abroad, through their national engineering office in North Carolina, and four other US regional offices. In addition, their corporate interconnections enable them to manage full EPC contracts through their affiliated construction companies. Pike Energy Solutions | www.pike.com

Booth 277

# Harvest More Green



Magnetek's E-FORCE® Wind Inverter, a three-phase, utility-scale commercial wind power inverter, maximizes the full potential of your wind turbine. E-FORCE is available in both air-cooled and liquid-cooled models for use with permanent magnet generator technology. Our modular design allows wind turbine designers to develop scalable products from 500 kW to 2.5 MW.

For more information visit www.magnetek.com.



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#### windpower 2011



#### Suppressing EMI currents on high-power motors

MH&W introduces Magnetec Cool Blue torroid cores for use as common mode chokes to reduce the build volume of damaging motor bearing currents in high-power inverter systems/turbine generator drives. Cool Blue cores also suppress asymmetrical EMI currents generated by parasitic currents of motors and their cables. Result is increased service life of motor bearings. Cool Blue cores are typically placed over hot legs (L1-L2-L3) of a motor drive cable assembly. Cores are easily adapted to retrofit maintenance operations as well as new installs. The Cool Blue material provides superior performance to other materials. They provide a wide range of permeability, 25,000-90,000 at 10 KHz, and a saturation flux density of 1,200 mT. Cool Blue core sizes range from 50mmIDx63mmODx-H30mm to 450mmIDx500mmODx-H30mm.

MH&W International www.mhw-intl.com Booth 5249



# Fiber optic cable solutions

OFS, a supplier of industrial-grade fiber optic links for wind towers, is committed to renewable energy. Cables using HCS optical fiber from OFS have been in service for generations, extending from turbine to controls while providing reliable high-speed data transfer and isolation from electrical surges in the harsh environmental conditions found on inland and offshore wind farms. Tranquil from afar, blades slowly rotating, wind towers harness the breeze, effortlessly converting renewable energy to useful electric power. Up close, these massive structures endure the conditions that HighWind cables and connector systems are designed for—from temperature extremes to lightning strikes, OFS fiber optic cables meet the demands and perform. Coupled with the OFS crimp & cleave connector system, control cable installation and maintenance has never been easier. **OFS** | www.specialtyphotonics.com Booth 5518



#### Wind power planning, permitting & construction

Conestoga-Rovers & Associates (CRA) provides a complete range of wind energy services. With their experience and a thorough understanding of the services required for developing, permitting, and constructing wind farms, CRA can take a project from vision to implementation, operation, and decommissioning. Some of the related services offered include: project planning, permitting, operation, and decommissioning; environmental assessments; site surveying; and, civil engineering. They also have a extensive experience in providing government representation services.

Conestoga-Rovers & Associates www.craworld.com Booth 3008



# Fire suppression systems

Firetrace International has more than 150,000 fire suppression systems installed protecting critical equipment worldwide. The Firetrace solution is fully automatic, requiring no power for discharge and ease of installation on new or existing wind farms. Firetrace is ideal for the wind turbine environment, able to withstand vibration. debris, temperature extremes, and airflow. Firetrace is able to protect the heart of the hazard: control cabinets. capacitors, brake, hydraulic, and transformer, resulting in smaller amounts of agent adding few pounds to the turbine. Firetrace offers full-hazard assessment protecting.

Firetrace International www.firetrace.com Booth 3819



#### Small-scale wind support system

NRG Systems, manufacturer of wind measurement equipment for the global wind energy industry, has introduced a 34-meter system to support smallscale wind energy projects and wind energy research. With more incentives for small and community scale wind, there is a greater need for people to understand their wind resource before investing in a turbine. This 34-meter complete system includes a tubular tilt-up tower, a SymphoniePLUS 15-channel datalogger, three NRG #40C anemometers, a wind vane, and parts. Easily installed and portable, the system can be used for micro-siting or prospecting applications, or in remote locations where installation of taller towers may not be possible.

#### NRG Systems, Inc.

www.nrgsystems.com Booth 2953 & 6415

# ACCESS REMOTE TOWER SITES IN THE WORST CONDITIONS!





www.volkswind.com



# Power delivery solutions

American Electric Technologies, Inc. (AETI) is a provider of power delivery solutions to the traditional and alternative energy industries. AETI provides: LV, MV & HV start-up, commissioning and maintenance services, such as electrical yard, substation, collection system and cabling design, analysis, construction, test, and maintenance services. LV & MV power generation, conversion, control, distribution, and management products, such as UL/IEC converters up to 6 MW, turbine pitch and yaw control units, UL/ IEC power distribution units, MVANSI/ IEC switchgear, energy storage systems, and met tower and electrical monitoring and data collection systems—all delivered with fast delivery times. Construction assistance and equipment refurbishment services are available, such as electrical system engineering, as well as procurement and construction assistance for OEMs, developers, contractors, and operators.

American Electric Technologies, Inc. www.aeti.com



#### Wind project environmental permitting support

With today's potential for opposition to wind energy projects, the right environmental permitting strategy is critical to a project's success. Ecology and Environment, Inc. specializes in strategic environmental permitting, agency consultation, and public outreach, plus the full range of required avian, bat, terrestrial, aquatic, cultural, socioeconomic, and historic resource studies. Their multidisciplinary expertise has proven valuable for clients, with 320 projects in 36 states from coast to coast. Find out how E & E can help get the green light for wind energy projects.

Ecology and Environment, Inc. www.ene.com/service/energy/wind.aspx Booth 1129



#### Wind turbine replacement parts

HYDAC offers quality replacement elements for all major wind turbine brands. Their advantages include: high dirt holding and lower differential pressure capacities, which allow for longer life; high-efficiency ratings that maintain cleanliness levels; great cost to value ratio; and, global availability and support to get the parts and answers required quickly. HYDAC has been a trusted name in filtration for over 35 years, and is a single source for all filter element needs.

Booth 2453



The Wind Energy industry is one of the fastest growing markets, and products from Megger offer turnkey testing solutions. Our instruments are recognized for their versatility and impressive power capability. So look to Megger products to help produce more power testing with less effort.

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#### Custom products for commercial wind turbines

Schunk Graphite Technology, and associated members of the global Schunk Group, manufacture a complete line of brushes, holders, slip rings, rocker assemblies, and custom products that are compatible with almost all commercial wind turbines. Schunk products have been approved by many wind turbine OEMs worldwide and offer them increased uptime, as well as longer intervals between service shutdowns. Schunk Graphite Technology supports a broad offering of products with sales, customer service, and technical experts across North America.

Schunk Graphite Technology, LLC www.schunkgraphite.com Booth 1085

#### Weather sensors & air-quality instrumentation

Met One Instruments, Inc. has been designing and manufacturing professional-grade weather sensors/systems and air-quality instrumentation for over 40 years. Their products for the wind energy industry include meteorological sensors for wind resource assessment, wind farm power management and forecasting, and wind turbine control applications. They are proud to introduce their new highaccuracy Class One Cup Anemometer and Air Density Measurement Package for meteorological measurement towers.

Met One Instruments, Inc. www.metone.com Booth 2008



# Balance-of-plant & EPC contractor

Michels Corporation is a full balanceof-plant, engineering, procurement, and construction contractor with more than 3,600 MW of wind farm experience. Michels offers turnkey wind power projects by selfperforming all of the scopes of work and operations, including all civil construction, foundation design and construction, erection, and electrical work. Self-performing all wind project scopes of work are supported by a strong project management structure and Corporate Quality Management System.

Michels Corporation www.michels.us Booth 2067



# Wind cargo handling port

The Port of Longview, Washington has eight years of experience handling wind energy components. Located on the Columbia River, the Port is situated near strategic transportation connections. Port facilities include deep-draft marine terminals, improved laydown space, and a warehouse complex. Competitive pricing and custom services make the Port of Longview the ideal facility for wind cargo handling operations.

The Port of Longview www.portoflongview.com Booth 3423

# your business

#### Seeking to capture the power of the wind?

Look to Foley. With a long history of managing wind projects and financings, Foley is one of the leading wind energy legal practices in the country. From permitting, community relations, land and coastal rights, to finance, maximization of tax credits, and project acquisitions and divestitures, Foley has the experience needed to help you reach your business goals.

At Foley, we treat your business like ours, because we're in this together.

To learn more, please contact Jim Tynion in our New York office at jtynion@foley.com.

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# Steel fabrication for wind industry

Since 1959, FWT, LLC has been developing solutions for the steel fabrication industry. FWT has evolved to be one of the largest, most well known, and respected manufacturers of utility infrastructure in North America. FWT manufactures transmission and distribution poles, lattice transmission structures, substation structures, and the patented PowerMount (cell on utility) antenna mount.

**Booth 1475** 



#### WPP100 Wind Power Performance System

Campbell Scientific offers turnkey data acquisition systems for wind turbine power performance monitoring and wind resource assessment. The WPP100 is an automated data acquisition system specifically designed for wind energy applications. This system meets the power performance measurement requirements of IEC 61400-12-1. It measures and records wind, environmental, and power data necessary for power performance applications. The WPP100 can also be configured for wind resource assessment applications. Installation and start-up times are reduced by using a pre-programmed datalogger, pre-configured peripherals, and pre-mounted equipment. Though offered as a turnkey package, the WP100 retains the powerful, modular nature of the Campbell Scientific product line, allowing one to customize the station to fit an application's specific requirements. Campbell Scientific data acquisition systems are made in the US, and are used worldwide in the wind industry.

Campbell Scientific www.campbellsci.com/wind-energy Booth 3210

#### Concrete & chemical products

Dayton Superior is one of the largest North American manufacturer/distributor of concrete accessory and chemical products, and is also the source in the wind industry for foundation components such as anchor bolts, grouts, and Symons brand forming. Their success is based on their commitment to bringing higher performance, better efficiency, and lasting results in construction projects around the world. **Dayton Superior** www.daytonsuperior.com **Booth 3306** 



#### Planning & design software

WindPRO is one of the world's most widely used software package for planning and designing wind farm projects. More than 1,800 companies and institutions, including the world's leading turbine manufacturers, project developers, engineering companies, utilities, planning authorities, and research institutions are using WindPRO. WindPRO includes more than two decades of research and experience in design, planning, and documentation of wind farm projects worldwide. The calculation results and documentation from WindPRO are recognized and accepted worldwide by investors, banks, and planning authorities. **EMD International A/S** | www.emd.dk

Booth 1940

# **Get Connected. Stay Connected.** SEL Engineering Services and Consulting

Managing renewable energy requires innovative solutions. From electrical engineering studies and design to installation and testing, SEL engineering services provide superior quality and performance using the best products in the industry.

