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# EPTUAL MODEL RESERVOIRMODEL WELL HALLO HALE



contents

10

20

23

departments

Wind Power

Investing in

Guide

**Clean Energy** 

Solar Energy:

2011 Solar Buyers



#### 06 NACE News

- 08 Feed-in-Tariff Experimentation in the US
- 10 Jones Act Ramifications on the Future of US Offshore Wind Energy Development
- **12** Case Study: Offshore Wind Farm Uses Innovative Onshore Grid Connection to Reduce Maintenance Costs
- 14 Keeping Them Safe: Qualifying **Electrical Contractors**
- 16 On-Site Crane Logistics: A strategic approach from the contractor's perspective
- **18** Third-party Warranty for Wind: Guaranteeing financial strength & project performance

- 19 The Scales of Wind Energy: Scope matters more than size
- 20 Sustainable Industries Financial Forecast for 2011
- 22 Recovering From the Recovery Act: Life after stimulus in the renewable power sector
- 23 SOLAR BUYERS GUIDE 2011
- 62 New Opportunities for Energy Independence: Site assessment vital for geothermal production projects
- Producing Geothermal Power: 64 Generating more power from the same resource
- 66 First Mover Wastewater Utilities Convert Human Biogas into Natural Gas

Geothermal Energy

Hydro and Marine

Events calendar

BioPower

Energy

62

66

70

74



- 67 Growers Ready to Put Marginal Lands to Better Use
  - 68 The Power of Waste: Innovative dairy fuels green energy microturbines
  - A Breakthrough in Clean Energy 70 Technology: Taking advantage of a tremendous energy resource in the earth's atmosphere
  - 73 A Strong 2011 for Clean Technology

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Happy New Year! Seems 2010 went out with a bang. About a week before Christmas, the tax bill, which includes a one-year extension of the 1603 investment tax credit for developing renewable energy sources such as wind and solar power, was passed. With the cash grants extended, it's been estimated that not only tens of thousands of American jobs have been saved, but that new recipient companies will also help create another 100,000-plus new jobs in the coming year. It should be a good 2011.

"Lifeline" is a term I've read a few times over now in relation to Section 1603, defined by the

*World English Dictionary* as "a vital line of access." Some might say the extension of the cash grants was a make or break decision for many Americans in terms of their livelihood, and for much of the renewable energy industry itself.

According to AWEA, the American Wind Energy Association (www.awea.org), the grant program enabled the construction of 10,000 MW of new wind capacity in 2009, which is more than double the 4,000 MW that would have been installed without the program. Solar power has also grown, by 37% in 2009 and 100% over that in 2010. Moreover, it's been predicted that renewing the grant program, indefinitely, would create over 58,000 additional permanent jobs in the

solar industry and the installation of over 1,600 MW of solar electricity by 2016 (US Partnership for Renewable Energy Finance | www.uspref.org).

Although "indefinitely" might be the term many in the renewable energy industry were going for in regards to the grant program, 2011 is what's been granted for now. In just one year, we'll be full circle again, with a few more stats on the line and many of the same arguments for extending 1603.

Until then, I say, let's make the most of it. For all intents and purposes, the year ahead looks promising. According to a recent clean tech analysis, "The clean tech sector will continue to attract high levels of investment and foster innovation in new, unexpected areas in 2011" (www.kachan.com). Sounds intriguing! For more predictions, check out page 73 as well as the Financial Forecast piece on page 20. This issue, we also look at offshore wind power, third-party warranties, the potential to generate more geothermal energy, and don't miss our annual Solar Power Buyers Guide (starting on page 23).

For more information on the extension of the 1603 investment tax grant, go to www.treasury.gov/initiatives/recovery/Pages/1603.aspx.

Wishing you a strong "lifeline" and all the best in 2011~



news bites



**Guide for offshore wind turbine installations** Classification society ABS has announced the release of a "Guide for Building and Classing Offshore Wind Turbine Installations," the first Guide to address design considerations for the bottom founded support structure of an offshore wind turbine situated in tropical storm prone areas on the US Outer Continental Shelf (OCS), such as the Gulf of Mexico and East Coast.

Guides developed to date have been primarily based on experience from European coastal waters. However, ABS' Guide is the first to specifically consider the conditions these structures may encounter in tropical storm prone waters. The Guide takes into account the well-established International Electrotechnical Commission (IEC) 61400 series of standards for wind turbines, the American Petroleum Institute's "Recommended Practice for Planning, Designing and Constructing Fixed Offshore Platforms" (API RP 2A), ABS' offshore Rules and Guides and the unique environmental conditions on the US OCS.

"The direct application of design criteria in existing standards, such as IEC 61400-3, is not sufficient for the offshore wind turbines in US waters," explains ABS Managing Principal Engineer, Qing Yu and the Guide's principal author. "We incorporate additional requirements based on calibration studies that use regional and site-specific conditions of US waters," he adds. **ABS** | www.eagle.org

# US: A net exporter of solar

According to a new report from SEIA, the Solar Energy Industry Association (prepared by GTM Research), the United States is a net exporter of solar energy products, with total net exports of \$723 million in 2009. This runs contrary to some early data that lent credit to the demise of the US solar industry. The report show that the US trade in the solar industry was actually found to be more balanced than the overall economy, which had a trade deficit of \$374 billion in 2009.

"The US imports and exports product from every continent. But, in addition to being a major net exporter of solar energy products, the industry is creating significant wealth in the United States and jobs in all 50 states," said Rhone Resch, president and CEO of SEIA.

Here are the key findings from the SEIA report:

- The US is a significant net exporter of solar products, with total net exports of \$723 million in 2009.
- The largest solar energy product export is polysilicon, the feedstock for crystalline silicon PV, of which the US exported \$1.1 billion in 2009.
- Moreover, 74% of the total value created from US solar installations in 2009 came from the US (despite the majority of installed modules being assembled abroad).

Read the full report at www.seia.org.

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# Feed-in-Tariff Experimentation in the US

# Lessons & experiences from three sunny iurisdictions

By Allan Marks, C Thomas Paschall & Ralph Vogel

ebate surrounding Feed-in-Tariff (FIT) legislation has been raging since the latter half of 2010 and early into 2011. In Europe, solar markets have been forced to adjust to dramatic reductions in FIT prices and necessary capacity cutbacks following the solar generation boom of the past several years. In the US, FIT advocates point to the dramatic examples of Germany, Spain, Italy, Portugal, and other European territories as proof that FIT contracts are the only proven method for ensuring solar energy generation becomes a meaningful percentage of the power supply.

Critics of the European-style FIT programs argue that "intelligent pricesetting" of the FIT is an oxymoron. Without market forces at work, prices will inevitably be too high, resulting in capacity constraints, potential reductions in technological innovation, and unnecessarily higher prices for consumers—or too low—resulting in no impact on rates of new project development. Critics also claim the programs are not managed with proper oversight and responsiveness.

Political debates at the national level also center on whether subsidization of renewables should exist at all based on the idea that it's just another form of "pork." The good news is supporters of continued subsidization of renewables can be found on both ends of the political spectrum, whether based on environmental, economic, or national security concerns. The US also has the benefit of hindsight as state utility commissions considering FIT legislation can learn from "mistakes" made in other FIT program designs. This article provides a quick synopsis of legislation and experiences in three select territories: Gainesville, Florida, California, and Hawaii.

#### European-style FIT: The Gainesville, Florida experience

On February 5th, 2009, the City Council of Gainesville, Florida approved a city ordinance for its municipal utility, Gainesville Regional Utilities (GRU), to implement the first true solar FIT in the United States. The total scope of the FIT ordinance was 32 MW with four megawatts to be built each year. The Gainesville FIT was largely modeled after the German FIT by including a 20-year fixed price contract, a first-come, first-served allocation queue, and rate declination for each vintage year based on historic installation costs. Gainesville was interested in distributed generation with a particular emphasis on rooftop solar. To that end, the municipality restricted the size of ground-mounted systems, which could be built in each vintage year.

There have been many lessons to learn from Gainesville's program. In particular, the timing difficulties involved in commercial-scale solar development have not always coincided with GRUs expectations—a factor exacerbated by the fact the program went effective in the middle of the US credit market crisis when project financing and tax equity markets contracted. These growing pains have required patience and a willingness to work through issues by the utility and developers. By most views, the City of Gainesville has succeeded in creating a solar friendly environment for developers. The permitting department, the inspectors, GRU engineers, the solar team at GRU, and the City Council worked hard to streamline the permitting, interconnect, and PPA processes.

At the end of the day, the Gainesville FIT has been a boon to the North Florida solar industry. GRU has made sure there is allocation for residential installations, which have been almost exclusively built by local installers. On the commercial side, the financial institutions that finance solar require bankable EPCs with a track record of commercial-scale installations. Those bankable EPCs have subcontracted electrical, roofing, engineering, and construction firms in Gainesville and other parts of North Florida to perform the work under the EPC's supervision. Gainesville's FIT program has earned accolades from FIT rating groups based on its substantial megawatts per capita (4 times a similar program in Vermont and 5 times that of Hawaii).

#### Hawaii: The multi-tiered, "Let's Do It" approach

Hawaii's recently adopted FIT program for solar PV and other renewable energy generation systems took effect November 24th, 2010. The Hawaii model establishes four tiers of FIT classifications and tariff rates based on project size and renewable energy technology. It targets 80 MW of total new development capacity—60 MW on Oahu, 10 MW for Maui, and 10 MW for Hawaii Island. Pricing has so far only been established for Tier 1 and Tier 2 (capped at 500kW), but pricing for Tier 3 is expected shortly. Eligible projects in Tier 4 would be capped at 5 MW nameplate capacity.

Despite favorable pricing, the independent observer for Hawaii's program reports that, as of early January, 2011, only 2.6 MW of solar PV applications have been received. This result is lackluster in view of Hawaii's robust solar resource, and compared to other solar FIT programs in Gainesville and Sacramento that were fully subscribed almost as soon as they went effective. The Hawaii program was launched by the Hawaii PUC with a view that the commission would learn from the experience and adapt if mistakes were made. Consequently, the program provides for a review after two years (and every three years after the initial two-year review). Meaningful expansion of program participation likely depends on the FIT rate set for Tier 3 and Tier 4 projects.

# California: The "Next Generation" reverse auction mechanism

Until recently, California's FIT program was limited to small generation projects (less than 1.5 MW, scheduled to increase to 3 MW at a later date) with a total

FIT program capacity of 500 MW (scheduled to increase to 750 MW upon later approval). The pricing mechanism was a CPUC market-pricereferent (MPR) based on the long-term ownership, operating, and fixed-price fuel costs for a new "proxy" 500 MW natural gas-fired combined cycle gas turbine (CCGT), with a time-ofday adjustment. Initially, this pricing mechanism did not offer attractive rates of return to developers, but there are signs that as solar module costs have fallen and bids for PPAs have similarly dropped, the FIT may soon offer an attractive pricing alternative.

Following poor reception of California's program in 2009 to 2010, with very few solar installations participating, the California PUC recently launched a major new hybrid FIT program known as the "RAM" (Reverse Auction Mechanism). The RAM targets mid-size solar developers (projects greater than 1.5 MW, but no larger than 20 MW). RAM requires the three investor-owned utilities (SCE, PG&E, and SDG&E) to purchase electricity from solar or other renewable sources following a biannual bidding process among developers participating in competitive auctions. Contracts are to be awarded initially based on lowest viable cost. The program is a one-gigawatt pilot project viewed as innovative by most analysts.