- Complete system protection and data integration
- Automated megawatt output load control to interconnecting utility
- Revenue metering with the ability to serve multiple owners
- Automated capacitor control



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www.selinc.com | +1.509.332.1890





# Wind industry partner

For over a decade, Fredrikson & Byron has played a role in the development and financing of wind projects, and sale and acquisition of wind assets throughout the United States and Canada. They've assisted with the development and financing of approximately 2,000 MW of wind projects in the Upper Midwest region, with close to another 6,000 MW under development in 16 states. They serve as a "virtual development" company for clients, assisting them in all aspects of wind development, from site control and permitting to commercial operation. Fredrikson & Byron's extensive knowledge and experience extends into the wind industry supply chain and service sectors. They've helped clients invest over a half-a-billion dollars in component manufacturers and service companies, and have assisted in the acquisition of component manufacturers, service, and operation and maintenance companies. Their global practice includes clients headquartered in Europe, China, US, and Canada.

Fredrikson & Byron, P.A. www.fredlaw.com Booth 357



# Scaffolding & access solutions

The SafAscent Turbine Maintenance Platform is specifically designed to provide access to the exterior of wind turbine towers for maintenance, cleaning, and repairs. Since 1936, Safway Services has offered reliable scaffolding and access solutions. Now, with SafAscent, the newest addition to the Safway's Motorized Division, Safway has developed an access solution for the wind energy industry. The 6'6" 500-pound capacity modular platform allows companies to perform routine maintenance on turbines, reaching any access-point, while the padded roller system protects the tower and blades. Because wind power is a growing trend across the country, nationwide support is a necessity for maintenance needs. With more than 80 branches across North America, Safway has localized products and services to quickly and safely help with any wind turbine project, located anywhere.

Safway Services, LLC www.safway.com Booth 3200



# Wind measurement systems

Second Wind develops wind measurement systems that make wind power pay off for consumers, investors, and the environment. The company's technology provides wind farm developers with the bankable wind data they need to plan, finance, and operate highly efficient wind generation facilities. Second Wind's systems are making wind farm development profitable in 50 countries on seven continents. Second Wind's systems include Triton, a remote sensing system; Nomad 2 wind datalogger systems; the ProMast 60, a 60-meter meteorological mast; and, the SkyServe web-based data service. Second Wind www.secondwind.com

www.secondwind.com Booth 2001 (indoor) & 6621 (outdoor)



#### Fit-up roller bed

ESAB Welding & Cutting Products introduces the FUB 30 roller bed for fitup of sections. This roller bed features a robust design to withstand the rugged environment in the welding industry. Designed to assemble 1+1 sections, the system is fast and easy to assemble. Each set consists of one power and one idler roller bed with four independently adjusted rollers to align the two sections with each other. The roller bed and the rollers are mounted on one main frame. The FUB 30 is ideal for use in fabricating large vessels, wind towers, and pipemills. The FUB 30 offers a maximum load of 30 tons with roller speeds of 130 to 1295 mm/min. Other features include steel rollers with polyurethane tires, an inverter-style drive control, and a remote pendant with push buttons. ESAB Welding & Cutting Products is one of the world's largest and most knowledgeable manufacturers of welding and cutting equipment and welding filler metals.

ESAB Welding & Cutting Products www.esabna.com Booth 989





# Wind energy equipment provider

Free Breeze Energy pioneered wind energy over 11 years ago. Since then, they have earned a reputation as a trusted and reliable provider of wind energy equipment and expertise. Their premier product is the RRB PS600. RRB's PS-600 is still manufactured using the same exacting standards that have always made the V47 a workhorse with over 5000 installations. It is still equipped with the same components of the nacelle (e.g. gearbox and generator), the same hub assembly, and same blades, formed on the same blade machines installed at the original time of tooling.

Free Breeze Energy www.freebreeze.com Booth 2599C



#### Turbine interface cable

TowerGuard CCAä is American Wire Group's most recent cable innovation toward providing a userfriendly, lower-cost alternative to DLO cables. It's a low-voltage cable concept designed and developed to carry power from the nacelle, through the tower, to the set-up transformer at the base of the tower to feed the underground collection system of a wind farm. TowerGuard CCAä 2000 volt power cables are recommended for use in all low-voltage circuits where continuity of service is the prime consideration. They can be installed in wet or dry locations, indoors or outdoors in conduit, underground ducts, or approved raceways.

American Wire Group | www.buyawg.com Booth 3443

# **Unlimited Solutions** to Harness Limitless Resources

#### tion Prevention Program.

**QHSE** services

Bureau Veritas offers QHSE services for

the wind industry. They have provided multiple services with over 450 MW

on multiple wind projects—for example, The High Winds Project, Shiloh

Wind Farms I & II, EnXco Wind Farm, and Montezuma Hills Wind Farm are bringing much needed green energy to California. Bureau Veritas was able to provide assistance for the entire document review and inspection process, electronically saving time, money, and implementing an award winning "green solution" to paper waste. These projects were licensed under the CEQA to comply with unique environmental protection laws. Bureau Veritas provides the engineers and inspectors needed with specific experience in wind farm projects designed to suit building standards, safety programs, verification of CAD weld testing, and high-pot testing. Bureau Veritas also offers underground feeders to transformers, distribution, and complete electrical substations, as well as providing compliance monitoring for Wetlands and Storm Water Pollu-

**Bureau Veritas** 

www.us.bureauveritas.com/energyusa **Booth 3909** 



#### **Energy cables**

Prysmian is a producer of energy cables. With multiple production facilities worldwide, Prysmian supplies cables from extremely high to very low voltage, with a vast range of accessories, for land and underground applications such as wind power.

**Prysmian Power Cables and** Systems USA, LLC www.prysmianusa.com Booth 2101

Sapa Extrusions Renewable Energy Organization is a major supplier to the solar and wind power industry. We provide critical components that support your designs to harness the Earth's most abundant sources of renewable energy.

#### **Powering the Future Together**

Sapa's cornerstone for renewable energy products is comprehensive and seamless. Our North American Technical Center provides innovative customer features for new end-use applications. We can help optimize the value of your products, affording you a competitive advantage in the marketplace.

#### See us at AWEA Expo Booth 5125 PV America Booth 827

#### Jason Weber Manager, Business Development Renewable Energy

605-321-4387

Andrew Pappas Business Development Manager (Canada and Northeast US) 416-606-8640

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

#### Advanced product solutions for the solar, renewable energy and wind power markets

Sapa's 16 North American plants and Technical Center work with customers to optimize designs for:

- Nacelle support structures • Turbine mounting brackets
- and frames · Profiles for ladders and lifts
- Platforms, stairways, railings
- and elevator components
- Bus bar
- Aluminum hydraulic manifolds
- Rigid aluminum conduit

Sapa is the right development partner for your renewable energy application.

> **5d** Shaping the future

Photovoltaic mounting

Solar module frames

Concentrated solar power

and components

Inverter housings

and components

Thermal management

systems

collectors

systems

North American Clean Energy 93





#### Light control system for wind turbines

Reduce the visual impact of wind farms by turning off the lights. OCAS, Inc. provides a radar-based, ondemand light control system for wind turbines that keep all flashing strobe lights OFF at all times—unless an aircraft is detected flying in the near vicinity of the wind farm. Overall community acceptance of wind farms is increased by lowering the visual impact of wind farms in the form of light pollution. When developers offer OCAS in their projects, they can reduce project carrying cost by improving the permitting cycle. Communities may also request a visual impact mitigation solution, such as OCAS, to reduce the environmental impacts of wind farms in their communities.

OCAS, Inc. | www.ocasinc.com Booth 4757



Wind energy hoists

Harrington Hoists, Inc., a Kito group company, is an innovator of wind energy hoists and nacelle cranes. Meeting today's most demanding applications, Harrington Hoists provides service, reliability, highquality product features, and unparalleled services. Harrington Hoist supplies hoists and cranes with a perfect track record of on-time delivery. They manufacture and supply electric and air-powered chain hoists, electric wire rope hoists, lever hoists, manual hand chain hoists, push and geared trolleys, overhead cranes, crane accessories, and a full line of replacement parts. Their understanding of service, commissioning, engineering, and procurement needs, and their global network of dedicated wind staff ensures quality solutions for wind turbine applications.

Harrington Hoists, Inc. www.harringtonhoists.com Booth 656

# Rescue & life safety equipment

Pigeon Mountain Industries (PMI) designs, manufactures, and distributes classic and innovative life safety rope and related rescue, rigging, and professional equipment. With rope as the foundation, they offer connected and closely related products for life safety.

**PMI** | www.pmirope.com www.verticalrescuesolutions.com **Booth 3509** 

#### Wind energy law firm

Stoel Rives LLP. a full-service law firm. is proud to have been at the forefront of the explosive growth of renewable energy in recent years. Rated one of the nation's best renewable energy law practices by both Chambers and Partners and US News & World Report, they represent major national and international energy developers and operators in wind, as well as other renewables such as biofuels, ocean and tidal, geothermal, and solar energy projects throughout the United States and abroad. Their services encompass all aspects of power project licensing, local permitting, financing, taxation, real estate, equipment, procurement, construction, project acquisition, and project operations. By 2009, Stoel had provided legal counsel to nearly 25% of the installed capacity of US wind power.

Stoel Rives LLP www.stoel.com Booth 2158

#### Motion control & adhesion solutions

Building on a long history of innovation, LORD Corporation provides expertise in vibration and motion control, as well as structural adhesives and coatings. They are at the forefront of evolving these technologies for customers in the wind energy market. Their engineers are developing solutions for wind turbines and power generating equipment that enable longer component life, reduced operating costs, increased availability, and longer maintenance intervals. With more than 85 years of experience, LORD is responsive to the ever-changing marketplace and is focused on providing products and solutions for customers worldwide. **LORD Corporation** | www.lord.com

Booth 2496





#### Environmental & EPC construction services

The AMEC Black & McDonald joint venture has served the wind energy industry for 20 years and has constructed numerous wind farms. The joint venture provides a full range of environmental, engineering, procurement, and construction services. They offer these services on a design-build basis or through other contracting arrangements. AMEC Black & McDonald has the experience and resources to manage entire wind energy project developments from site assessment to design, and installation to operational support. The joint venture's EPC experience, combined with its worldwide project and construction management experience, has established a history of delivering projects on time and within budget by designing innovative facilities and processes, efficiently managing large and small industrial construction projects, and developing and implementing an effective project control program.