Concerns were raised that the reverse auction process could result in bidders under-pricing their bids to bargain for an "option" should equipment prices fall enough to make such projects financeable. The CPUC responded to these concerns by implementing strict viability standards, significant nonrefundable deposits by developers, and proof of key project milestones to weed out the most speculative developers.

The auction mechanism addresses criticisms of the European-style FIT programs because it enables the market to determine efficient prices. Although the auction process creates transactional uncertainty and may result in stranded bids, it's generally seen as efficient and potentially groundbreaking. The utilities are expected to announce auction procedures and guidelines in the first quarter of 2011, making this one of the more intriguing programs to follow this year. It remains to be seen if the auction-based pricing will provide the desired stimulus to renewable project development sought by incoming Governor Brown.

In conclusion, FIT programs are gaining momentum in the US and the GRU, California, and Hawaii experiences demonstrate that different jurisdictions have unique approaches with divergent results. Developers and financiers should weigh the legal and economic characteristics of each program carefully to determine their optimal path to achieving attractive returns for viable projects. Allan Marks is a partner and C Thomas Paschall is a senior associate, both for Global Project Finance at Milbank, Tweed, Hadley & McCloy LLP. Ralph Vogel is the principal of Green Energy Development, LLC.

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# Jones Act Ramifications on the Future of US Offshore Wind Energy Development

By Douglas Burnett & Michael Hartman

The Merchant Marine Act of 1920, more popularly known as the Jones Act, has far-reaching ramifications for offshore wind energy development in the United States. There has been dramatic recent debate in Congress about the future of the Jones Act, and whether it should be more restrictive to protect US cabotage interests, or relaxed and possibly abolished as a protectionist barrier that has ended up impeding international offshore energy development.

Last summer, the House of Representatives passed a bill (H.R. 3534: Consolidated Land, Energy, and Aquatic Resources Act of 2009) addressing the Gulf of Mexico oil spill. The bill contained a provision aimed directly at the Jones Act, which would make it strictly applicable to US offshore energy projects. To date, the Senate has not yet taken up the bill and, to the contrary, several key US senators including Senator McCain have proposed a repeal of the Jones Act. Clearly, a maelstrom is swirling around the Jones Act and offshore wind energy development in America.

The Jones Act covers "transportation of merchandise by water" that occurs "between points in the United States to which the coastwise laws apply," and requires all goods transported by water between US ports be carried in US-flagships, constructed in the United States, owned by US citizens, as well as crewed by US citizens and US permanent residents. The United States Customs and Border Protection (CBP), which administers the Jones Act, has promulgated regulations providing: "No vessel shall transport, either directly or by way of a foreign port, any passenger or merchandise between points in the United States embraced within the coastwise laws, including points within a harbor[.]\*"

CBP has consistently ruled that a point in the United States territorial waters is a point in the United States embraced within the coastwise laws, and recently stated the Jones Act applies to US waters "defined as the belt, three nautical miles wide, seaward of the territorial sea baseline, and to points located in internal waters, landward of the territorial sea baseline." CBP has also been careful to limit the Jones Act to governing law provision of the Outer Continental Shelf Lands Act ("OC-SLA"), a federal law regulating mineral exploration and leasing of the US Outer Continental Shelf, primarily giving effect to the terms "installations and other devices," "attachment," and "exploration, development, or production" included in purpose provision in section 4(a). Recent CBP decisions demonstrate that the CBP interprets OCSLA to apply federal law to artificial islands and attachments that have specific mineral, oil, or gas purposes (exploring, developing, and producing).

An offshore wind farm is not involved in any of these specific purposes, and would likely be exempt. Under the language of the Jones Act, the act of installing a wind tower is unlikely to involve "coastwise trade" or "transportation of merchandise" between points. In particular, one recent CBP ruling speaks directly to this point, and concludes in the context of a wind farm,

CBP has long held that neither drilling nor pile driving, in and of itself, conducted by a stationary vessel, constitutes coastwise trade or coastwise transportation. (See HQ 109817, dated November 14th, 1988 and HQ 111412, dated November 28th, 1990, respectively.) The proposed activity with respect to the driving of a monopile foundation into the seabed is very similar to pile driving and is governed by the same principle. Therefore, the activity of the stationary construction vessel described above, involving driving of a monopile foundation into the seabed and then adding a platform deck, anemometer tower, and other components does not



constitute coastwise trade or coastwise transportation. In summary, the engagement in the proposed activity will not result in a violation of 46 U.S.C. § 55102.

By extension of this ruling, a vessel used in monopole installation, and even the installation of the turbines themselves, would likely not constitute coastwise trade under the Jones Act. Foreign-flagged vessels and crews could likely be used for these activities (albeit the components installed would probably have to be transported by a US flag coastwise qualified vessel unless all such transportation can be arranged from a foreign port directly to the installation site with no US entry). With regard to foreign-flag jack-up vessels using foreign crews, this ruling also confirms that foreign flag jack-up vessels with foreign crews could be used for wind farm drilling, pile driving, and installation activities-as long as that vessel is stable and stationary, and does not transport persons to or from US ports. Ideally, the jack-up rig would arrive functional from a foreign country with a foreign crew without requiring any US modification ashore. A foreign flagged vessel with foreign crew vessel entering US port and disembarking for modification would directly violate the ruling, so the foreign vessel should proceed directly to the project site to begin drilling, driving piles, and installing the wind tower. This ruling follows past offshore oil and gas CBP rulings that permit foreign vessels, that are non-coastwise qualified, to be used as a moored construction facility.

In summary, the Jones Act does not apply to the transportation of merchandise from foreign ports to US ports, so wind tower components could initially be delivered to a US port by a foreign vessel. On the other hand, the Jones Act does apply to transportation of merchandise from a US port (a point) to another point, that point being a jack-up rig operating as a stationary, stable construction platform. So, a US flagged tug would have to be used to transport the components by barge to the jack-up rig. As discussed above, offshore drilling, pile driving, and component installation are not considered coastwise trade or coastwise transportation under the Jones Act, so it does not apply in this phase. A foreign flag construction vessel or jack-up rig that is stable and stationary would likely be used for the operation, repair, and maintenance functions performed on the wind towers. The Jones Act would apply since the these activities would involve a vessel leaving from a US port (a point) and traveling to another point (the completed wind tower) with merchandise (say, repair components), and then returning to a US port (another point). Under the Jones Act, any vessel moving merchandise or passengers between a stationary platform and another coastwise point must be US flagged documented for the coastwise trade.

On November 23rd, 2010, United States Interior Secretary Ken Salazar announced that the federal government would expedite permitting for qualifying projects on the East Coast, with first leases being issued in late 2011 or early 2012. The Jones Act is certain to have major ramifications on the future of offshore wind energy development in the US, however, the exact nature of those implications remains far from determined until the dust settles around the energetic debate in government surrounding proposed changes to this law.

\* CBP rulings and decisions can be found at http://rulings.cbp.gov/index.asp. All other article references available upon request.

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#### Larger, "greener" machine tools

MAG IAS, LLC is in production of a new family of vertical turning centers (VTCs), with table sizes from five to eight meters and facing capacity up to nine meters in diameter. These dual-column machines can handle workpiece loads up to 250,000kg, and feature fixed or adjustable rail styles. The company also recently introduced a new-concept machining system for high-volume production of wind turbine hubs.

The ground-up, modular designs allow for economical customization of these machines, along with the industry's fastest build and delivery times. This allows manufacturers of extremely large work pieces to have a machine configured to match their exact needs using families of preengineered and optimized components such as columns, tables, heads, tool changers, controls, etc. In addition, MAG's new machines are incorporating unprecedented levels of flexibility with new multifunctional features and green design elements focused on the lowest total cost of ownership-including minimal hydraulics and oil systems, reduced need for chillers and ancillary equipment, as well as energy monitoring and conservation capabilities.

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# Case Study: Offshore Wind Farm Uses Innovative Onshore Grid Connection to Reduce Maintenance Costs

By Rashid Abdul

Image 1: Belwind Offshore Wind Farm

"The current industry standard of high-voltage direct connections requires a lot of moving parts on the offshore substation, and that means a lot of maintenance and high costs," said Mark Scher, president of CG Power Solution. "What CG has done is devise a way to install those moving parts onshore, where maintenance is much easier and cheaper. This dramatically improves the reliability and cost-effectiveness of the offshore farm."

The conventional method of direct connection requires a high-voltage circuit breaker and step-up transformer equipped with an on-load tap changer to regulate voltage—in short, the installation of a complete high-voltage substation at sea (see Image 2). Reactive power compensation is performed onshore, through the use of onshore reactors, capacitor banks, and static VAR compensators.

"The Belwind project takes a different connection approach, while still meeting the grid code requirements of the transmission system operator," Scher said (see Diagram 1).

#### Meeting grid requirements, reducing maintenance costs

Because of its size, Belwind must meet the same strict connection requirements as a conventional plant to maintain stability of the grid. The Belwind connection should be able to absorb or deliver a minimum reactive power between -0.1 Pnom and 0.45 Pnom. When all turbines are out of service, the wind farm is treated as a consumer and the reactive power should be between -0.0326 and +0.0326 of the total maximum wind farm output. These reactive power requirements must be met for grid voltages between 90% and 105% of the 155kV operating voltage.

The connection method developed eliminates the static VAR compensator onshore, as well as the offshore high-voltage switchgear and circuit breaker. The required reactive power compensation is met by using the reactive power of the export cable, the regulating capabilities of the wind turbines, and the installation of offshore reactors, which can be smaller and lighter because they are rated for a medium-voltage design.

Moreover, in the Belwind model, an onshore booster transformer is added to regulate the 33kV voltage of the offshore grid. This transformer allows for a large reduction of short-circuit current on the export cable, and opens the way for use of less expensive cables and switchgear with a lower rating.

The onshore transformer is equipped with a soft-closing device. This feature, with the use of an onshore, high-voltage circuit breaker, makes it possible to switch in the export cable and offshore step-up transformer at the same time without causing excessive transients. This eliminates the need for offshore high-voltage switchgear, resulting in an easier platform design and less offshore maintenance. With the voltage being regulated onshore, the export cable maintains constant voltage and reactive power is constant. This allows for the offshore step-up transformer to be equipped with a fixed turn ratio and no moving parts, again leading to lower maintenance costs.

When critical, high-maintenance elements are moved onshore, maintenance is easier, cheaper, and faster. High seas and bad weather do not interfere with maintenance schedules. The entire performance and reliability of the offshore wind farm increases.

#### Insight for other offshore wind farms

North America, take note: offshore wind farms can produce green electricity at the output levels of conventional carbon-producing power plants, although the economics have not always worked in favor of offshore wind farms. Now, thanks to technology and a new connection method, that conventional thinking has been turned around, and soon the rotors of more offshore turbines may be turning in the wind.

Rashid Abdul is the VP of Renewable Energy & Industrial Services at CG Power Solutions.

CG Power Solutions | www.cgpowersolutions.com



Image 2: Belwind Offshore High Voltage Substation (OHVS)



Diagram 1: Belwind wind farm control system for reactive power & voltage control

Solutions must be found to meet the rising energy demands of our society, while protecting the environment and controlling carbon emissions. The Belwind project, one of Europe's largest and deepest offshore projects, offers a shining example of a solution being implemented.

#### The massive Belwind project

The Belwind wind farm is located 46 kilometers off the coast of Zeebrugge, Belgium. Belwind is the most distant, offshore wind farm on record—its turbines beyond sight from the port (see Image 1). The project is being constructed by a consortium that includes Lemants, the steel fabrication firm; Fabricom, which is handling installation and maintenance services; and CG Power Solutions (CG), which is solely responsible for the design, procurement, and construction of the high-voltage substation and its connection to the electricity grid.

The project's first phase, completed in record time during 2010, less than a year from the date of contract signing, consists of 55 three-MW turbines with total output of 165 MW. A second phase will add another 165 MW. Once fully operational, Belwind will power the equivalent of 350,000 households with 330 MW of green electricity, and eliminate 540,000 tons of  $CO_2$  emissions per year.

#### Defying conventional methods

Belwind's turbines are connected at 33kV level to the offshore high-voltage substation by means of 33kV array cables. A transformer steps up the voltage to 150kV. The method for connecting the offshore wind farm to the onshore electricity grid is the most remarkable innovation of the Belwind project. Its design eliminates the greatest downside for offshore wind farms: the expense of maintaining offshore substation parts.

12 | JANUARY/FEBRUARY 2011 nacleanenergy.com

new wind farm offers proof that thought-<br/>provoking designs can be accomplished. The<br/>wind farm is a model of cost-saving innova-<br/>tion, and is one of the integral first steps in<br/>helping to fuel the success of future offshore<br/>projects in the US.The<br/>and<br/>shore<br/>tive<br/>shore energy production. The giant rotors of

ff the coast of Belgium, in the turbu-

lent, cold waters of the North Sea, a

shore energy production. The giant rotors of wind farms turn along the coasts of Germany, Norway, Denmark, and now Belgium, as Europe is racing ahead in the offshore wind market. These offshore wind farms, which tend to be much bigger than onshore versions, provide green energy to the electrical grid, eliminate land-use issues in densely populated areas, and take advantage of higher and more sustained winds at sea.

Undoubtedly, offshore wind farms are a benefit to energy usage; however, they do present a number of challenges. Typically, the upfront investment is higher than onshore farms. The turbines are harder to set up and maintain at sea. And access, even for routine maintenance, can be hazardous or impossible in harsh weather and rough seas.



#### Submerged arc welder

Lincoln Electric's Power Wave AC/DC 1000 SD submerged arc welder 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 set-up. It is rated at 1000 amps at 100% duty cycle, housed in a protective, stainless steel case and features a severe-duty IP23 rating. This unit can be used with MAXsa drives and controllers. **Lincoln Electric** | www.lincolnelectric.com



# Transmission line installation

The Vermeer CL80 cable layer attachment is designed to sort, configure, and feed a series of three cables one ground wire, one conduit with fiber optic cable, and one tracer tape in a specified configuration into the trench—all in one pass. A series of rollers guide the cables over the machine, then feed them into a cable box where they are sorted in the appropriate configuration. On descent into the trench, the cables then begin to align in triangular formation, becoming more tightly knit on approach. The ground wire, conduit, and tracer tape are placed on top of the triangular formation as specified. The CL80 attachment eliminates the need for one machine to dig the trench, and then another to come back and lay and secure the cable. A contractor can complete the cable trenching and installation process with just one machine, saving time. The CL80 attaches to the Vermeer COMMANDER line of track tractors equipped with either a trencher boom or bucket-wheel attachment. Vermeer | www.vermeer.com



#### Light mast extendable boom for light towers

Larson Electronics' previewed the release of the LM-25, a 25-foot tall steel two-piece light mast. Equipped with a fold-down winch and a winch to elevate the mast from 15 feet to 25 feet, each mast can be used to mount several high-powered metal halide or LED lights. Typically used in a trailer configuration and powered by a solar-powered generator or standard diesel generator, the Magnalight light mast boom is ideal for large-scale portable lighting configurations at job sites. Offering telescoping and fold-down capabilities, the Magnalight LM-25 painted steel light mast weighs just under 300 pounds. Equipped with a 12-inch square, half-inch thick steel surface mounting plate, the four corner holes enable operators and OEMs to mount the light mast to any surface securely. Larson Electronics | www.magnalight.com





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n average, 4,000 non-disabling and 3,500 disabling electrical contact injuries occur every year in the United States. Unfortunately, 400 fatalities are caused by electricity annually. Over 2,000 workers are sent to burn centers each year for electrically related burn injuries. Based on these facts, it's very important as an owner or host to ensure those working on electrical equipment are qualified and kept safe. An owner/host assumes full responsibility of safety for their employees, as well as anybody else who steps foot onto their wind farm. OSHA can issue citations to the highest authority—the primary supervisor of a wind farm—whether or not he or she has an employee involved in the incident.

As the owner/host, one has to qualify the electrical contractors on a job to prevent injury or death at the worksite. It is good practice to be proactive in qualifying contractors before they arrive on-site. A starting point is to obtain safety records, training records, and safety procedures from the contractors that will be working.

The following are documents that should always be required before a contractor arrives at a jobsite and begins work:

- Electrical Safety Program. Each employee's training documentation should be recorded and include safe work practices, LOTO, and testing procedures for denergized electrical equipment. If a contractor cannot provide this documentation, then it must be assumed they are not qualified.
- Injury and Illness Prevention Program. Compare the contractor's IIPP with the OSHA 300/300A documented procedures.
- Job Hazard Analysis (JHA). A contractor must provide a JHA to the owner/host before working on any electrical equipment. The owner/host will review the JHA and, only once approved, can the contractor begin work on the electrical equipment.

Each site will have different hazards and one cannot assume a contractor exhibits safe work practices just because they have 20 years of similar work-related experi-

# Keeping Them Safe: Qualifying Electrical Contractors

By Paul Idziak

ence. As each jobsite is different, the host should always perform specific on-site safety training with a contractor prior to starting the job. It is also important to communicate the site hazards that have been identified, and understand how the contractor expects to mitigate those hazards. Spend the extra time on due diligence to investigate safety records, ask colleagues their impressions of the contractor, determine what an acceptable TRIR is for the site, and ask questions. In other words: do your homework.

As an owner/host, one must be aware that anytime a contactor or even a subcontractor arrives on-site, OSHA's Mulit-Employer Worksite Policy CPL 02-00-124 is in effect. At that point, as owner, one has more responsibilities and risks to recognize and mitigate.

The OSHA Multi-Employer Worksite Policy categorizes four employer roles at a worksite:

- **1. Creating employer.** Any employer in a multi-employer worksite, who causes a hazardous condition, or has knowledge that a hazardous condition will be exposed to on-site workers.
- **2. Exposing employer.** Any employer in a multi-employer workplace may be cited if he or she exposes employees to known hazards.
- **3. Controlling employer.** Any employer who has sufficient control over a multiemployer workplace may be cited for failing to correct known hazards; whereby, employees have a reasonable likelihood of being in contact with such hazards.
- **4. Correcting employer.** An employer is responsible for correcting any violations or hazardous conditions. The correcting employer must exercise sensible care in preventing and discovering hazardous conditions.

Another useful tool in helping qualify electrical contractors is the NFPA 70E. The NFPA 70E will cover the safety related work practices, safety related maintenance





requirements, and safety requirements for special equipment. The owner of a wind farm should perform an arc flash study and provide hazard labels for each piece of electrical equipment complying with the NFPA 70E. Before the contractor's arrival, an owner should communicate the findings and potential hazards to the contractor. This open communication will allow the parties to decide if the contractor is qualified to perform the work, and decide on the appropriate PPE for the job.

In summary, the safety of the electrical contractor and their subcontractors falls directly on the owner/host of a wind farm. An internal contractor qualification process is recommended to help ensure any contractor at a jobsite is qualified and skilled to perform the required task(s). It is the responsibility of the owner/host to know their rights and what OSHA policies are to be followed. Upfront communication with a contractor will create a proactive attitude and help mitigate the risk associated with performing electrical work.

**Shermco, Industries, Inc.** www.shermco.com



#### Wind turbine monitoring

Wind energy is one of the fastest growing industries to date. Fixturlaser has gone one step further in developing systems that have become an essential tool in the maintenance of wind turbines. With its new Windmonitor system, Fixturlaser enables manufacturers, owners, and service companies to directly monitor the movement of wind turbines during start-up and operation. This new technology takes the alignment process one step further, giving data, which to this date was impossible to acquire due to safety regulations. The system allows online monitoring of the movement of the equipment for alignment purposes. The system simply needs to be put in place and started up. No sophisticated wiring or lengthy installation required, and the system can be moved from one installation to another.

Services Techniques Claude Drouin | www.stcd.ca

IBC "Top States for Doing Business," July, 2009



#### Tracking wind resource & project performance

AWS Truepower, LLC recently announced a major release of its wind-Navigator application. windNavigator 3.0 moves beyond wind project siting and resource assessment with the addition of two new modules designed to support wind monitoring campaigns and plant operations. Campaign Management, a free value-add service available to all of AWS Truepower's wind resource assessment clients, puts tower data at analysts' fingertips. Through the secure windNavigator platform, service subscribers can download raw and quality controlled meteorological data, view meteorological mast statistics, site commissioning information, and receive monthly summary reports for their towers.

For wind projects already in operation, Asset Management provides owners, operators, investors, and asset managers with information enabling them to better understand and track wind plant performance. Asset Management subscribers can easily build out their project portfolio by using AWS Truepower's comprehensive US wind plant database. For each project in the portfolio, the subscriber receives a monthly report of the estimated wind speed and production deviation (or anomaly) from long-term expectations. In addition, the subscriber receives a long-term hourly wind resource dataset commonly known in the industry as a virtual met mast or VMM. The Asset Management version of this dataset, VMM+E, includes the estimated plant energy output for every hour.

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# **On-Site Crane Logistics** A strategic approach from the contractor's perspective

By Steven Klatt

The Dokie Wind Project in Chetwynd, British Columbia, required the switchbacks pictured here to successfully move the crane along the ridgelines. (Photo credit: Brent Bergland)

ransporting cranes to and from project sites is an often-discussed hurdle for wind farm construction. However, well-orchestrated crane movement on project sites is equally crucial to keeping wind project construction on schedule. Experienced contractors and owners/developers always plan ahead for on-site crane moves, and see this as a significant factor for project success. From the contractor's perspective, ensuring immediate access to required resources and efficient timing are primary considerations for on-site crane moves. The most successful contractors have an in-depth understanding of how best to effectively move cranes between turbine strings on a project site, and how to avoid common pitfalls.

#### Necessary resources for crane movement

During peak seasons crane availability can be a challenge. Since most contractors do not own their own cranes, it is essential to contact crane

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A Manitowoc 16000WA lifts a rotor in Spearville, Kansas. (Photo credit: Kenny Oxford)

rental companies at least two to four months in advance to secure a crane and ensure its on-time arrival. The crane arrives at a project site in multiple truckloads. For instance, the Manitowoc 16000WA, 750-ton crawler crane, requires approximately eighteen truckloads for all is components. This delivery takes a great deal of coordination for proper delivery and assembly. If this part of the process is not orchestrated well, the results will affect the budget and project schedule. Other necessary resources include additional trucks, support crane, crane mats, forklifts, and rigging equipment. The contractor should time delivery of the crane and support equipment based on the timing of the turbine deliveries, so that wait time is minimized between the start of wind turbine erection and having the crane fully assembled.