AMEC Black & McDonald www.amec.com/wind www.blackandmcdonald.com/wind-power Booth 4211



# **GEOTHERMAL BUYERS GUIDE**





# **GEOTHERMAL BUYERS GUIDE**

#### CONSTRUCTION

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Fallon, Nevada

- Geothermal Resource Consulting System Integration Services

Geothermal Buyers Guide cover photo courtesy of Enel Green Power (www.enelgreenpower.com): the Stillwater geothermal power plant located near

Photo provided by Atlas Copco Mafi-Trench Company LLC (www.atlascopco-gap.com)

**CONSTRUCTION** 



#### PCL Industrial Services, Inc.

PCL is a diversified heavy industrial contractor and fabricator based in California. Their 104+ year track record of adapting to market need has well positioned them in the rising field of alternative energy. PCL shares and supports their clients' commitments to exploring new technologies that are designed to reduce the carbon footprint. Areas of service include: steam generators, ASME-coded pressure vessels, pipe spool fabrications, process skids, ducting, steel plate fabrication, and heavy weldments

www.pclindustrialservices.com

580.234.4141 • domsales@gefco.com



#### **GEFCO**

GEFCO has been manufacturing high-quality drill equipment for 80 years. With some of the broadest drill equipment line in the industry. they continue to develop and support all new technologies that introduce clean energy. GEFCO's newest models, such as the SS185K and SS1100 top head drills, are suited for both clean natural gas drilling and large geothermal projects; whereas, some of their smaller units, such as the Quikdrill and SD300, are well suited for the heat-loop market. www.gefco.com

#### ThermaSource



#### **ThermaSource**

Since its inception over 30 years ago, ThermaSource has been primarily focused on and committed to one industrygeothermal drilling. With a management team representing over 100 years of experience in all forms of geothermal resource drilling, ThermaSource provides engineering, drilling contracting, and drilling services. Their focus is on customers and their challenges, specifically working with them to manage risks, reduce costs, and increase the probability of successful geothermal wells. www.thermasource.com



#### **Atlas Copco Construction & Mining**

Atlas Copco Construction & Mining drill rig models like the TH60, T3W, and T2W are ideally suited for geothermal drilling. In addition, Atlas Copco has the geothermal drilling industry's most complete consumables product range, including the Secoroc Agua 60 down-the-hole hammer, which uses water as a lubricant and leaves no trace of oil in the drill hole; Symmetrix casing advancement systems; and, Econo-Crown PDC bits that offer high performance at an economical price. www.atlascopco.us

#### **ENGINEERING & EQUIPMENT**



#### **CG Power Solutions USA Inc.**

CG Power Solutions has extensive experience working with developers on the electrical design of utility scale projects, ranging from 5 MW to 500 MW. To date, CGPSOL has provided engineering/EPC services on six geothermal projects, accounting for 185 MW. One of these projects includes an 18 MW to 30 MW geothermal project in Nevada where CGPSOL's role consists of Engineering, Procurement, and Commissioning (EPC) services. The company's involvement in geothermal is a natural extension of proven success in wind energy, where they are responsible for connecting approximately 22% of all existing North American wind power. CGPSOL's proven track record for speed-to-grid and project management expertise will prove invaluable to the geothermal sector. With nine offices across North America, CGPSOL's experience in providing T&D Engineering and EPC services to the utility and power generation industries makes it well positioned to serve the geothermal market segment. www.cgpowersolutions.com

Outstanding for Methane Release. **Compact footprint allows** for set-up in the most remote locations Fewer loads make for reduced cost and quicker set-up 300,000-lb. hoist capacities Driller's cabin designed for comfort and safety www.gefco.com



#### Industrial Cooling Solutions (ICS)

ICS is a company dedicated to providing a total quality solution for cooling tower system needs. By combining high-quality design and performance together with a focus on total customer satisfaction, ICS's goal is to be recognized as the cooling tower company to go to when quality and performance matter. **www.h2ocooling.com** 



#### PBS&J, an Atkins company

The PBS&J Renewable Energy, Geothermal Group provides engineering, procurement, and construction management (EPCM) services to the energy industries with particular focus on geothermal energy development. Their staff brings decades of full-service E, EP, and EPCM expertise that is ideally suited to support the ongoing operations and future growth needs of energy developers. With regional presence and a strong commitment of cost-effective delivery, PBS&J's sound work practices in a highly skilled, multi-discipline workforce result in safe, environmentally attractive projects. PBS&J has garnered a knowledgeable staff that has built a quality business focused on repeat work and long-term relationships. The company has put together the necessary resources to perform a complete range of services from pre-feasibility studies to major EPCM projects. www.pbsj.com



#### **Process Unlimited**

Processes Unlimited International, Inc. (ProU) is a full-service engineering, design/drafting, construction management, and safety compliance company. Their Pasadena office has been in operation since 1960, originally as the Ben Holt Company. Process Unlimited has performed numerous studies, bringing the geothermal industry a broad range of experience in engineering, design, construction, and operation of binary cycle, steam flash, and geo-pressured geothermal power plants. **www.prou.com** 

#### **ENVIRONMENTAL CONSULTANTS**



#### **Ecology and Environment, Inc.**

Ecology and Environment, Inc. offers all the professional environmental support required to site, permit, and operate geothermal energy generation and transmission facilities. E & E covers all the bases from environmental constraints analysis; identifying permit requirements; and performing baseline studies for hydrogeology, water quality and availability, geology, meteorology, air quality, ecology, and cultural resources. It can provide all required federal environmental impact statements, state-equivalent impact assessments, and local use permits. It can assist in identifying stakeholders and engaging them early on to obtain consensus on clients' wind projects. www.ene.com

## Renewable Energy is Our Future. Geothermal is Our Business.

Since its inception over 30 years ago, ThermaSource has been exclusively focused on and committed to one industry – geothermal drilling.

With a management team representing over 100 years of experience in all forms of geothermal resource drilling, ThermaSource has emerged as a worldwide industry leader for engineering, drilling contracting, and drilling services.

Our focus is on our customers and their challenges, specifically working with them to manage risks, reduce costs, and increase the probability of successful geothermal wells.



Drill Rig Operations • Drilling Engineering • Geothermal Economics • Field Supervision • Project Management Resource Assessment • Well Testing • Cementing • Drilling Fluids • EGS Exploration • Well Logging

#### **EXPLORATION & SITE ASSESSMENT**



#### Tetra Tech

Tetra Tech is a provider of consulting, engineering, program management, construction, and technical services worldwide. The company supports government and commercial clients by providing innovative solutions focused on water, the environment, and energy. Tetra Tech's capabilities span the entire project life cycle. Geoothermal capabilities include: site assessment, modeling/ simulation analysis, environmental/permitting support, engineering, and 0&M.

www.tetratech.com



#### TRE Canada Inc.

TRE Canada is a remote sensing company specializing in InSAR. This technology analysis radar images, captured by satellites equipped with radar sensors, to measure ground deformation. Using the unique properties of radar waves, measurement of displacement can be achieved to millimeter accuracy over large areas. Using its proprietary SqueeSAR algorithms, the company provides information on ground deformation, uplift, and subsidence caused by injection and extraction of water, oil and CO2 to users in the geothermal, mining, oil & gas, energy, transportation, and litigation sectors. The company's offices are in Vancouver, BC. www.trecanada.com

#### FINANCIAL SERVICES



#### **Taylor-DeJongh**

Taylor-DeJongh (TDJ), an energy and infrastructure investment banking firm, has expertise across a broad spectrum of alternative technologies and renewable energy projects including geothermal, solar, wind, fuel cells, and hydropower. The firm is advising on several conventional and renewable power projects internationally, and is a financial advisor to the USDOE Loan Guarantee Program. TDJ has advised on over 240 power projects, globally. TDJ offers project development, capital structuring, and project financing services and has 30 years of experience in closing energy projects. TDJ provides tailor-made capital solutions to its clients. The firm also advises on corporate finance, capital raising, and M&A transactions.

www.taylor-dejongh.com

#### **GEOTHERMAL DEVELOPMENT**



**Raser Technologies** Raser Technologies is a developer of utility scale geothermal power plants using low to moderate temperature resources. Raser has one of the largest resource portfolios in the geothermal industry with approximately 275,000 acres of leased land in Utah, New Mexico, Nevada, and Oregon. The company recently began drilling its first production well for the project and expects the plant will deliver 15 MWs to Arizona under a 20-year power purchase agreement. Raser plans to expand its development of geothermal power plants in the coming years. www.rasertech.com

#### **GEOTHERMAL EQUIPMENT**

(suppliers/manufacturers): Large-scale projects



#### **Atlas Copco**

Whether it's to produce electricity from a geothermal resource or recover power in a pressure letdown application, Atlas Copco expander generators are a reliable solution for energy production. Utilizing the Organic Rankine Cycle (ORC), typical energy recovery applications include: geothermal, waste heat recovery, pressure letdown, and cold energy recovery. The speed reduction gearbox features a parallel shaft and integral gearbox. Driven by Atlas Copco's integral-gear expertise, the expander generators can be configured with one to four stages on a single gearbox to achieve the lowest cost-per kilowatt power-train solution. Atlas Copco provides partial or complete solutions, from the core expander to the complete system.

www.atlascopco-gap.com

One enormous outlet for clean renewable electricity. It's in our power.™

Efficient. Dependable. Organic Rankine Cycle power plants offering heat to electric power generation for geothermal, biomass, heat recovery and concentrated solar applications. Generating 280 kW to more than 12 MW of clean, reliable electricity. Discover more at www.pw.utc.com.



**Power Systems** 





#### **Pratt & Whitney Power Systems**

Pratt & Whitney, a division of United Technologies (UTC), is committed to providing clean, efficient, and reliable power within the renewable energy market. Pratt & Whitney Power Systems' (PWPS) Organic Rankine Cycle (ORC) power plants provide heat to electric power generation for geothermal, biomass, heat recovery, and concentrated solar applications. ORC systems are ideal for utility scale or distributed power plant installations with sizes ranging from 1 MW to 12 MWs and up. PWPS' ORC products include benefits such as 24/7/365 remote control and monitoring, 195°F to 660°F (90°C to 350°C) temperature range, and standardized components and assembly processes. PWPS offers aftermarket services designed to ensure maximum plant availability. www.pw.utc.com



#### **RigKits LLC**

As the demand on geothermal equipment increases, RigKits has developed several solutions for residential and commercial installations. They are now proud to offer Geothermal Drilling Mast Attachments for existing excavators, backhoes, loaders, and so on. These mast attachments can be customized for both residential and commercial drilling applications. RigKits is the most cost-effective solution for geothermal drilling with high-grade industrial drilling equipment (K40 shown in picture). www.rigkits.com



#### Brush Turbogenerators Inc.

Brush Turbogenerators are an original equipment supplier of Steam & Gas Turbine driven electrical generator equipment for industrial, utility, and process applications on and offshore. Direct air TEAAC (air-to-air) and TEWAC cooling is available in most powers. The product range built is generally rated 10 MW to 800 MW, and includes: salient pole generators for geared turbines 5 MW to 50 MW; turbo type direct coupled generators and motors rated 10 MW to 150 MW; as well as, water- and hydrogen-cooled turbogenerators rated 150 MW to 1000 MW. Brush excitation control products provide monitoring and protection of the generator support system. Brush also customizes new build generators for geothermal applications, and provides aftermarket support services worldwide.

Atlas Copco Gas and Process Solutions

## **Producing Tomorrow's Energy**



Our constant commitment to innovation and sustainable productivity makes us a pioneer in the field of Geothermal Energy Solutions. With several decades of experience, we help our customers around the world unlock the vast potential of renewable energy sources.