In addition to equipment, moving a crane in a safe manner requires careful coordination between on-site staff. A knowledgeable erection superintendent and general foreman must be available to supervise the move and ensure worker safety. In addition, third-party resources are also often required to haul freight and to serve as the crane assembly crew. For best results, one crew disassembles and loads the crane out of the turbine site, and the second crew receives, offloads, and assembles the crane at the new site.

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Patrick Henry, vice president of Laramie Enterprises, one of the largest crane fleet rental companies in North America, adds, "It is imperative that the assembly/disassembly crew coordinate with turbine erection crew. Turbine deliveries cannot be scheduled to sites where the crane is to be assembled, thus interrupting the assembly process. If we keep these things in mind when planning moves, it makes the moves go much smoother."

The bottom line is the route and all required personnel, equipment, and transportation elements must be carefully planned before the crane arrives.

#### Logistical factors for walking cranes

There are many factors to take into careful consideration when moving a crane on a project site. Some of the most significant considerations include the distance between the turbine strings, weather, ground conditions, steep grades, presence of transmission line and drainage tile, and location of bridges and rivers and streams.

#### • Covering large distances

A typical crane used on a wind project (like the Manitowoc 16000WA) is 317 feet tall and weighs 750 tons. The first rule is to walk a crane this size the fewest number of miles necessary. Some of the most challenging projects require cranes to walk great distances. Multiple cranes may be ordered and placed at opposite ends of the project site to minimize extensive walking distances.

#### • Weather

Cranes cannot operate safely in high winds. Given that wind project sites are selected for their wind patterns, it is important to plan for bad weather during wind farm construction.

#### • Managing steep grades

Cranes cannot negotiate steep grades, and may need to be dismantled and reassembled on-site. Grades that are greater than 10% require additional civil infrastructure such as leveling the grade with soil or the creation of switchbacks as pictured (see image) by the Dokie Wind Project located on a ridgeline in British Columbia.

### • Re-routing to avoid drain tiles & transmission line

Project pre-planning involves mapping the location of transmission lines and drainage tiles so crane and truck paths can avoid these crossings. Landowners do not want their drain tiles damaged during wind farm construction, and heavy cranes can easily crush the tiles.

#### Planning ahead for different turbine types

In addition to logistics and resources, there other details which are a significant part of the planning process. For example, cranes must be rigged for a specific turbine type. The kind of crane will largely be determined by the heaviest component the crane must lift—often the nacelle. Some projects install more than one type of turbine. As turbines get taller and larger, it is essential to make sure the correct crane is on-site and configured appropriately.

Cranes are the most expensive pieces of equipment on a wind farm, and the most challenging to move on-site. They require expert coordination between the owner, contractor, transportation company, and on-site staff members. A successful construction phase necessitates careful planning for how to move cranes most efficiently.

As Mortenson Construction's crane manager, Steven Klatt has more than five years of experience overseeing the use of cranes on wind power projects throughout North America, and has directed crane transportation and resource allocation on more than 50 wind projects on vastly different terrains.

Mortenson Construction www.mortenson.com



#### Automated tool control

Precise, efficient tool control can mean the difference between project success and failure. With the introduction of the automated Level 5 ATC tool control system from Snap-on Industrial, advanced digital imaging technology delivers another layer of security in applications that extend from standard jobs to highly controlled, mission-critical functions. In addition to day-to-day issues like inefficient maintenance practices or critical tool breakdown, Foreign Object Damage (FOD) and maintaining strict Foreign Material Exclusion (FME) procedures pose a whole new level of risk. The Snap-on Level 5 ATC system advances tool management by ensuring both tool access and security. As the tool storage unit is accessed to remove or return tools, ATC uses digital imaging technology to scan each tool in the drawer and determine its status. ATC's audio system announces tool issue and return. If tool status is questionable, the Snap-on Level 5 ATC can display the disputed tool transaction on the 7" LCD, or it can be identified in the audit image at the administrator's PC. User log data and time-date information is available for every transaction.

**Snap-on Industrial** www.snapon.com/industrial



# Third-party Warranty for Wind

Guaranteeing financial strength & project performance

ne of the single most important components to the viability, longevity, and ability to secure financing for a wind farm is the turbine's warranty. Until recently the only option to obtain a warranty was through the OEM, which came with certain restrictions such as time frames, service providers, replacement parts, and contract nuances that could limit coverage. In this economic climate, project owners and financial lending institutions are looking for a unique alternative to the status quo. The good news is third-party warranty/financial guarantee and performance guarantees are available.

There are differences between what a warranty covers and what the traditional equipment breakdown insurance product covers. Equipment breakdown coverage is designed and intended to cover equipment after a "fortuitous" loss. This means in order for the coverage to respond, the loss must have a "trigger" or sudden and accidental cause of loss. What few realize is this traditional coverage is not intended or priced to be a first line of defense. In fact, most equipment breakdown policies have certain exclusions addressing this issue, specifically stating that if coverage was provided by warranty, or should have been provided by warranty, then no coverage will be awarded through the equipment breakdown policy. Other exclusions, such as design flaws or manufacturing defects, are also found within these policies.

Over the past seven years, the wind industry has seen a multitude of variations related to what OEM's are offering for their warranty. The variations have ebbed and flowed depending on how hard or soft the market is at any given time. This uncertainty leaves project owners and financial lending institutions nervous about the long-term performance and viability of their wind farm investment. There are now some unique financial instruments available that act as a bridge, either wrapping around an existing OEM warranty, or extending the warranty coverage beyond what was the industry norm.

A warranty is supposed to, and intended to, be a first line of defense. It is designed to cover all issues, whether fortuitous or non-fortuitous. It includes parts, resulting damage, and related direct cost (crane, labor), serial loss, availability, liquidated damages, power curve, and noise warranty.

The third-party warranty/financial guarantee and performance guarantee now available can be secured in one of two ways: directly by the project owners themselves, or through a few very selective O&M service providers. When the warranty or extended warranty is secured directly by the project owner, there are certain





obligations the owner will be responsible for—such as the payment of warranty and absorbing a deductible associated with the warranty. If the warranty or extended warranty is secured through one of the selective O&M service providers, the warranty gets wrapped into the overall package of services offered by the O&M provider. This option offers the owners one contract and one payment for all of their O&M and warranty needs.

One of the advantages of a third-party warranty is the ability to get financing. Over the last several years, the equity market has tightened up, putting many projects in a state of perpetual purgatory. One of the main reasons for this stagnation is that lending institutions have had a lack of confidence in some of the equipment selected and how that equipment will be taken care of when a warranty claim arises. By implementing a third-party warranty, the project is essentially renting an investment-grade balance sheet and assuring the warranty provisions of the TSA, which, in turn, eliminates many of the concerns of lending to second tier, third tier, and overseas OEMs.

Other applications where a third-party warranty makes financial sense is on grey market turbines and parts-only warranties. Over the past couple of years, there have been a growing number of projects unable to reach completion for a number of reasons. Some of these projects had already secured their equipment and now hold turbines that cannot be used. The easy solution would be to sell the equipment to a party that can utilize the assets. The problem, however, is the warranty clock has been ticking. Typically, the warranty has time constraints: the lesser of 24 months after commissioning, or 30 months after shipping. These provisions make it difficult to re-sell turbines. A third-party warranty can continue the OEM's warranty for the remainder of the term, or act as the primary warranty if the term has already expired. The other scenario where a third-party warranty would supplement an OEM's warranty is if part(s) were only being offered. In this case, the third-party warranty would wrap around the OEM's parts warranty and supplement the coverages not included.

The third-party warranty and extended warranty acts just like a normal warranty, set-up to guarantee and safeguard a project's performance and assets. The programs are generally written on a five-year term with an option to extend to additional years. These programs are applicable to any location within North America, and anywhere else in the world upon request and approval.

The warranty and extended warranty covers:

- Parts;
- Resulting damage;
- Related direct costs (crane, labor, etc.);
- Serial loss;
- Availability;
- Liquidated damages;
- Powercurve; and,
- Noise warranty.

Wind projects have a long list of hurdles to overcome—from financing to the simple unknown of what might happen after year two or five of the project. The goal, therefore, is to install and commission a project while also safeguarding and guaranteeing the viability and longevity of the investment. Third-party warranty programs allow project owners to more fully safeguard their significant investment.

TJ Rolfing is the renewable energy account executive for Holmes Murphy & Associates.

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The Scales of Wind Energy Scope matters more than size

By Amy Berry

ACCIONA's Red Hills Wind Farm in Oklahoma.

pon looking at both scales of wind energy, large and small, the similarities and differences that exist within the industry are striking. Yet, regardless of size, it is clear the wind industry has the power to provide a great, clean energy solution. Unfortunately, unfounded concerns in regards to costs and community impact, combined with the lack of national clean energy policies, are keeping the wind industry in North America from reaching its true potential.

Perhaps where the large and small wind sectors differ most is in the cost of energy and in purchasing behavior. Small wind, used in distributed energy scenarios, is most often purchased by homeowners, businesses, and academic institutions. By the very nature of the turbine sizes (less than 100kW), the amount of energy small wind is able to provide is minimal, and often has a bigger impact on the heart of a neighborhood or community. Buyers are motivated by the energy independence their small wind systems give them, and how that may make them look and feel in their community.

Thanks, in large part to generous rebate programs and the 30% US federal tax credit, the cost of energy produced by small wind is getting closer to the retail price of energy provided by the grid. In a state like California, with tiered pricing and rates as high as 40 cents per kWh, a small wind system can have a major impact on energy bills.

In sharp contrast, large-scale wind power, though used by consumers, is purchased by power companies to add renewable energy to their portfolios. This purchase decision is almost always done for one reason—to fulfill a renewable energy mandate. Thanks, in large part to major fossil fuel subsidies, the cost of renewable energy is still higher than coal. But, with recent technological improvements, wind turbines are now able to generate more energy from the wind while, at the same time, the current economic environment has forced manufacturers to reduce costs to build and sell these machines. The result is wind energy is more affordable than ever and within cents of competing with coal.

It is important to keep in mind, however, that large-scale wind competes against wholesale pricing while small-scale distributed wind systems compete against much higher retail pricing. Although utilities will boast of "green energy" to their customer base, it is no surprise their purchasing behavior is solely driven by costs of energy absent of any clean energy policies.

The other major issue facing both sectors of the wind industry is community support or, as most in the industry recognize, the increased "Not-In-My-Back-Yard" (NIMBY) mentality that awaits wind energy developers. Small wind faces this issue as neighbors concerned about the potential impacts their neighbor's wind turbine will have on their quality of life and real estate values. For most, small wind is still a relatively new concept and the fears arise from out-dated concerns over noise and appearance. It has been shown that education and experience with the turbines can completely change sentiment. In neighborhoods where small wind turbines are installed in clusters, neighbors become comfortable with the technology and realize they, too, can benefit from generating their own clean energy.

In contrast to the very personal experience of small wind, large-scale wind farms offer benefits to an entire town or community. More often than not, wind farms are located in rural communities dependent on agricultural businesses that are feeling the effects of the current economic environment. The combination of tax payments, landowner lease payments, and jobs that come with the development of a wind farm provide economic stimulus to these communities. It is not uncommon to hear town supervisors refer to their wind farms as "wind falls" because of the enormous economic impact the turbines have on their communities. Unfortunately, unfounded fears of health concerns (none of which have been proven by numerous researchers to date) have allowed NIMBYs to gain a foothold in conversation. It is up to the industry to continue to support responsible development, and to continue to ensure the facts about wind energy and health are communicated to the public.

Although the economics and community impacts of small and large wind may differ, one point remains true across the renewable energy industry: policy drives the market. Small-scale wind is only present in markets with generous rebate programs. Offtake agreements are purchased by utilities that need to meet renewable portfolio mandates. Just look at the amount of wind energy activity in Ontario, Canada right now—a direct relation to the Feed-In-Tariff. The right policies work.

For renewable energy to have the impact required to bring about a clean energy future, it is imperative to have stable, consistent national energy policies. For the US, a national Renewable Portfolio Standard is needed. An RPS would inspire all utility companies to bring more clean energy online. In Canada, we need to show the citizens of Ontario that their FIT is going to bring economic stimulus to their province along with clean energy. More clean energy, whatever flavor of whichever size, means more jobs, a higher level of energy independence, and the added benefit of doing what's best for the environment.

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# Sustainable Industries Financial Forecast for 2011



By Michael Butler

Any headlines over the past few months paint a dismal picture of financing in the clean tech space—whether it's venture capital, private equity, public market investing, or M&A—causing many people inside and outside of the industry to question whether we're experiencing a bursting of the clean tech bubble. However, many investment banking advisors who work with renewable energy and clean tech companies are seeing significant momentum building from a more seasoned, knowledgeable, and energetic pool of investors and acquirers.

In the past few years, the renewable energy and clean tech markets have faced high hurdles including tremendous challenges in the global economic environment, as well as inconsistent and often conflicting national positions on environmental frameworks and policies. Private funding for development of new sustain-

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able technologies has been scarce, and obtaining the capital necessary to mature the commercial side of the market has been a challenge, regardless of the caliber of the technology behind it.

While investments and M&A in the sustainable area have struggled in the broader market, the rate of financing mechanisms, technological innovation, and policy changes that impact the sustainable industries space has been staggering over the past five years. Energy policy and sustainable technologies continue to draw significant debate from consumers, pundits, politicians, and investors around the world. With the state of the market improving, however, there are many new financing opportunities on the horizon for the sustainable industry.

In 2011, the energy landscape will be marked by significant investment activity from Fortune 100 companies, merger and acquisition activity, and the introduction of new technologies for transforming waste-to-energy and natural gas extraction and production. These markets will continue to draw a great deal of attention as oil prices continue to rise and the formation of a national energy policy is thrust back into the spotlight. This push toward new investments is also bolstered by recent concerns over traditional energy supplies, including those stemming from last year's British Petroleum spill in the Gulf of Mexico.

We predict that as sustainable technologies mature in 2011, there will be a flurry of strong M&A and investment activity stemming from the energy sector as more big oil companies turn their attention to new energy sources. The following trends will be significant factors in shaping the future of Sustainable Energy markets, both in terms of investments and innovation.

#### 1. Cap and Trade discarded by Congress in National Energy Policy

A national energy policy is a top priority that crosses party lines, given its importance to the future of the economy and the environment. We believe that Congress will implement a policy in the coming year that focuses primarily on gas, nuclear, and renewable energies; however, it will not include economic incentives for achieving a reduction in carbon emissions. There are too many loopholes, including free permits and offsetting, which prevent cap and trade from becoming a feasible option in the US.

#### 2. Rising oil prices lead to investments in natural gas

Oil markets are traditionally sensitive to a pick-up in economic activity. As the economy continues to improve slowly over the next 12 months, oil will likely hit \$100 per barrel. At the same time, oil companies will look to expand their operations by purchasing natural gas assets and companies that make technology for natural gas extraction. Although natural gas is not as clean as renewable sources, it will continue to be seen as a viable energy source readily available in the US.

#### 3. Waste-to-energy technology ready for prime time

Technologies capable of converting municipal solid waste to energy will be ready for commercialization in 2011, with companies like Plasco Energy Group and InEnTec leading the charge. The industry will also see projects similar to the Salinas project in California roll out over the coming year.

#### 4. Traditional energy companies pursue acquisitions in renewable energy

Traditional energy companies such as BP, Chevron, and Shell will enter the renewable energy sector through acquisition. M&A activities will be primarily focused on companies in the wind, solar, waste-to-energy, and energy efficiency markets.

Michael Butler is the chairman and CEO of Cascadia Capital, a Seattle-based boutique investment bank that serves domestic and global clients. Butler leads the firm's Sustainable Industries practice.

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### Recovering From the Recovery Act Life after stimulus in the renewable power sector



By Steven Wellner (left) & Richard Lehfeldt (right)

or those who viewed the 2009 American Reinvestment and Recovery Act (Recovery Act) as a latter-day Gold Rush, the era was short-lived, and the gold ended up to be mortgage-backed securities. After one year of ramp time and a second year of "ironing out the kinks," the nation emerged with a smattering of viable renewable power projects—but not the fully mature and self-sustaining renewable industry hoped for at the time of the Recovery Act's passage in early 2010. Instead, the rosy optimism of the 111th Congress ("What projects are 'shovel-ready'?") has been replaced by the dour negativism of the 112th Congress ("Spend no money;" "There's no scientific consensus on climate change;" etc.). And, the most popular parlor game in Washington these days is trying to craft a legislative proposal that passes the laugh test under what Bill Maher might call The New Rules.

In a time of new fiscal penury, the renewable sector has narrowed its definition of the art of the possible. As we go to press, the 111th Congress has, as one of its final acts, extended through the end of 2011 the Section 1603 Treasury grants—probably the crown jewel of the Recovery Act's benefits for the renewable sector—and provided what may be the last meaningful federal legislative incentive for renewable power for the foreseeable future. Meanwhile, the industry has begun to turn to other agencies in quest of non-cash support for new projects. As a result, 2011 should



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USA (818) 668-3100 Canada (647) 977-9200 www.greenpowercap.com info@greenpowercap.com be a transition year for the industry, as it attempts to move from the sugar high of the Recovery Act incentives to a more balanced, predictable diet that might be available from traditional development support sources.

If the Department of Energy and the Treasury Department, with their billions of dollars for renewable power, were the leading lights of renewable project development for the federal government under the Recovery Act, the Department of Interior (Interior) and the Federal Energy Regulatory Commission (FERC) appear to be taking the lead in 2011. Even if Interior has no cash for the struggling renewable industry, it has something else of great value: lots of land. In just the past few months, Interior has approved several solar energy projects totaling roughly 3,500 megawatts on federal lands in California and Nevada, and has announced plans to conduct broad environmental reviews for designated "Solar Energy Zones" in the western United States, which will expedite the environmental permitting for proposed projects in those zones and reduce the burden of project-byproject environmental reviews. Given the federal government owns approximately 650 million acres of land—nearly 30% of all land in the country opening up those lands could dramatically expand renewable deployment.

Interior is also taking major steps to develop and support the fledgling domestic offshore wind industry by streamlining its offshore permitting process, previously estimated to take seven to nine years. As part of this effort, Interior is adapting its onshore "Solar Energy Zone" concept to designated offshore areas in the Atlantic that are particularly promising for wind projects. With the federal government preparing to close the purse strings after one final spending spree, Interior is at least giving credence to the old adage that "time is money." Given the US currently has no offshore wind installations, reducing the time required for these environmental reviews should eliminate a major obstacle to the initial projects in federal waters. When coupled with recently announced efforts for the private development of an offshore backbone transmission system to facilitate these new projects, and the announcement by Deepwater Wind that it intends to install the first regional offshore wind farm, 2011 should be a banner year for the offshore wind industry.

Meanwhile, FERC and the Regional Transmission Organizations (RTOs) it oversees are seeking to expand transmission capacity for new renewable resources. In the past year, the RTOs that run the transmission system for much of the Midwest have submitted proposals to broadly allocate the costs of new backbone transmission facilities used to deliver renewable energy from often-remote areas where little existing transmission infrastructure is currently in place. This effort should dramatically reduce the costs of transmission infrastructure assigned to individual renewable projects and, therefore, improve the financial viability of pending and future projects.

States also continue to jockey for lead positions in the long-predicted green economy heralded by the growth of renewable power, and that competition can be expected to heat up as the year progresses. For example, states in the Mid-Atlantic and Northeast are betting on the eventual arrival of a sizable offshore wind industry by offering project developers and manufacturers of turbine components tax breaks and other incentives to locate in their states. If states also approve long-term power purchase agreements sufficient to finance project construction, states will wield enormous control over the siting and development of generating facilities to usher in a new era of renewable power and to overcome the economic doldrums of the past three years.

The renewable industry, which struggled to make its first major inroads into the nation's electricity portfolio over the past several years with significant federal support, now enters the next phase of its growth with a one-year federal lifeline, but limited prospects for new legislative support beyond that time. Of course, in a bittersweet consolation, the nation appears just as stymied in its ability to develop other new resources (nuclear, clean coal, and even natural gas) as it does to renewables. The renewable portfolio standards that are still law in some 29 states hold the greatest promise that domestic renewable power will continue its impressive pace. But with the benchmarks of the 111th Congress-cap and trade, carbon pricing, direct grants, etc.-out of fashion in Washington, the industry will have to look to new and different opportunities for incentives and support as the nation continues its slow path toward recovery.

Steven Wellner is an associate in Dickstein Shapiro LLP's Energy Practice, counseling developers, owners, and operators of large terrestrial and offshore energy infrastructure projects.

Richard Lehfeldt is a Partner with Dickstein Shapiro LLP's Energy Practice, and is a corporate attorney with extensive experience in the electricity industry.