#### **Customer benefits:**

- Standardized and customized solutions available
- Best project feasibility by means of tailor-made ORC with maximum power generation
- Turboexpander stage with up to 25,000 kW power
- Single-stage or multi-stage radial inflow turbine designs are available
- Maximum energy recovery efficiency and plant availability
- Partnerships with expert companies for complete cycle design/complete recovery solutions
- High availability and short downtimes through global service network with presence in over 160 countries

More on our energy recovery solutions at www.atlascopco-gap.com.

#### Sustainable Productivity





Freemyer Industrial Pressure, LP

Freemyer Industrial Pressure, LP is a manufacturer of geothermal well service equipment for all environments, including: arid, arctic, mountainous, high humidity, and offshore. Their FIP Smart Op-Acq System electronic package features data acquisition and/or automated cement density control for more consistent slurry designs. www.indpress.com



#### Nash, A Gardner Denver Product

Gardner Denver Nash manufactures and supports Nash liquid ring vacuum pumps, compressors, and engineered systems, serving the power, chemical, environmental industries, and more. Nash has manufacturing facilities in the US, China, Germany, and Brazil, as well as Engineered to Order (ETO) centers in the US, Singapore, Australia, and Europe. Their service centers are ISO 9001:2008 certified, and can be found worldwide.



#### Ormat Technologies, Inc.

With over 40 years experience, Ormat Technologies, Inc. is the only vertically integrated company solely engaged in geothermal and Recovered Energy (REG). The company owns, operates, designs, manufactures, and sells geothermal and recovered energy power solutions primarily based on the ORMAT ENERGY CONVERTER—a power generation unit that converts low-, medium-, and high-temperature heat into electricity. With over 75 US patents, Ormat's power solutions have been refined and perfected under the most grueling environmental conditions. Ormat's flexible, modular solutions for geothermal power and REG are ideal for the vast range of resource characteristics. The company has engineered and built power plants, which it currently owns or has supplied to utilities and developers worldwide, totaling over 1300 MW of gross capacity. Ormat's equipment can be found throughout the world in 71 countries and on six continents.



#### **Plymouth Tube Co.**

Plymouth Tube is a domestic producer and global supplier of specialty carbon, alloy, nickel alloy, and stainless steel tubing (in rounds and in shapes) for a variety of industries including power generation, the geothermal industry, and more. **www.plymouth.com** 



#### Siemens Industry, Inc.

Siemens has the technology to provide complete electrical systems and balance of plant solutions that lower the total operating costs of a geothermal power plant. They address cooling tower, pump, process control, and drive train applications with reliable and energy efficient systems. Product offering include: generators; motors and drives; automation; instrumentation; switchgear; circuit protection; transformers; and, operation and maintenance services. www.usa.siemens.com/geothermal



#### Stork H&E Turbo Blading Inc.

Stork H&E Turbo Blading is the world's largest ISO 9001 certified independent, aftermarket turbine blade manufacturer, dedicated solely to new steam turbine blading and new gas turbine compressor blading for all turbine types. They have over 70 years of proven dedication to quality with manufacturing facilitates in the US, as well as Holland. Stork H&E Turbo Blading offers some of the best alternatives to high prices and long delivery times. www.he-machinery.com

#### **GEOTHERMAL EQUIPMENT**

(suppliers/manufacturers): Small-scale projects



#### ElectraTherm, Inc.

ElectraTherm delivers distributed heat-to-power solutions that make electricity from low-temperature (190°F to 240°F) heat. ElectraTherm's Green Machine converts waste heat into fuel-free, emissions-free energy. Primary markets include geothermal, stationary engines, biomass, and solar thermal. www.electratherm.com

#### **GEOTHERMAL HEATING & COOLING**



#### **REHAU CONSTRUCTION LLC**

REHAU RAUGEO ground-loop heat exchanger, made with the highly robust PEXa pipe and featuring a unique double U-bend, offers one of the most secure, efficient, and effective ways to harvest renewable solar energy from below the earth's surface. Equally effective with commercial or residential applications, RAUGEO leverages the heat tolerance of PEXa pipe to deliver geothermal energy where it's needed, with fewer, more secure connections in the field, using EVERLOC fittings. By integrating REHAU's Polymer XP manifold, gain an unprecedented degree of control and security over ground loops. Individual control of each loop, together with the double U-bend, means that risk of borehole loss is minimized.

#### LEGAL SERVICES Holland & Hart LLP

For over 60 years, Holland & Harp's energy group has advised clients on the changing laws affecting energy development. They handle geothermal and renewable energy project matters from inception to completion including permitting, environmental compliance, project development and finance, real estate matters, and virtually everything in between. With over 400 attorneys in seven states, including Washington, D.C., Holland & Hart is ready to help with the energy projects that matter most. www.hollandhart.com

#### Van Ness Feldman, P.C.

Established in 1977, with over 90 lawyers and policy professionals, Van Ness Feldman is referred to as "the premiere energy boutique in the USA," according to Chambers USA 2010. The firm is a proud participant in the development of numerous geothermal projects in the US and abroad, in addition to their work in other renewable areas. They have encountered virtually every conceivable sort of issue renewable energy project developers and investors may face, allowing them to serve clients with an unparalleled depth of experience. In addition to their subject matter expertise, Van Ness Felman is known for their creative approach to problem solving. www.vnf.com

#### **MONITORING & DATA EQUIPMENT**



#### MadgeTech, Inc. MadgeTech designs and manufactures dataloggers—small, batterypowered, intelligent devices for measuring and recording temperature

powered, intelligent devices for measuring and recording temperature, humidity, pressure, shock, and more. www.madgetech.com

# POWER PLANTS | POWER PLANT DESIGN & CONSTRUCTION



#### **The Shaw Group**

A Fortune 500 company, The Shaw Group is a global provider of engineering, construction, technology, fabrication, remediation, and support services for clients in the energy, environmental, infrastructure industries, and more. Shaw's full-service portfolio of nuclear and fossil power expertise delivers safe, efficient and clean energy solutions around the world. From building new plants to retrofitting existing plants for modernization and clean-air objectives, Shaw delivers premier Engineering, Procurement, and Construction (EPC) services to the geothermal industry and more. **www.shawgrp.com** 

#### **R&D | EDUCATION**



#### **RMOTC**

Combining traditional oilfield resources with geothermal properties, RMOTC can help test and demonstrate advancements in low-temperatures and enhanced geothermal systems in a real-world environment. RMOTC can support both traditional and renewable energy technology testing and demonstration. They have the infrastructure, personnel, and project coordination experience to work collaboratively with industry, government, and academia toward a balanced, secure energy future. www.rmotc.doe.gov

# SITE ASSESSMENT & GEOTHERMAL MONITORING



#### **Campbell Scientific Inc.**

Campbell Scientific offers packages for geothermal resource assessment and energy monitoring. These systems accurately and reliably monitor direct-use plants, acting as on-site customizable BTU meters for commercial or residential distribution. Their systems can measure a variety of parameters including ground-water level and temperature (including mesh networks), thermal gradient profiling (thermograms), well casing monitoring (temperature profile and integrity), and water quality and flow in open or closed systems. They can also measure most meteorological parameters. Each system can be custom made for a plant's unique application and data gathering needs. Data collected can be integrated into existing SCADA systems using protocols such as MODBUS and DNP3. Communications options include direct connection, cell phone modem, radio, or TCP/IP. Campbell Scientific's Renewable Energy Group is available to help customize any geothermal application. www.campbellsci.com

#### OTHER Chemical Testing Services & Instrumentation



#### Thermochem, Inc.

Thermochem, Inc. is an integrated consultancy, service, and OEM firm with over 25 years experience in the geothermal energy industry. The company provides comprehensive field sampling, source testing, laboratory analysis, and chemical process design services to geothermal projects across the globe. Thermochem's USA and Indonesian analytical laboratories specialize in high-purity steam condensate, high-salinity brine, and non-condensable gas analysis. Thermochem also performs on-site chemical analysis and pilot testing for corrosion and scale control systems. Process chemistry modeling and design services include detailed chemical mass and heat balance studies, gas partitioning, scale formation, corrosion potential, acid steam and brine treatment, and power plant environmental emission calculations. Thermochem designs and manufactures pH-control and inhibitor delivery systems for scale and corrosion management in the sub-surface, gathering systems and power plants; and, two-phase flow metering, steam purity, and steam quality instrumentation. www.thermochem.com

#### **District Energy**



#### Corix Utilities, Inc.

Corix provides a broad range of infrastructure services, which include district energy and geoexchange. They also design, build, own, and operate for municipalities, resort properties, developers, and institutions (e.g. universities). www.corix.com

#### **OTHER** Fabricator



#### **Imperial Pipe**

Imperial Pipe, an affiliate of Kelly Pipe, is a major steel pipe fabricator in California. The company services several critical sectors of the construction industry with special emphasis on producing cement-lined pipe used in water distribution projects, including the geothermal industry and solar device components. With 25 years of experience in designing, engineering, and manufacturing steel pipe structures, Imperial Pipe has emerged as an experienced manufacturer of thermal solar pedestals and torque tubes. Its plant in Riverside County is located within 250 miles of the largest thermal solar projects in the US, which ensures on time daily delivery for large-scale utility power generating plants. **www.imperialpipe.com** 

#### **Geothermal Resource Consulting**



#### GeothermEx

Since 1973, GeothermEx has been working with geothermal developers, investors, regulators, and land owners to explore, assess, and develop their geothermal resources. Focusing on the higher-risk subsurface issues, GeothermEx's team of senior geoscientists and engineers each have 20+ years of experience in geothermal projects around the world including conventional hydrothermal projects, Enhanced Geothermal Systems (EGS) projects, and non-convective resources hosted in sedimentary basins (including geopressured systems and oil & gas co-production). Known for its expertise in resource assessment and numerical simulation to forecast future reservoir behavior, GeothermEx has supported more than US\$11 billion in project financing for about 7,000 MW of geothermal power. Following its acquisition by Schlumberger in 2010, GeothermEx is well positioned to serve the growing global geothermal market in the coming years. www.geothermex.com

#### System Integration Services George T. Hall Company

George T. Hall Company offers complete systems integration services including engineering, programming, and design. They are experienced in PLC, HMI, and wireless technologies. In addition, they are a distributor of industrial process and combustion instrumentation. They have two full-service UL508 Custom Control Panel Shops that enable them to take a project from concept to completion. **www.georgethall.com**  Wood Pellets Renewable, sustainable energy for today & tomorrow

By John K Keppler





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Percival Scientific, Inc. 505 Research Drive | Perry, Iowa 50220 800.695.2743 or 515.465.9363 percival-scientific.com **WOOD BIOMASS** has been used to generate heat for thousands of years. It is one of nature's cleanest, most renewable, and most sustainable sources of energy. When harvested and processed responsibly, it offers an economically viable alternative to fossil fuels with significant environmental benefits.