Dickstein Shapiro LLP www.dicksteinshapiro.com

22 | JANUARY/FEBRUARY 2011 nacleanenergy.com



# **SOLAR BUYERS GUIDE**





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#### **ADHESIVES, SEALANTS & TAPES**



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With focus on edge sealants, attachment adhesives. primers, J-Box adhesives and pottants, frame adhesives, and rail bonding, ADCO Products' total systems approach to material, equipment, reliability, and installation brings all the pieces together. Innovative chemistries including polyisobutylene (PIB), acrylic, MS polymer and polyurethane, as well as others, have proven track records of performance. "Best in Class" moisture barrier with PIB makes it the solution for UL Certification. Equipment alliances ensure this systems approach provides a material/equipment-integrated solution, with equipment expertise. ADCO Products' history of reliability and expertise is built around a century of glass-to-glass bonding and sealing insulated glass, along with 20 years of in-field expertise with peel & stick commercial roofing installation areas that directly relate to solar PV module assembly and installation.

www.adcocorp.com



#### **Sika Corporation**

Sika Corporation has created technologically advanced solutions that are optimized to provide improved performance, quicker curing times, and increase process capabilities for solar system manufacturers and installers. Their full line of fast curing, high-strength bonding and sealing products allow for fewer stress peaks on the glass panel, simplifying frame designs, PV in-frame constructions, bonding back rail mounting systems, junction box potting and bonding, as well as installation. Sika's high-performance products enable simple automation of production and provide best-in-class load and weathering resistance. www.sikaindustry.com



#### Adhesive Applications

Harness the power of better adhesion with pressure-sensitive film and foam tapes designed specifically for use in the manufacture, assembly, and transport of PV products. Adhesive Applications has spent years formulating their solar adhesive product line to meet the specific requirements of the solar industry. They offer a wide range of standard and custom highperformance tapes including high/low temperature, low surface energy, and UV resistant adhesives. Their pressure-sensitive film and foam tapes are available on a variety of substrates for: mounting, gasketing, surface protection masking, splicing, laminate attachment, reverse cell fixation, insulation, and wire wrapping

www.adhesiveapps.com

#### **ANALYTICAL INSTRUMENTS**



#### Shimadzu Scientific Instruments

Shimadzu's comprehensive line of analytical instruments, including FTIR and UV-Vis-NIR spectrophotometers, provides testing solutions for photovoltaic manufacturing processes and R&D that contribute to higher conversion efficiencies, reliability, and yields from solar cells. This includes testing of first-, second-, and third-generation PV cells created from silicon and non-silicon material such as polycrystalline silicone and dyesensitized/organic thin-films

www.ssi.shimadzu.com

#### **ARCHITECTS | BUILDERS**



#### **Oldcastle Precast, Inc.**

Oldcastle's newest solar foundations are designed for use in the most demanding solar panel applicationswhere panels need to be secured in unstable, environmentally sensitive, or impenetrable ground conditions, such as landfill applications. The footings are designed for relocation and reuse. The ballast footings are independent, precast concrete footings for ground-mounted solar electrical systems. With the company's extensive engineering staff, the footings are custom-engineered for any specific location, wind speed, tile angle, support and racking configuration, solar module size, weight, local design code, and project requirements. www.oldcastleprecast.com



#### Solar-Trac by OmegaFlex

Solar-Trac is flexible 316L stainless steel tubing for residential and commercial solar hot water systems. Solar-Trac comes in 3/8" up to 2" insulated or un-insulated supply and return lines. Coupled with Solar-Flare self-flaring fittings, Solar-Trac offers installers the highest levels of quality and ease-of-installation for tomorrow's energy needs. Since 1975, OmegaFlex is the preeminent international producer of flexible metallic piping products. www.solar-trac.com



#### **Bibb Engineers, Architects, Constructors**

Bibb Engineers, Architects, Constructors is a multi-discipline, full-service consulting firm that provides innovative power design solutions. Services include detailed design, EPC, CM, studies, and Owner & Bank Engineering. Bibb has experience with solar (Thermal & PV), biomass, wind, and more. Depend on them to engineer innovative, dependable, cost-effective design and construction solutions. www.bibb-eac.com

#### **BALANCE of SYSTEMS**



#### American Electric Technologies, Inc.

American Electric Technologies, Inc., a global supplier of custom-designed power infrastructure solutions for the traditional and renewable energy industries, offers products and services that provide the balance of solar system such as: modular solar substations, which bundle custom-designed medium-voltage distribution switchgear along with supervisory control and HVAC; modular solar power conversion systems, which bundle combiners, inverters, circuit breakers, meters, and monitoring equipment into containers to secure assets and deter theft; site engineering design, procurement, construction, and project management services; site start-up and equipment commissioning services; preventative maintenance and downtime avoidance services; and, on-demand, 24/7 emergency electrical services. By bundling the balance of solar system equipment with design, construction, and maintenance services, AETI can help lower initial and life cycle cost per watt for end customers. www.aeti.com





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VP 1MW PowerVault

PVP260kW

PVP100kW

PVP50kW PVP35kW PVP30kW



#### Blue Sky Energy, Inc.

Blue Sky Energy, Inc. now offers remote access communication for its IPN Based Solar Boost MPPT Charge Controllers. The new Universal Communication Module (UCM) provides a full-featured communication bridge or gateway between Blue Sky Energy's Integrated Power Net (IPN) Based Charge Controllers and external systems. Their newest product works with all IPN based Solar Boost Charge Controllers to allow for remote access via Modbus RS485, Modbus I/P, and embedded Ethernet HTTP web site driver. Additional key benefits include periodic FTP data upload to a remote server, 128 days of data logging, and capability to access data and setup parameters worldwide.

www.blueskyenergyinc.com



#### **Fibox Enclosures**

Fibox's ARCA JIC enclosure family has been tested and certified by SGS FIMKO to comply with the European Community's Low Voltage Directive, and may bear the CE Mark. The CE Mark is recognized worldwide and CE Conformity is required for importation of electrical equipment into the European community. ARCA enclosures were evaluated against EN 60529 and EN 62262, achieving ingress ratings of IP66/IP67 and an impact rating of IK09. Additional test results are available. The Fibox ARCA enclosure sizes ranging from 6 x 6 x 4" D to 18 x 16 x 10" D.



Schunk Graphite Technology and associated members of the global Schunk Group manufacture a complete line of products used in the production of photovoltaic wafers. These include wafer carriers and boats for coating processes, a full line of furnace components for crystal growing, as well as purified products and those containing either pyrolytic carbon or silicon carbide coatings.

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#### **Solectria Renewables**

Solectria Renewables, LLC is a US-based PV inverter, string combiner, and web-based monitoring company for residential, commercial, and utility scale solar projects Their wide range of products includes 1.8kW to 500kW grid-tied inverters for 1kW to multi-MW PV systems. Backed by over 20 years experience with inverters, all of their commercial and utility scale PV inverters are manufactured in the USA, are ARRA and Ontario FIT Content Compliant, and listed to UL 1741/IEEE 1547. Solectria Renewables also offers string combiners and web-based monitoring systems. Their string combiners are capable of combining four to 30 strings with multiple fused positions. They also offer a variety of web-based monitoring system options through their SolrenView monitoring system. SolrenView provides customers with the opportunity to view their solar system performance. www.solren.com



#### Thompson Technology Industries, Inc. (TTi)

Thompson Technology Industries, Inc. (TTi) engineers and manufactures innovative mounting and racking systems for PV solar installations with the highest manufacturing standards and best-of-breed technologies. From the highperformance SunSeeker Single-Axis Tracker to the Flat Jack roof mount, TTi offers the latest tracking technology and the most dependable mounting systems. By offering fresh, innovative solutions, including Floatovoltaics, the world's first floating solar system, TTi is moving renewable energy forward.

www.thompsontec.com



#### Wieland Electric Inc.

Wieland's PST 40I1 DC solar connectors now include ETL certification for their panel mount (bulkhead) connectors and field assembled units. ETL certification assures users that Wieland PST 40l1 panel mount connectors have been tested by an independent testing laboratory and conform to applicable performance and safety standards. Rated to 40A DC, use panel mount connectors for enclosure applications including DC - DC converters, combiner boxes, and transition boxes. External installation of panel mount connectors allows an enclosure device to be tested offsite, and shipped ready to install in the field. The contact's wire size ranges from 2.5 mm<sup>2</sup> (14 AWG) to 10 mm<sup>2</sup> (8 AWG), allowing for higher gauge wire to mitigate voltage drops. Connector resistance, typically below 1 milli-ohm, minimizes power losses. NEC code requires a tool to disconnect the PV connection. Wieland PST 40i1 connectors provide a low-cost solution using a safety clip, which can be removed with a screwdriver. www.wielandinc.com



#### **Border States Electric**

Established in 1952, Border States has grown into one of the largest electrical distribution companies in the country. Their growth didn't rise from quality products alone, but also from the value-added services on which the company is based. Count on Border States not only for the latest solar products, but also for the industry knowledge that will help a business grow. Border States is an experienced supplier that is focused on success. **www.borderstateselectric.com** 



#### **Cooper Interconnect**

With a 50-year legacy of designing, developing, and manufacturing custom cable assemblies and connectors for challenging environments, Cooper Interconnect is connecting a world of technologies. Innovative engineering designs are applied to each product to ensure solar systems last decades in harsh environments. Interconnect's high-quality assemblies are built in controlled conditions with trained personnel using highprecision Swiss made equipment that provide reliable solar power performance.

www.cooperinterconnect.com



#### Lufft USA

The WS301 and WS501 are the latest additions to the Lufft line of innovative WS weather stations with intelligent microprocessors. The sensors are designed to reduce costs by integrating multiple climate parameters into one precise flexible sensor. The new sensors are named the WS501 and WS301 and will measure global irradiance in addition to wind, temperature, humidity and air pressure (WS501) or temperature, humidity and air pressure (WS501). The climate parameters are extremely accurate and calibrated to internationals standards of quality and accuracy IS017025/9001. Data is transmitted via digital stream or analog channels. Lufft is a manufacturer of high-quality German weather monitoring equipment operating for the last 125 years.

www.lufftusa.com



#### **National Semiconductor**

National Semiconductor's SM3320 SolarMagic smart panel analog-intensive power management chipset provides junction box and module manufacturers with the "smarts" to ensure the highest efficiency and return on investment for solar system owners. By coupling more energy production with a lower balance of systems cost, the SM3320 provides solar system owners a high-performance solution at the lowest cost per kilowatt-hour. SolarMagic can recoup up to 71% of power lost to mismatch—regardless of cell technology—giving installation owners more predictable power output and increased return on investment.

www.solarmagic.com



#### **P4Q Solar Tracking Controllers**

P40's Suntrack product line is a global vendor of solar tracking controllers. Over 500 MW of solar energy are created using Suntrack products. These include concentrated PV, PV, and CSP technologies.

www.suntrack.es

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#### 2011 solar buyers guide

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**Kipp & Zonen USA Inc.** 125 Wilbur Place



#### Princeton Power Systems Princeton Power Systems Energy Storage System com-

bines batteries with GTIB inverters and a communications system that allows it to interface with the electric grid and provide valuable services, as well as being programmable to run in a variety of grid support modes. Grid support services are critical to enabling further penetration of

SALES OFFICE

intermittent resources like solar, especially technologies like concentrating solar that can see wide swings in power output during short-term events like cloud coverage. Integrating with storage can be valuable to prove the cost-effectiveness of these generation technologies, the ESS provides a simple solution to demonstrating various types of storage. www.princetonpower.com



#### Sedona Energy Labs

With a new approach to dual-axis tracking, Sedona Energy Labs released the InteliTrack, its new line of dual-axis solar tracking frames that enable maximum possible power production. The line includes the IT1500, designed for lightweight applications (rooftops, parking shade structures) and IT2000 designed for commercial/industrial installations. Based on patent-pending Balanced Frame technology, these systems are low-to-ground, require no or minimal foundations, and have very low wind loading. The InteliTrack enables solar arrays to generate a 40% or greater increase in power produced, compared to fixed solar frames. This shortens project payback by about half and raises typical project ROI from single digits to the mid-teens. Pricing is in the \$1.00/produced watt range depending on the project.



#### Wiley Electronics LLC

The WEEB line of products is designed to bond solar PV modules to mounting structures, creating an electrical path to ground. WEEBs eliminate the need for older, more costly grounding methods and greatly reduce the amount of labor and materials used in installations. The innovative WEEB design removes the need to run ground wire to each individual module and eliminates the need for surface preparation on anodized aluminum components. To install, WEEBs are placed between PV modules and mounting rails at clamping points or at bolted connections. When anti-seize is applied and the hardware is tightened down to the appropriate torque spec, the WEEBs' specialized teeth embed into the anodized aluminum, galvanized steel, or any electrically conductive metal to establish a gas tight electrical connection.

#### **BATTERY | ENERGY STORAGE**



#### **Rolls Battery Engineering**

Surrette Battery Company Ltd., exclusive manufacturer of Surrette and Rolls Battery products, is a North American lead-acid battery manufacturer. Established in 1935, with a production facility in Massachusetts, Surrette Battery Company relocated to Canada in 1959, and is the nation's only remaining independent battery manufacturer. At their ISO 9001 registered production facilities in Nova Scotia, they manufacture a range of batteries for railroad, marine, motive power, and renewable energy applications. With complete distribution throughout North America, and with customers around the world, their batteries are considered to be the best and toughest in the markets they serve. Success has been the result of a dedicated workforce, continual process advances, a company wide commitment to satisfying customer needs, and a full range of batteries for every application. www.rollsbattery.com



#### Saft America, Inc., Standby Division Saft makes PV power predictable in the delivery of

effective battery systems that make the inherently variable output from PV plants reliable and predictable. Their wide range of specialized PV batteries, including nickel-based and state-of-the-art lithium-ion (Li-ion) technologies, can provide the ideal solution for virtually any application—from off-grid rural electrification schemes to MW-scale, on-grid energy storage systems. www.saftbatteries.com



#### **Sun Xtender Batteries**

Sun Xtender batteries are manufactured by Concorde Battery Corporation, the largest supplier of sealed lead acid batteries to aircraft and helicopter manufacturers worldwide. Sun Xtender renewable energy storage batteries are constructed with the same premium quality as the aircraft batteries and the AGM design adopted by the military. They have corrosion-free terminals, are not exposed lead, offer no spillage, and are maintenance free. Sun Xtender batteries ship Hazmat Exempt via land, sea, or air—they are the heart of a solar system. www.sunxtender.com



#### **Trojan Battery Company**

As a manufacturer of deep cycle batteries, Trojan Battery Company offers high-quality, deep cycle flooded, AGM and gel products for a variety of renewable energy and back-up power applications. Manufacturing a superior quality product is only the beginning of a successful application—it also takes expertise and technical support that goes beyond the necessary. Backed by more than 85 years of experience in developing deep cycle battery technology, Trojan offers expertise, dedication, and support to customers. www.trojanbatery.com/RE



#### U.S. Battery

U.S. Battery is recognized for their work in energy storage, and is proud to release their all-new Renewable Energy Battery, designed from the ground up. They have made real improvements including outside positive plates, their own OSP design, Diamond Plate Technology, and the new Defender Moss Shield, perfect for their "RE L16 XC" battery line for renewable energy. www.usbattery.com



#### **International Battery**

International Battery's large format lithium-ion rechargeable cells and batteries are specifically designed for the energy storage demands of solar and wind power. Utilizing a unique, water-based, environmentally friendly manufacturing process, these large-format cells are 10 to 50 times larger, and result in greater energy density than competitive offerings. Managed through International Battery's comprehensive battery management system, these energy storage systems are safe, reliable, and meet ramping requirements for interconnection to the grid. Manufactured in the US, International Battery's lithium-ion batteries improve the efficiency of renewable production and assist with intra-day production shifting. www.internationalbattery.com



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

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A durable die-cast aluminum chassis and a NEMA 4 enclosure rating allow you to position the SOLIVIA solar inverter indoors or outdoors, worry-free for the life of your PV system, knowing the unit is dust-proof, completely safe to touch and protected from moisture damage.



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SOLIVIA solar inverters feature industrial grade components to provide one of the widest operating temperature ranges available. Full power up to 122 °F (50 °C) without derating, maximizes energy harvest and ensures maximum return on your investment.

Get convinced of our new SOLIVIA product line and visit our website www.solar-inverter.com/na and on facebook @ "SOLIVIA Solar Inverter from Delta"!





Delta Products Corporation, Inc. 15700 Don Julian Road City of Industry, CA 91745, U.S.A. Sales Hotline: 1-877-440-5851 or 1-626-369-8021 Email: sales.usa@solar-inverter.com www.solar-inverter.com/na

#### **MK Battery**

Deka Solar Photovoltaic Batteries, manufactured in the US and deployed on all seven continents, exceed the highest quality standards of the alternative energy industry. The Deka Solar line includes sealed lead acid GEL and AGM batteries, in multiple configurations, as well as select flooded products. For superior quality and environmentally conscious battery solutions, choose Deka Solar

www.mkbattery.com

#### **COMPONENTS / ELECTRICAL PROTECTION**



#### 3M

3M provides innovative solutions for the solar power industry. Today, 3M can draw on its portfolio of more than 40 core technologies to bring 3M products for solar applications, improving manufacturing, efficiency, system reliability, and ease of installation. These products, backed by 3M's renowned technical expertise and 20+ years of experience with solar technology, include: specialty films; conductive and dielectric tapes; insulating and sealing products; splicing and termination solutions; wire management solutions; solar concentrating lenses; and, structural adhesives.

www.3M.com/renewable www.3M.com/ electrical



#### BURNDY

BURNDY provides innovation in engineering and manufacturing of high-quality compression connectors, grounding products, and installation tooling. Today, BURNDY brings this rich tradition of product innovation to the renewable energy industry. BURNDY manufactures a complete selection of one- and two-hole compression terminals, H-taps, C-taps, as well as other compression products that are specifically engineered to meet the demanding environment and applications of the renewable industry. BURNDY offers the most comprehensive offering of grounding products (HYGROUND compression, BURNDYWeld exothermic, and mechanical grounding). BURNDY's grounding connectors are systems-engineered to provide the utmost in system integrity, as well as to withstand the harshest of environments. www.burndy.com



#### Lectrus

Whether a project involves solar power generation in PV installations or concentrating solar power (CSP) farms, Lectrus builds and integrates customer-supplied inverters, combiner boxes, transformers, and switchgear into efficiently designed mobile inverter and control modules Lectrus engineers fabricates and installs custom-metal enclosures that protect complex electrical power systems. Lectrus works in a wide variety of markets and operates plants throughout the US. www.lectrus.com



#### Silicone X-Treme Tape

Silicone X-Treme Tape's X-Treme Tape is a permanent, no-adhesive, self-bonding durable all-weather wrap, which forms an air-tight and moisture-proof seal. Silicone X-Treme Tape is UV resistant, a Class H insulation, stays flexible to -60°F (-50°C) and won't melt up to 500°F (260°C). Made from a special, high-quality silicone compound, X-Treme Tape is guaranteed for up to 25 years. Solar Contractors and Installers use X-Treme Tape to wrap, seal, and protect foam insulation and weatherproof electrical connections. Other applications include preventing corrosion, bundling wires, sealing hoses, ducts and joints, and repairing vacuum and fluid leaks on pipes and hoses. Many widths, lengths, and color options. www.xtreme-tape.com



#### **Remke Energy**

Remke Energy offers an expanded line of Helio-Link solar products for thin-film and crystalline PV panels and arrays. The Helio-Link line includes MC/Type 4 fully mateable field wireable and bulkhead connectors, assembly/installation tools and kits, PV/USE cable, custom cable assemblies, thin-film junction boxes, combiner boxes, and grid-tie products. Remke Energy is also a one-stop source for grounding, bonding, and termination grid-tie products. In-stock at their online warehouse are many sizes and configurations of mechanical lugs and splices, heat shrink tubing, strain relief cord connectors, dome-style cable glands, and grounding connectors.

www.remkeenergy.com



#### S&C Electric Company

S&C Electric Company is a global provider of equipment and services for renewable energy plants, electric utilities, and power users. A total solution provider, S&C designs, installs, commissions, and maintains electric power transmission and distribution systems, and it designs and manufactures switching, protection, power quality, and energy storage products for those systems. S&C also offers a wide range of engineering, project management, laboratory, testing, and field services. Founded in 1911, the Chicago-based company is applying its heritage of innovation to address challenges facing the world's power grids and shaping the future of reliable electricity delivery. The mission of employee-owned S&C is to continually develop new solutions for electricity delivery, fostering the improved efficiency and reliability required for the intelligent grid. www.sandc.com



#### **STEGO Inc.**

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



#### **US Digital**

US Digital's precision motion control products are used in a wide variety of places including motors, solar tracking, automation, robotics, and other industrial applications requiring position feedback. Their innovative building blocks include absolute and incremental encoders, inclinometers, drives, and more. US Digital supplies the CSP, CPV, and PV industries with high-accuracy, rugged, costeffective inclinometers and encoders supporting solar tracking position sensing systems and other applications within the renewable energy marketplace. US Digital also specializes in custom solutions. With their vertically integrated design and manufacturing capabilities, custom solutions and standard products are delivered with very short lead times. Their customer service team provides customers with all the support required to solve motion control requirements.

www.usdigital.com





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#### 2011 solar buyers guide



#### Allied Moulded Products, Inc.

Allied Moulded manufactures a full line (6" X 6" X 6" through 72" X 49" X 25") of NEMA Type 4X (IP66) fiberglass enclosures offering all the advantages of non-metallic materials, including: increased strength, reduced weight, corrosion resistance, UV protection, non-conductivity, and ease of installation. These enclosures are especially well suited for the outdoor enclosure applications found with outdoor alternative energy applications. Allied Moulded's fiberglass enclosures are molded with a proprietary fiberglass reinforced polyester material formulation called ULTRAGUARD. Based upon customer feedback, Allied Moulded recognized an increased number of customer applications requiring outdoor capability and the related challenges to non-metallic enclosure designs. Customer applications often require enclosures to be mounted on expensive systems where aesthetic appearance is critical. ULTRAGUARD provides better UV protection and aesthetic appearance (less change in color/gloss) www.alliedmoulded.com

#### **Anderson Power Products**

Anderson Power Products offers the SPEC Pak connector, which is ideal for alternate energy applications requiring rugged and sealed (IP68) connections. The Spec Pak material is UV- and corrosion-resistant, and the housing is configurable to provide 1,000's of available combinations of power and signal, as well as ground contacts. The technology within the SPEC Pak is the Powerpole that has provided decades of proven reliability. When Powerpoles are combined within the SPEC Pak, the result is a powerful environmental interconnect for use in a vast array of demanding applications.

www.andersonpower.com



#### **Basler Electric**

Basler Electric Introduces the first in a line of grid-tied PV inverters: the new PCS-250, a 250kW inverter with integrated protection and high-speed Ethernet communications, plus high-efficiency ratings, providing the maximum power output. Basler also designs and manufactures the bridges, enclosures, transformers and electronics, providing in-house control over all critical parts. Utility grade construction and NEMA 4/3R weatherproof enclosures make the PCS-250 suitable for the most severe outdoor applications. Since 1942, Basler has manufactured equipment for power conversion, as well as control and protection, with experience in all forms of generation including renewables. Basler's reputation for quality and reliability is evident in this new product line.

www.basler.com



#### **GRI Pumps**

Since 1953, OEMs in a wide range of industries have trusted GRI for pumps and related equipment used in highly diverse fluid pumping applications. GRI's reputation and success have been built on innovative designs, customer service, and providing products to meet the exact specifications of their customers. GRI's focus has always been on meeting the needs of a single customer. Designed for the re-circulation and transfer of fluids, GRI's new integrated magnetic drive pumps bring a uniquely engineered design to GRI's portfolio of custom OEM pumps. GRI's new Integrity Series integrates the pump's components into a compact, lightweight design, eliminating motor bearings and leaving the impeller assembly as the only moving part. Fewer parts promote longer life, quieter operation, and lower nower consumption

www.gripumps.com/integrity

#### Krayden, Inc.

Krayden, Inc. Adhesives, Sealants, and Lubricants, offers many solutions for the solar manufacturing industry. As an authorized distributor serving the PV market, Krayden, Inc. supplies: a full line of coatings; tapes; PV sealants; conductive inks; PV adhesives; lead-free solder; PV potting agents; electrically conductive; and, thermal transfer materials. As a global distributor, Krayden also provides materials for applications, such as: PV rail bonding; junction box bonding; PV frame sealing; and, PV cell and module coatings. Krayden's technically based staff helps companies manufacturing solar cells and modules with knowledgeable manufacturing solutions. They also assist with repackaging and dispensing needs in solar power applications.