When used for energy generation, wood biomass is rarely burned in its raw state. Instead, many utilities and industrial-scale consumers use wood that has been processed into pellet form. These pellets, which can be made from 100% sustainably sourced wood, are a dense, uniform fuel that offers a range of advantages. Most notable, perhaps, are its environmental efficiencies. Wood pellets burned for energy release significantly lower emissions than fossil fuels.

In addition to the environmental benefits, wood pellets are also a highly efficient fuel with an energy value nearly double that of unprocessed wood (pellets have a calorific value of, approximately, 17.5MJ/kg versus 10.9MJ/ kg for non-pelleted, non-dried wood). They can be manufactured to any size or specification, and are consistent in their quality and performance. Energy generated from wood pellets is dispatchable—meaning it is available at a moment's notice, 24 hours a day, seven days a week. It is predictable, reliable, scalable, and controllable. Equally important is the fact that power-generation facilities are able to retrofit existing facilities to "co-fire" wood pellets with coal relatively economically and quickly, if a dedicated wood biomass facility is not feasible.

An examination of the pellet-production process, as well as the sustainability practices associated with pellet manufacture, demonstrate how the unique advantages of this fuel source are preserved and enhanced from the forest to the furnace.

#### Life cycle of a wood pellet

The life cycle of a wood pellet comprises multiple stages, which begins on the forest floor. • **100% wood raw materials** 

The wood biomass used in pellet production comes from sources that previously have been left behind by traditional forestry operations. The removal of a tree trunk or other "primary biomass" results in debris—tree tops, branches, stumps—that often went unused, but are now collected as biomass for pellets. Other sustainably sourced material includes residues such as chips, bark and sawdust by-products, as well as low-grade wood fiber and round timber. Once the wood biomass arrives at the pellet manufacturing facility, it is processed

into small chips, sorted, and dried. • Storage & secondary processing The chips next arrive at a large area where they are stored and undergo secondary processing in a hammer mill before being sent through a pellet press. The secondary processing also includes moisture-conditioning systems, using water or steam, to give the material the proper moisture content required for the presses. Unlike raw wood, the pellets that ultimately emerge from processing have an extremely low moisture content (5% to 7% vs. 40% to 60%), as well as a low ash content (1% to 2% vs. 5% for non-pelleted wood). The low moisture content of the pellets offers another important advantage, as together with their geometric, uniform shape, it enables pellets to be shipped in standard, dry bulk vessels.

#### • Pellet presses

In the pressing area, pellets go through a second moisture-conditioning system before entering the presses themselves. The presses force the processed wood through a die, resulting in a dense and consistent product that can be more easily handled, stored and, ultimately, combusted. The press also takes advantage of the wood's natural properties while going through the press, the lignin found in the wood melts to form a natural casing for the pellet.

#### • Pellet conditioning & storage

Next, pellets are cooled and stored for export. Following their trip through the press, the cooling system administers a forced airflow to the hot pellets. When they emerge, the cooled material is screened for any small material that was not pelletized or pellets that do not meet customers' standards. Cooled and screened pellets are moved to a storage area where they await transport.

#### • Transport from the facility

Often times wood pellets travel to a port in barges, railcars, or trucks, where they are loaded on to a ship in increments (often up to 40,000 metric tons), and exported, where they are burned for energy in utility plants. Pellets can either be "co-fired" with coal in traditional coal-fire utilities, or burned alone in dedicated biomass facilities. Because pellets can ship in dry bulk vessels and don't require specialized transport, no energy is wasted on vessels that would otherwise have to return without cargo.

#### Sustainability

Wood pellet manufacturers supplying renewable wood biomass fuel to industrial-scale and utility companies must ensure their product is sustainable, not only at the procurement stage but also throughout the supply chain. Some of the ways that wood pellet manufacturers ensure the sustainability of wood pellets are detailed below.

#### • Ensuring a strong "Growth/Drain" ratio

Wood biomass manufacturers must source their feedstock from regions that consistently grow more timber than is harvested. The "Growth/Drain Ratio" measures the number of trees planted in a region against the number removed, and that ratio is on the rise in many regions of United States. The net volume of timber grown on forested land in the Southeast US, for instance, has roughly doubled in the past 60 years. Other regions of the country have seen similar increases, lead by the Northern US, where forest inventories have swelled over 130% in the past 60 years.

#### • Robust sustainable forestry practices

Sustainable wood pellet supply also requires responsible forestry practices, and the forestry industry has developed a robust system of "best practices" through certification programs such as the Sustainable Forestry Initiative (SFI), The Forest Stewardship Council (FSC), and The Programme for the Endorsement of Forest Certification (PEFC). These practices, developed over decades, ensure forests are managed sustainably, the local environment is maintained, and biodiversity is protected.

#### Conclusion

Sustainably sourced wood biomass is one of nature's most economical and viable energy alternatives to fossil fuel. Biomass has been burned for years, but the biomass renewable energy industry is young. The market is tremendously fragmented, due in part to the intensely localized nature of the business. It lacks industry scalable standards (on moisture content, size, ash content, etc.), and it's playing on an uneven field against other "renewables" with respect to government regulation and incentives. Those who know the benefits of wood pellet biomass, however, are glad to be industry pioneers and should be doing so with the utmost of care for the environment, and great confidence in a fuel source with endless potential.

John K Keppler is the chairman and CEO of Enviva LP.

**Enviva LP** | www.envivabiomass.com



### Case Study: Switching from Natural Gas to Syngas for Process Heat Biomass handling challenges & solutions

By Bob White

**Image 1:** Raw wood fuel ascending to the disc screen. **Image 2:** Disc screen separation of oversized material in the foreground with acceptable material on the background conveyor. **Image 3:** The 110' tall bucket elevator for loading storage bins. **Image 4:** Screener feed conveyor, disc screen, accepts conveyor, overs conveyor, over-belt magnet, and bucket elevator.

**BACK IN 2007**, Chippewa Valley Ethanol (CVEC) of Benson, Minnesota decided it was time to reduce their energy costs and environmental impact by switching from natural gas to syngas for process heat. A new gasifier fueled by biomass would generate the syngas. Initially, the biomass fuel would be wood residue, which was readily available, with the intent to use corncobs, stover, and other biomass as a fuel source in the near future. A material handling system with the flexibility to convey a variety of biomass products would be required. Live floor trailers would deliver the solid fuel biomass with the contents stored in a large silo for ongoing use and consumption by the gasifier.

On the surface, getting wood off a trailer and into storage did not appear to be a challenge, but the experience of others indicated several underlying serious issues. Biomass is notorious for its ability to stick, wedge, jam, plug, bridge, and simply not cooperate with material handling and process equipment. The angle of repose can be as high as 90° and, in some cases, even higher. Consequently, Chippewa Valley Ethanol looked for a material handling system that could handle the load.

#### Challenges & solutions

Essentially, the first challenge to be overcome was time. The delivery trucks could unload about 125 cubic yards or 25 tons of material in about 10 minutes, which sounded great. However, there was a lot of material to deal with in a short amount of time, and the trailer owners would not accept an unload time of more than 20 minutes—which was proving impossible. A trailer-sized receiving surge bin was considered, but rejected as it cost as much or more as the equipment to handle the product as discharged from the trailer. A decision was made to unload the biomass fuel trailers in 20 minutes, a reasonable compromise between time and the equipment capacity and cost.

Another challenge proved to be the wood itself. Discharged from the trailers in three to four cubic yard surges, essentially, the wood would fall at random from the end of the trailer; however, the downstream process equipment required feeding at a uniform metered rate. This challenge was met with two chain conveyors. The first absorbed the impact of the surge from the trailer, and provided the initial product metering. It would discharge onto a specially designed drag conveyor that conveyed the product with the top chain to accommodate both oversized products and frozen clumps of wood. A second conveyor provided additional metering, elevating the product to the disc screen inlet.

All of the conveyors were of an enclosed design with the belt trapped inside a four-sided enclosure. Fugitive dust, an inevitable side effect, was controlled using a self-cleaning and reloading system with the return belt ridding on the bottom cover of the conveyor frame. The conveyor bottom cover was equipped with an anti-static liner, which bowed the belt with a special rubber wiper attached to the leading edge of the belt splice—allowing the belt to ride back on the anti-static bottom. It pulled material back toward the conveyor inlet and, with special devices in the tail section, reloaded the material centrifugally to the topside of the belt. As a result, any of the fines or dust was dealt with by re-circulating them at the tail section of the conveyor. Additionally, the conveyors were fitted with dust-collection suction pipe that kept the enclosed conveyors under negative air pressure to control any dust released at transition points.

Although Chippewa Valley Ethanol specified a threeinch minus fuel to their vendors, they knew they would inevitably receive oversized and frozen material that would cause problems with the storage silo unloader and other material handling conveyors that fed the gasifier. As a result, a disc screen was selected to remove the long splinters and oversized material with the "overs" diverted to a scrap container beside the receiving process line. CVEC also knew the wood they would receive, either green or dried, would contain metal that would cause problems in the gasifier and other process equipment. A powerful overbelt magnet was mounted above the "accepts" conveyor to remove ferrous materials. In addition to the anticipated staples, nails, and banding the magnet has captured some surprising tramp material ("screw conveyor flighting"). A magnetic head pulley was provided on the discharge of the accepts conveyor, under the disc screen, as a back-up for any metal that might be missed by the first magnet.

To this day, the wood or biomass fuel is stored in a forty-foot diameter silo with a 64-foot sidewall height, and an inlet at the top center of the silo. Because the receiving system was designed for a capacity of up to 100 tons, or 500 cubic yards per hour, a high-capacity bucket elevator with a 100-foot discharge height was selected to deliver the processed wood to the top of the storage silo inlet.

Even today, the flexibility provided by this system allows CVEC to use the most current, clean, and cost-effective fuel source available, prepare the fuel for storage, and receive and process biomass of varying bulk densities.

Robert White Industries, Inc. (or RWI) specializes in biomass equipment system integration.

#### Robert White Industries, Inc. | www.rwii.net

#### Chippewa Valley Ethanol (CVEC) | http://cvec.com



#### Pressure & back-pressure regulators

Asahi/America is now stocking PolyPure PPn (Natural Polypropylene) Frank Series Pressure Regulators and Back-pressure Regulators in sizes ranging from 1/2 " to 2" for their PolyPure piping system. Frank Series regulating products are engineered to meet the toughest demands. Mechanical parts are isolated from the system media by a diaphragm. Regulators are adjustable under working conditions, and provide accurate and stable control over pressure regardless of fluctuations or change in system demand. Installed in municipal, wastewater, and processing facilities, Frank Series Regulators are designed to outperform. Frank Series regulating products include pressure regulators, back-pressure regulators, pressure relief valves, and manual flow meters. In addition to PPn, Frank Regulators are available in PVDF, PP, and PVC up to 4" size, depending on the model.

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# Transporting Biomass: Improving energy logistics

By Jarl Gjønnes

**Biomass handling challenges** 

Biomass and bioenergy is developing to represent an important resource of energy for the future. A critical point of utilizing biomass is transportation and storage of the different biorelated products. Materials occurring in loose or bulk forms are often challenging to handle due to the low density of their mass. It is difficult to keep track of many cubic meters under changing weather conditions, and during operations and handling. Drift-offs, pollution, and self-illumination are other challenges related to handling bio-related products. Fortunately, there are solutions.

# Established & traditional ways of biomass logistics

To date, most biomass logistics and transportation has been made by means of lorries, specifically arranged for shavings and other biomass products. Lorries based on "walking floor" concepts (offering storage along a conveyor system) are well established in the industry. Other solutions, like containers for loose materials, are common as well. Both means, though efficient, may have limitations in relation to the degree of compaction of the material being handled. As a result, the means of transporta-



road transportation, it is folded together, and can be pulled by a tractor or a lorry. The unit is automated and has a hopper where material for compaction is loaded. The material is moved from the hopper, up an elevator, to the top of a baling chamber for compaction. The chamber is continuously filled until the set pressure or weight of the package (bale) is obtained. Driven by its own hydraulic system, power is only needed from a tractor PTO or from an external electrical engine. Depending on the material, the output of the machine is 40 to 60 bales/h, which for some materials equates to 30 to 60 tons/h, depending on the dry matter content. Normally, the degree of compaction is approximately three times the original size.

#### Simplifying energy logistics

A central question regarding utilization of biomass is the location for production, storage, and transport to the point of utilization. By putting the mass into sealed units at the location for production (harvesting), savings and flexibility is gained for the remaining handling and the further process of the actual material.

Orkel Compaction | www.orkel.no



# Custom-sized fuel

Continental Biomass Industries has introduced the latest addition to its powerful product line: the Chip-Max 484. Compact yet enormously

productive, the ChipMax Model 484 is extremely rugged. The main components such as the rotor, chipper box, and feed system are significantly stronger than any other chipper in its class. Featuring two chipper rotor options, users can go from making high-quality fuel chips custom-sized from 12mm to 25mm to "micro-chips" from 2mm to 12mm. Adding to its versatility, the ChipMax is available as a portable (pintle hook or 5th wheel mounting hitch), track, or truck-mounted unit, and is road legal (width and weight). Whether in a backyard or at a remote location, rely on the ChipMax to stay running and get the job done—ensuring the greatest level of uptime and reliability. At CBI, they build machines based on total ownership cost in mind, rather than compromise quality. **Continental Biomass Industries, Inc.** | www.cbi-inc.com



tion might be restricted to specific materials like shavings, bark

and sawdust—which means the lorries often go back empty after

A way of eliminating the challenges of storage, expensive trans-

ing the biomass into sealed "unit packages." As one solution,

a Norwegian compactor was developed in 2001 to specifically

press, pack, and wrap organic and fine structure materials for

different purposes. During the past few years, the compactor

has shown its abilities to simplify logistics for materials like

wood chips, saw dust, shavings, compost, manure, and other

wastes. Instead of handling the biomass as a loose material, the

unit forms the material into a compacted, sealed package, or a

wrapped round bale. Compared to the loose form, this technol-

ogy is able to compact most materials to three times its size—

which represents significant savings for transport and storage.

In principle, the compactor is a mobile production plant for

transforming loose materials into sealed packages (bales). For

Mobile production plant

ports, losses, difficult handling conditions, and so on, is by pack-

delivering the biomass product to its required location.

From bulk form to sealed packages

#### Mercury control silo discharger

Sodimate's unique Multiple Screw Discharger and Arch Breaker features a vertical spindle fitted with flexible blades to ensure a thorough discharge of dry solid materials and bio-solids from silos, bins, or hoppers via precise

mechanical agitation. This prevents the material from jamming, bridging, compacting, or rat-holing caused by vibration or fluidization. The mechanical Arch Breaker not only discharges bulk products gently and efficiently, but also integrates 1, 2, 3, and/or 4 volumetric screw feeders. Each screw feeder is completely independent and can feed up to 15,000lb/hr at different lengths and throughput variations. Lime, powder activated carbon, soda ash, grass, and woodchips are among the products handled by Sodimate's silo discharger. Perfectly adapted for the retrofit systems, this system is the best alternative for bulk handling. **Sodimate Inc.** | www.sodimate-inc.com



# Dryer fire prevention

The importance of a spark detection and extinguishment system when pneumatically conveying combustible dust from a dryer to a cyclone or dust filter cannot be overstated. To meet this challenge, Hansentek announces the AN6400 spark detection system that provides the most advanced spark detection equipment available in the industry. The high-temperature detectors are designed for duct temperatures up to 500°F, making them ideal for protecting a dryer discharge pipe. The detectors are mounted away from the hot duct and only the stainless steel clad fiber-optic probes, with their hightemperature sapphire lenses, are in the high-temperature area. The detectors are mounted in pairs with each probe capable of scanning the full width of the duct. In the test mode, the sensitivity of each detector can be tested from the control panel under actual operating conditions, across the entire width of the duct, and through both lenses to confirm proper operation of the system. **Robert White Industries, Inc.** www.rwii.net











CB

CBI's complete material recovery and recycling systems are engineered to do exactly what you want it to do... consistently exceeding expectations by *producing more, lasting longer, and costing significantly less to operate* than anything else on the market today. We take responsibility for every aspect of the project (no finger pointing), offering on-time delivery and impeccable service. But don't take our word for it...come meet our customers. If this is the solution you are looking for, call us today at 603-382-0556 or visit our website at <u>www.cbi-inc.com</u>.

Continental Biomass Industries, Inc. • 22 Whittier Street, Newton, NH USA • © 2011 All Rights Reserved.



#### Biomass & biofuel feedstock preparation

As competition increases for biomass and biofuel feedstock, an effective front-end feedstock preparation system is one key for successful biomass and biofuel processors. West Salem Machinery's (WSM) bulk feeders allow loading of large amounts of material for metered feeding into the processing system. Screening removes fines and abrasive material for reduced grinder maintenance, and can classify sized material prior to grinding to reduce power consumption.

Cleaning with magnets removes large "uncrushables" prior to grinding. WSM's horizontal and vertical grinders process large volumes of raw incoming feedstock including stumps, land clearing, and urban wood waste. Finish milling for finer fiber is performed with WSM heavy-duty shredders and hammermills. These rugged machines produce fiber for pellet/densified fuel manufacturing, co-firing material, ag fiber, wood flour, mulch, fiberboard, and cellulosic ethanol feedstock. From individual components to fully engineered and integrated systems, count on WSM to provide the best value for processing a wide range of feedstock into fiber/fuel products. **West Salem Machinery** 

www.westsalem.com



#### Cellulosic biomass bailing technology

Forest Concepts' solution to the problem of collection, transport, and storage of woody biomass is an entirely new class of street-legal biomass balers that will directly contribute to the sustainability and growth of bioenergy industries. Baled woody biomass will enable cost-effective diversion of brush, branches, and woody debris into the bioenergy sector, thereby increasing feedstock supply and reducing competition for merchantable forestry materials. The biomass baler will enable woody biomass to become the next major recyclable in urban areas compacting urban brush into bales that handle just like recycled paper, cardboard, and other recyclables.

Balers are safer, quieter, and more economical to operate than chippers, and bales are easy to stack and store for drying without the threat of spontaneous combustion. Biomass balers will cost approximately the same as a chipper of equal horsepower and without the safety issues.

Forest Concepts, LLC www.forestconcepts.com



#### Vehicle scale for chemical applications

METTLER TOLEDO has announced the release of the VTC221 and VTS231 vehicle scales for weighing applications in the chemical industry. The VTS231 (steel deck) and the VTC221 (concrete and steel composite deck) are the latest editions to the METTLER TOLEDO vehicle scale portfolio. With concentrated load capacities of 100,000lbs and real-world testing of over two million load cycles, these scales have been designed to meet the needs of the chemical industry.

VTC221 combines a concrete driving surface with a robust orthotropic understructure. The composite design draws upon the strengths of concrete and steel to produce an exceptionally durable structure. VTS231 sets the industry standard for steel deck truck scales, and is the ideal choice for a wide variety of weighing applications. The steel deck is supported by sealed orthotropic ribs, which eliminates the potential for rusting from the inside and distributes concentrated loads better than I-beam designs. Both incorporate the newly released POWERCELL PDX load cell network—a revolutionary new technology that eliminates the typical maintenance, repair costs, and downtime related to conventional analog vehicle scales. **METTLER TOLEDO** 

www.mt.com/us



# Tub, horizontal & solid waste grinder models

Legendary Diamond Z performance is now available in a smaller horizontal package— Diamond Z introduces the DZH4000. The DZH4000 will out-grind competitors' comparably sized machines. The C18 Caterpillar engine, available in 700HP tier 3 or 765HP tier 2 sizes, combined with Diamond Zs aggressive down-cut mill, delivers production rates up to 120 tons per hour. The smaller stature offers easy transportability. Friendly operation, ease of maintenance, and attention to detail are evident throughout. Diamond Z offers a broad range of tub, horizontal, and solid waste grinder models designed to suit any application. From composting to construction and demolition, land clearing to tire disposal, and municipal solid waste to asphalt shingle grinding, nothing grinds quite like the Diamond Z.

 $\textbf{Diamond Z} \mid www.diamondz.com$ 





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# International Biomass Conference & Expo

This dynamic event (widely known as "BIOMASS") unites industry professionals from all sectors of the world's interconnected biomass utilization

industries—bio-based power, thermal energy, fuels, and chemicals. BIOMASS is where project developers converse with utility executives; where researchers and technology developers rub elbows with venture capitalists; and, where Fortune 500 executives and influential policy makers sit side-

May 2nd to 5th, 2011 • America's Center, St. Louis, Missouri

#### Show in Print

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



#### Organic Rankine Cycle (ORC) power plants

Pratt & Whitney, a division of United Technologies (UTC), is committed to providing clean, efficient, and reliable power within the renewable energy market. Pratt & Whitney Power Systems' (PWPS) Organic Rankine Cycle (ORC) power plants provide heat to electric power generation for geothermal, biomass, heat recovery, and concentrated solar applications. ORC systems are ideal for utility scale or distributed power plant installations with sizes ranging from 1 MW to 12 MWs, and up. PWPS' ORC products include benefits such as 24/7/365 remote control and monitoring, 195°F to 660°F (90°C to 350°C) temperature range, standardized components, and assembly processes. PWPS delivers highquality aftermarket services designed to ensure maximum plant availability. **Pratt & Whitney** 

www.pw.utc.com



by-side with American farmers and foresters.

www.biomassconference.com

#### Wood chip moisture meter

The new CheckLine BLL Wood Chip Moisture Meter employs a 39" (one meter) long probe to measure the moisture content of wood chip piles in seconds without prior sample preparation. It automatically converts wood moisture into percentage of water content (from 10% to 50%), and displays the results with the sample temperature (°F or °C) on a large, well-lit LCD display. Other features include automatic averaging, automatic temperature compensation, and a builtin datalogger that stores up to 10,000 measurements along with date, batch, and temperature. Gauge menus can be specified in English, German, French, Italian, Spanish, or Russian. The BLL is battery powered for portability and comes pre-programmed with three separate calibration curves—wood chips, coarse wood chips, and industry wood chips—as described in the European Standards. Two models are available: the BLL and the BLL-232, which includes an RS-232 interface, transfer cable, and software. **Electromatic Equipment Company** www.checkline.com



#### Combustion monitoring system

The HURST BIOMASS-ter Control System is one of the most advanced systems available for biomass combustion in today's market. The expertise gained through the years of biomass installations, combined with the company's commitment to continuous quality improvements, has created a control system unsurpassed in the biomass industry. The control system is fully automated and provides the ultimate in flexibility to meet the requirements of the varying types of biomass fuels. The complete control system is developed and manufactured in-house by the control system department. Through the use of the latest PLC, VFD, instrumentation, and HMI technologies, HURST BOILER provides a comprehensive user-friendly system. Each system is designed not only to control the boiler, but also to provide information to address diagnostic and emission concerns.

HURST BOILER

www.hurstboiler.com/biomass\_boiler\_ systems



#### Industrial waste treatment technology

ADI Systems Inc. (ADI) provides industrial waste treatment technology and turnkey solutions to meet the needs of virtually any industry—from pre-treatment to water reuse and energy recovery. ADI has been active in the industrial wastewater treatment field since 1975, and has developed, acquired, or licensed a number of innovative technologies that allow them to offer unique solutions to waste treatment and energy issues including: proprietary low-rate anaerobic treatment system; the most widely utilized membrane bioreactor (MBR) technology on the market; the only commercially available submerged anaerobic membrane bioreactor (AnMBR) technology; as well as, biogas scrubbing and utilization. ADI's primary business model is design-build, which offers the benefits of "one-stop shopping" for a complete treatment solution, a single point of contact and responsibility, a single contract, and consistency in design and construction quality. Technology only packages are offered for select applications. ADI Systems Inc.

www.adisystemsinc.com



#### Tub & horizontal grinders

DuraTech Industries has been involved in industrial manufacturing since 1966, specializing in tub and horizontal grinders along with one tree chipper. DuraTech offers several products such as their massive 9564 Horizontal Grinder, the powerful TC-12 Tree Chipper, and the efficient 5064 Horizontal Grinder. **DuraTech Industries** 

www.duratechindustries.net

#### Industrial construction & maintenance services

Matrix Service provides engineering, fabrication, construction, material handling, repair, and maintenance services to energy and industrial markets throughout the US and Canada. They have the expertise and proven capabilities to provide construction services necessary to meet the power industry's increasing need for alternative energy, power generation, transmission, and delivery.

Matrix Service Company www.matrixservice.com



#### Material handling equipment & services

For over a century, BEDESCHI has been supplying raw material handling equipment and services around the globe, including to the biomass and power industries. BEDESCHI designs and manufactures industrial equipment to fit the specific needs of clients. Their product line encompasses: apron feeders; crushers; stackers (linear and circular); reclaimers (linear, circular and blending); ship loaders and un-loaders; and, dust collection and air filtration. BEDESCHI fabricates, assembles, and tests all machines in their 500,000 ft2 manufacturing facility. Their in-house engineering department uses the latest software programs, guaranteeing a state-of-the-art system. Their field technicians follow the erection/assembly phase of the machines onsite, along with providing start-up and commissioning assistance. BEDESCHI's first priority has been to improve the quality of their products and the service to clients. BEDESCHI | www.bedeschiamerica.com



# Bin measuring sensors & software

BinMaster Level Controls offers sensors and software for measuring the material level in bins, silos, and hoppers. The revolutionary 3DLevelScanner measures and visually maps bin contents to provide a highly accurate volume estimate that helps optimize inventory levels and delivery schedules, while reducing inventory carrying costs. SmartBob cable-based sensors, combined with eBob inventory management software and user-friendly consoles, are another proven and highly reliable, multi-tank management system. For point level detection, BinMaster offers rotaries, capacitance probes, vibrating rods, pressure/diaphragm switches, and tilt switches. BinMaster's SmartSonic ultrasonic and SmartWave radar devices offer continuous level detection for a variety of solid, powder, and liquid materials. Other plant-friendly products include dust detection, flow detection, as well as aeration devices. BinMaster is a division of Garner Industries—an ISO 9001:2000 certified company established in 1953, and headquartered in a 75,000-square-foot manufacturing facility in Nebraska. **BinMaster Level Controls** 

www.binmaster.com



# Boiler & energy system cleaner

Chemex Solutions manufactures ASH KLEEN, an industrial ash modifier that effectively eliminates clinker and glassy ash from any boiler, kiln, or energy system. ASH KLEEN is a safe, inert, nonhazardous dry material that turns hard glassy deposits into weak, friable ash that is continuously removed. ASH KLEEN programs come complete with product, equipment, and technical service to give customers the best value in the industry. Used in biomass boilers, recovery boilers, furnaces, and kilns, ASH KLEEN is used by several corporations in the industry to make their boilers and energy systems run longer between shutdowns, and run more efficiently.

Chemex Solutions www.chemexsolutions.com

#### Above-ground storage tanks

ATEC Steel is a full-service industrial contractor specializing in above-ground storage tanks and construction, along with tank maintenance and repair. Additional services associated with aboveground storage tanks including foundations, piping, and painting are also provided. ATEC Steel is also an ASME pressure vessel supplier with the capabilities to provide shop fabricated tanks, skids, piping assemblies/spools, and specialty steel fabrication. **ATEC Steel Fabrication and Construction, LLC** www.atecsteel.com

#### **Biomass industry law & finance**

Stoel Rives attorneys are actively engaged in the continued growth of the biomass industry. They have the knowledge and experience in feedstock procurement, finance, taxation, corporate structuring, technology, construction, real estate, land use, water, environmental and regulatory law, and other energy regulations to help clients achieve their business objectives.

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WEIS ENVIRONMENTAL is a company specialized in manufacturing of Dry and Wet Electrostatic Precipitators designed for biomass power plants in the North American market. WEIS ENVIRONMENTAL represents Beth GmbH, a German company with more than 120 years of experience in pollution control technology. WEIS ENVIRONMENTAL offers tailor-made engineering solutions in designing, constructing, and implementing a wide range of dust removal systems. www.Weis-Environmental.com



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Vecoplan engineers and manufactures complete alternative fuel systems, including: pre-shredding, separation, screening, air classification, re-shredding, storage, unloading, sampling, and delivery of fuel to its' processing destination. Systems are used in the preparation of biomass boiler fuel, for co-firing with coal and other fuels, for size reduction prior to gasification, for size reduction prior to pelletizing, and in the conversion process for cellulosic ethanol and other biofuels. Vecoplan shredders provide consistently sized feedstock, the flexibility to change the size desired, high throughputs, heavyduty construction, and low cost and easily replaced wear parts. Vecoplan is experienced in wood, corn stover, switch grass, miscanthus, any ag fuel crop, and all organic matter used as alternative fuel.

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Freez-it-Cleen www.freezitcleen.com


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Aquatech's WATERTRAK is a collection of pre-engineered products derived from almost 30 years experience in the water treatment industry. WATER-TRAK delivers the most cost-effective and timely solution for all pure water treatment needs. Specifically for the biomass industry, WATERTRAK can containerize most of the unit processes like filtration, ultra-filtration, reverse osmosis, and electrodeionization. These units are fully assembled, which significantly reduces the system's lead time and site installation costs. Aquatech has developed WATERTRAK specifically with system integration in mind. Its' design incorporates the latest water treatment technologies, along with Aquatech's knowledge and experience, in such a way that the individual components can be quickly and easily integrated by the Controls Group. Some WATERTRAK products include the following: clarifier; pressure filters (media, activated carbon); ion exchangers (softeners, mixed bed); ultra-filtration; reverse osmosis; electrodeionization; and, seawater reverse osmosis desalination. Aquatech | www.aquatech.com



#### **Biomass analysis**

The TruSpec Elemental Determinator performs fast analysis of nitrogen, combined carbon/nitrogen, and simultaneous carbon/hydrogen/nitrogen configurations, with the ability to handle sample matrices such as woodchips, biomass, bio-oil, and char in a total analysis time less than four minutes. To meet the needs of the biomass industry, this versatile instrument is also available with sulfur and micro oxygen add-on modules, as well as both solid and liquid autosamplers. PC-controlled Windows-based operating software supports compliance to strict regulations mandated by the FDA (21 CFR Part 11). **LECO Corporation** 

www.leco.com



#### **Reducing dust** emissions

With rising energy prices, biomass combustion and biomass gasification plants have become more economically desirable. Combustion, by its nature, always results in a certain amount of undesirable pollutants in the flu gas. WEIS ENVIRONMENTAL LLC is a company specialized in manufacturing of dry and wet electrostatic precipitators, designed for biomass power plants. They represent Beth Filtration, which has more than 120 years of experience in pollution control (dedusting) technology offering tailor-made engineering solutions in designing, constructing, and implementing dust removal systems. The Weis/Beth ElectroStatic Precipitator (ESP) will comply with all pollution control regulations, while protecting the sensitive downstream components in a plant. Picking a knowledgeable ESP vendor with extensive experience in a wide range of industries will ensure a successful design for a facility.

WEIS ENVIRONMENTAL LLC www.weis-environmental.com



#### Engineering & product development

Applied Chemical Technology is an engineering company specializing in process and product development for the chemical, fertilizer, and biomass industries, as well as others. They are an international company working with clients to take their ideas and develop them into fullscale production plants. Projects range in size from a \$5,000 lab project to a multi-million dollar production facility. Many of their projects are one-of-a-kind, custom-designed plants or equipment. Services include lab and pilot plant operations, engineering, design and fabrication of complete process plants, as well as skid-mounted plants and equipment, combined with on-site project management during installation and start-up. **Applied Chemical Technology** www.appliedchemical.com



#### Walking floor systems

KEITH WALKING FLOOR systems are uniquely suited to handle the most difficult alternative fuels. Systems are mounted in semi-trailers or integrated into bulk material handling systems such as storage bins and receiving pits. Semi-trailers outfitted with WALKING FLOOR systems maximize volume and weight capacity, work under low headroom conditions, discharge partial loads, and are not prone to tipping on unstable ground or in windy conditions. Trailers can haul and discharge bulk loads one way and carry palletized materials on the return trip. WALKING FLOOR receiving, storage, and metering bins reliably handle whole and shredded tires, biomass, RDF, and other alternative fuels where other systems struggle. WALKING FLOOR systems handle these difficult bulk materials at competitive costs and require minimal power and maintenance compared to conventional belt, chain, and screw systems.

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#### Consulting, engineering & construction services

Roeslein & Associates, Inc. is a consulting, engineering, and construction services firm headquartered in Missouri. They offer alternative construction approaches through their wholly owned subsidiary, Integrated Manufacturing Technologies (IMT), where they fabricate, modularize, pre-assemble, and test complete systems prior to installation in their 250,000-square-foot facility located in Illinois. They are a global company having completed major projects in more than 50 countries on six continents in their 20-year existence. Roeslein's modular approach as a collaborative integrator of structural, mechanical, and electrical systems, with its relative equipment and vessels, is ideal when looking to increase productivity, improve safety, condense construction schedules, and control costs compared to conventional construction. They are experienced at shipping modules via truck, barge, and cargo ships domestically and globally.

Roeslein & Associates, Inc. www.roeslein.com



#### Biomass size reduction equipment

Bliss Industries, LLC is a manufacturer of wood and biomass size reduction equipment for residential, commercial, and industrial fuel. Founded in 1981, Bliss Industries maintains a reputation of manufacturing some of the most efficient, reliable, and well-built equipment in the industry. Bliss Hammermills were born and developed from listening to customers' suggestions. Overall reliability, maximum efficiency, and ease of operation and maintenance combine to provide lower operating costs to each owner. With the ability to provide a wide range of diameters, tip speeds, and drive power, Bliss can more than meet requirements for high quality at a reasonable cost. Bliss also manufactures an extensive line of pellet mills and coolers for biomass pelleting, processing, and cooling.

Bliss Industries, LLC www.bliss-industries.com



#### Biomass gasification & waste fuel technologies

The Babcock & Wilcox Company (B&W) is an international provider of energy products and services. As an operating group of B&W, Babcock & Wilcox Power Generation Group, Inc. has demonstrated experience with concentrating solar power, as well as biomass and waste fuel technologies for utilities and other industries. Technologies include fluidized bed and stoker boilers, as well as biomass gasification (through Denmark-based Babcock & Wilcox Vølund). Benefits include high reliability and reduced emissions when compared with other fossil fuels. Other capabilities include fossil and nuclear steam generating equipment, environmental systems, equipment upgrades, replacement parts, construction, condition assessment, field engineering, emissions monitoring, and advanced technology research and development. The Babcock & Wilcox Company

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www.martin-eng.com



#### **Thermal & chemical** conversion of biomass

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#### **B.N.W Industries**

www.beltomatic.com www.biogreen-energy.com



#### Belt & drum drvers for biomass

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Buettner | www.buettner-dryer.com



#### Contracting & construction services

Boldt has a proven record of leadership and success in building biomass, ethanol, biodiesel, hydroelectric, wind, solar, and other renewable energy facilities. Boldt provides general contracting and construction services including steel erection, concrete and civil, material handling, boiler, turbine, and major equipment installation to biomass customers nationwide. Boldt is among the nation's top-ranked construction firms and has 12 offices throughout the country. Boldt Construction | www.boldt.com

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# The Next Decade in Wave and Tidal Power

By George Gibberd; GL Garrad Hassan

**THE NEXT 10 YEARS** will be crucial for the development of the wave and tidal industry. With the right research and technology, this may be seen in the future as the decade of deployment—the period in which wave and tid-

al technologies moved into the mainstream alongside other more established renewables. In the meantime, however, there are significant obstacles to be overcome if the technologies being developed are to succeed.



The political pressure to deliver commercially viable wave and tidal energy solutions is such that it generates international news headlines on an almost daily basis. This is astonishing when one considers the



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ugies have survived prolonged testing and deployment. Although the development of these new technologies has parallels with the onshore wind sector of the 1980s, the political landscape is significantly different. Renewable energy is no longer considered the folly of idealistic hippies—in fact, quite the reverse is now true. It sits at the top of government agendas across the world and takes the form of targets, which politicians

are obliged to meet.

fact that less than a handful of technolo-

The success of onshore and offshore wind in delivering clean energy to grids throughout the world has resulted in significant pressure. This has ensured the scale of the first wave and tidal technologies going into the water is much larger than the early wind technologies, which were allowed to develop more slowly, out of the spotlight. While this large-scale approach might reap faster financial and political rewards once the right approach is found, it also makes the journey fraught with risks.

Although not well coordinated, there are many funding programmes and testing facilities available to aid the development of wave and tidal energy technologies. The question is: how do we take advantage of these while effectively managing the risks involved in moving new technologies from ideas, through to early stage demonstration projects, into large-scale deployment?

While the number of technologies in development is encouraging, the stakes are so high that much of the learning and expertise is veiled in secrecy. In the end, this wide and thin approach is unlikely to yield efficient results. Ultimately, some sort of convergence of technologies and rationalization within the industry will be required to move the focus beyond innovation and toward deployment. The involvement of large industrial players, who have significant financial and technical "muscle," should provide increased levels of confidence to the sector. It will always be easier for organizations like these to attract the interest of utilities and project developers as a result of their ability to provide warranties for their newly developed products.

Probably the most significant challenge for any device developer is the creation of a technology that is able to survive longterm in a hostile marine environment. Although a small number of devices have undergone open-sea testing, none have fully demonstrated the capability to survive in extreme operational conditions. Some very promising tidal turbine devices in the Bay of Fundy, Canada, at the EMEC site in Orkney, Scotland, and in Strangford Lough in Northern Ireland, have suffered failures during installation or testing. Such failures are to be expected during the development phase of new technologies operating in a unique and poorly understood environment, where much of the learning has to be done on the job. What investors in these new technologies must accept, and be prepared for, is a commitment for the long haul.

In the same way there are a range of device concepts, there are also many different approaches to their deployment and retrieval. The challenges faced should not be underestimated; particularly for tidal energy, where the operating windows and erratic nature of flows around slack water at some of the more promising sites present difficulties that have no parallels in other industries. It's important, however, that wave and tidal technology developers do learn from the experience gained in related industries (e.g. the oil and gas sector), while recognizing that increased cost sensitivity in renewables will always require a balance between extracting maximum benefit from such experience and developing more suitable, cheaper, and bespoke solutions.

One area that demands a special mention is that of seabed cabling for marine renewables as it delivers the biggest single risk as a result of the associated costs, and lack of research and understanding. Wave and tidal energy poses unique challenges such as rocky seabeds, cable laying and protection in near-shore wave zones, and the need for cheap reliable sub-sea connectors and transformer hubs. Though some of these problems are common to offshore wind, the wave and tidal sectors cannot rely on the offshore wind sector to find suitable solutions for all of its needs.

Once devices are successfully deployed, timely and cost-efficient O&M regimes will become crucial in maintaining reliability. Getting it wrong will lead to problems with device availability—a real bugbear for all renewable technologies operating in a hostile climate as it impacts on the supply of energy to the grid. Planning for scheduled and un-scheduled maintenance activities in a way that balances operational costs with lost production is a real challenge. The offshore wind sector is already facing this, and tools have been developed to support the design of cost-effective strategies. These tools should be adapted and utilized for wave and tidal projects as soon as possible.

Once wave and tidal devices start to deliver er energy reliably, the focus should then and only then—shift to cost reduction and performance enhancement. Ultimately, it's the return on investment that brings any new technology into the mainstream and cost reduction can only be achieved when the devices become mature enough to reap the benefits delivered by economies of scale and improved supply chain. Even when this has happened, as it has with onshore wind, the challenge to further improve designs and push down costs continues.

In conclusion, while the risks and challenges in the race for wave and tidal solutions are considerable, they are not insurmountable. Many have been overcome before, either within the wider renewables sector or in a different industry. This knowledge, combined with political support and a modern "yes, we can" approach to renewables, generally creates optimism despite the challenges. The next decade will definitely be challenging, but with sights firmly set on a move into the mainstream, it's also guaranteed to be an exciting journey. George Gibberd has recently joined GL Garrad Hassan, and has considerable firsthand experience from his involvement in the development and deployment of devices at Marine Current Turbines and Tidal Generation Limited.

GL Garrad Hassan, one of the world's largest dedicated renewable energy consultancy, offers

independent technical and engineering services to the onshore and offshore wind, wave, tidal, and solar sectors. Its wave and tidal team experts have worked on more than 60 projects across 18 countries including key R&D projects. They also have experience of projects going in to the water.

#### **GL Garrad Hassan**

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3-5	Fuel Cell Power Project Finance & Investment Summit Hilton Del Mar—San Diego, California; www.infocastinc.com/fuelcellpower11
9-11	Waste Expo 2011 Dallas Convention Center—Dallas, Texas www.wasteexpo.com/wasteexpo2011/public/enter.aspx
13-15	The Wind & Solar Expo 2011 Timonium Fairgrounds—Baltimore-Timonium www.thesolarandwindexpo.com
15-18	Hydrogen + Fuel Cells 2011 Vancouver Convention Centre—Vancouver, BC; www.hfc2011.com
16-18	NAWTEC Venue TBA—Lancaster, Pennsylvania; http://nawtec.swana.org
17-21	ASES National Solar Conference Raleigh Convention Center—Raleigh, North Carolina www.nationalsolarconference.org
22.25	WINDPOWER 2011 Anaheim Convention Center—Anaheim, California www.windpowerexpo.com
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8-11	SEL Modern Solutions Power Systems Conference Hilton Chicago—Chicago, Illinois; www.selinc.com/Events/Modern_Solutions
14-16	EnergyOcean International 2011 Holiday Inn By the Bay—Portland, Maine www.energyocean.com
15-16	West Coast Energy Management Congress Long Beach Convention Center—Long Beach, California www.energyevent.com
15-16	Intersolar Europe New Munich Trade Fair Centre—Munich, Germany www.intersolar.de
19-24	IEEE Photovoltaic Specialists Conference Washington State Convention Center—Seattle, Washington www.ieee-pvsc.org/PVSC37
21.22	11th International Biogas Networking Conference (Biogas USA East) Summit Executive Centre—Chicago, Illinois www2.greenpowerconferences.co.uk
29-30	5th Annual Concentrated Solar Power Summit Mirage Resort & Casino—Las Vegas, Nevada; www.csptoday.com/usa
JULY	
12-14	Intersolar North America Moscone Center—San Francisco, California; www.intersolar.us
19-22	HydroVision 2011 Sacramento Convention Center—Sacromento, California; www.hydroevent.com
20	<b>GEA Geothermal Energy Finance Forum</b> San Francisco, California; http://thinkgeoenergy.com/events
26-27	Biomass '11: Renewable Power, Fuels & Chemicals Conference Alerus Center—Grand Forks, North Dakota: www.undeerc.org/Biomass11
eret	MDED
36P16	AWFA Wind Dower Supply Chain Workshop
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1.44	<b>&amp; Networking Event</b> Toronto, Ontario; www.cangea.ca
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