#### PMA c/o Thomas & Betts

These conduits have an outer layer of modified Polyamide 12, a thin layer of a special bonding compound in the middle, and an inner layer of modified Polyamide 6. This combination of materials offers many outstanding characteristics. Above all, the conduits have excellent resistance to UV and weathering in general provided by the outer layer of PA12. They are highly flexible and resistant to continuous bending cycles, but at the same time have very high-compression strength and impact-resistance even at low temperatures. Additionally, they possess good fire safety characteristics and are free of cadmium and halogen.



#### Siba Fuses LLC

Siba Fuses provides PV fuses for combiner and inverter applications. Unlike other fuse manufactures, they refused to re-label existing product and call it PV fuses—their fuses are the first true 100% PV fuses. Siba Fuses also offers a full line of AC semiconductor fuses, UL, and IEC, to complete a design form one source. All fuses are made under one roof in Germany to ensure the highest possible quality. Their engineering staff is ready to help on any new design; simply ask about their new generation of PV fuses. www.sihafuse.com



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#### **Trench Limited**

Trench Limited is a specialized manufacturer of high-voltage electrical equipment dedicated to serving the electrical industry worldwide through engineering, service, and commitment. The Trench basket of products are made up of air-core reactors, variable impedance shunt reactors, line traps, instrument transformers (including current and voltage transformers, capacitor voltage transformers, and combi CT/PT units), transformer bushings, and power line carrier equipment. Many of these products are directly linked to applications within wind and solar farms, from high-accuracy, extended range metering instrument transformers to shunt reactor units used to compensate for capacitive VARs generated by lightly loaded transmission lines or underground cables. www.trenchgroup.com



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#### **CONCENTRATED SOLAR POWER (CSP)**



#### **AREVA Solar**

AREVA deploys a diverse portfolio of sustainable, low-carbon power generation solutions. Their global energy experience and emissionsfree concentrated solar power solutions help customers thrive in a dynamic energy market. Low-cost, land-efficient, and water-wise. AREVA's solar steam generators simply and reliably deliver superheated and saturated steam for solar thermal power plants, power augmentation installations, and industrial process steam facilities. They customize their Compact Linear Fresnel Reflector solar steam generators to meet customers' exact energy requirements, bring years of project delivery and commissioning services, and back their work with AREVA's performance guarantees. www.areva.com



#### **Epoxy Technology Inc.**

Since 1966, Epoxy Technology Inc. (EPO-TEK) has manufactured optimum, high-quality materials for advanced high-technology industries. EPO-TEK produces a full range of premium epoxy adhesives and coatings for the semiconductor, optoelectronic, PV, electronic assembly markets, and more. The selection of a specific epoxy adhesive depends on the end-product requirements, as well as the processing conditions. For processing efficiencies, most of Epoxy Technology's two-component adhesives are also available as single components, pre-mixed, and frozen syringes (PMF), and other specialty packaging. Epoxy Technology invests a large amount of resources in creating and maintaining epoxy products with a goal to minimize customers' downtime, improve efficiency, and provide prompt and professional support. All Epoxy Technology products are tested thoroughly and consistently to ensure product reliability. Epoxy Technology's recognized quality program includes comprehensive ISO 9001 and MIL STD 883/5011 certifications, as well as RoHS Compliance and Green Partnerships. www.epotek.com

#### **CONSULTANTS / BUSINESS** & ENVIRONMENTAL **CONSULTANTS**



**Ecology and Environment, Inc.** Ecology and Environment, Inc., (E & E) recognizes that successful renewable energy project permitting is as much about building relationships as it is about building infrastructure. E & E offers smart solutions to help solar energy clients move from concept to reality through careful planning and a proactive approach. From initial siting studies through construction and mitigation monitoring, they draw from their experience to anticipate potential project delays and resolve issues to keep solar projects on track. E & E is currently supporting the development of over 800 MW of PV capacity, bringing together 40 years of global leadership in environmental management and extensive multidisciplinary resources to meet deadlines and exceed expectations Since 1970, they have completed over 50,000 projects in 96 countries in nearly every ecosystem on the planet.

www.ene.com/service/energy/solar. aspx



#### AltaTerra Research

AltaTerra Research is a research consultancy specializing in sustainable business and the commercial marketplace for clean technology solutions. Through research reports, executive events, and advisory services, AltaTerra helps forward-looking organizations improve resource-efficiency in their operations and capitalize on new "green" market opportunities. They have been serving a global base of corporate, institutional, and government clients since 2007. www.altaterra.net



#### **GL Garrad Hassan**

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 off shore 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. www.gl-garradhassan.com



#### Harris Miller Miller & Hanson Inc.

HMMH provides airports, governments, and commercial businesses with planning support for proposed solar projects. They conduct solar siting and feasibility studies that evaluate potential locations, design, capacity, and business models for funding solar projects. For large solar farms, they evaluate natural resource and infrastructure constraints and develop a permitting strategy to gain required regulatory approvals. HMMH recently assisted the Federal Aviation Administration (FAA) with its "Technical Guidance for Evaluating Selected Solar Technology on Airports," also known as the Solar Guide. The Guide is the FAA's central reference document on solar PV projects at airports. It provides airport sponsors with technical and financial information to help them evaluate airport solar opportunities. The Guide also addresses the FAA's responsibilities to review projects for airspace safety and environmental protection, and provides direction for evaluating issues such as glare and radar interference. It further includes information from solar projects that have been developed and are operating at airports.





#### The Delphi Group

The Delphi Group is an environmental consultancy. specializing in GHG management and sustainability services. With over 22 years experience, and over 500 projects completed for both public and private businesses of all sizes, Delphi will deliver true value to a business. Delphi has worked with countless energy companies to both inventory and reduce GHG emissions to ensure regulatory compliance. As Canada's top environmental employer (2008), Delphi's unique core competencies in technical services, policy analysis, and management consultancy enable them to deliver innovative, valuable, and trusted solutions more effectively than others in the field. www.delphi.ca



#### Turquoise, Inc.

Turquoise specializes in solar resource assessment. For all solar energy investments from basic rooftop installations to utility scale PV systems, the need to accurately determine the characteristics of solar resource is paramount. The amount and variation of solar radiation at a project site are key factors affecting the profitability of the venture. Based in Canada, Turquoise merges science with practical knowledge of the solar energy industry. They invest in R&D to develop accurate, rapid, and cost-effective ways to estimate solar energy potential. They can provide an objective evaluation of a solar resource by determining both historical variations and long-term averages (daily, monthly, and yearly), and their clients can easily import their data files into feasibility and design tools

www.turguoisetech.com



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#### 2011 solar buyers guide

#### **CONTRACTORS**

Aevenia, Inc.



Aevenia, Inc. is a premier energy and electrical constructor

providing design-build services for collection systems, trans-

mission, tower wiring, interconnection, substations, and fiber optic systems. The Aevenia Renewables division provides new construction and continued maintenance services to the renew able energy sector (wind, ethanol, solar) for collection systems (aerial and underground), tower wiring, substations, interconnect facilities, and fiber optic systems. www.aevenia.com



#### Electrical Contractors Association of Ontario

Electrical Contractors Association of Ontario members are qualified solar installation and maintenance partners. With specialized training programs and safety standards that exceed provincial requirements, their skilled team of electrical contractors and electricians will get the job done right, on budget, and on time. **www.ecao.org** 





#### Hypower Inc.: Renewable Energy Division

Hypower is highly experienced in commercial and utility scale solar PV projects with over 84 MW installed or under construction. Their team has extensive interconnection experience with self-performing crews and NABCEP certified professionals. Hypower is distinctive in their ability to engineer, procure, construct, and provide a turnkey approach to renewable energy projects throughout the US. From pre-construction to commissioning Hypower has seven divisions, and their clients count on them to provide in-depth services such as preliminary layouts, project execution plans, project one-lines, and interconnection assistance.

www.hypowerrenewableenergy.com



#### **PCL Constructor**

As part of the PCL family of companies, the PCL Renewable Energy Division brings a century long track record of providing topquality construction solutions to customers in the renewable energy sector. PCL has been building trust and relationships through on-schedule delivery, innovative problem solving, collaboration, and efficient/effective management processes. They help clients develop complex and difficult projects and delivering beyond expectations, and offer the same level of service to customers in the renewable energy market—because they share and support the commitment to exploring opportunities and new technologies designed to reduce the North American carbon footprint. Their Renewable Energy Division is focused on providing Engineer, Procure, Construct (EPC) and Balance of Plant (BOP) services for customers in solar, wind, and bioenergy. www.pclrenewableenergy.com



#### **Sullivan Solar Power**

Sullivan Solar Power is a turnkey solar design-build firm. The company has installed over 5,000,000 watts of solar power ranging from small-scale residential to large-scale commercial and municipal systems. Sullivan Solar Power's office services all of Southern California and has been ranked as one of the fastest growing companies in the nation. Regardless of project size and scope, Sullivan is committed to delivering the best products and the most qualified professionals to its customers. www.sullivansolarpower.com

#### **ECONOMIC DEVELOPMENT**



#### **Idaho Department of Commerce**

The Energy Information Association has ranked Idaho as the seventh best state for renewable source electricity generation, and the Pew Institute has ranked Idaho the fastest state for growth in green jobs.

While hydro, wind, geothermal and biomass have traditionally been Idaho's renewable stalwarts, the solar industry is beginning to shine on the state. In the past year Idaho has seen stunning growth in solar industry companies.

www.commerce.idaho.gov

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#### Arizona Solar Power Society

The Arizona Solar Power Society is the largest solar association in Arizona, with over 860 members. They provide a fully developed distribution channel for solar manufacturing and finance companies that want to sell their products and services to more than 275 solar installation companies. www.arizonasolarsociety.com

#### **Kansas Department of Commerce**

Kansas is committed to alternative energy, thanks to a Renewable Energy Standard requiring that 20% of the state's energy come from renewable sources by 2020. International clean energy companies have found Kansas to be an ideal location from which to serve the US market. Kansas offers a property tax exemption for projects generating electricity from renewable sources, and their wind and solar incentive can provide up to \$5 million in bond financing for eligible manufacturing projects. www.thinkbigks.com



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#### General Cable

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www.generalcable.com

#### **PHŒNIX** CONTACT



#### **Phoenix Contact**

With its Sunclix connection system, Phoenix Contact offers easy-to-assemble connectors for installation and manufacturing of photovoltaic systems. The DC plug connector can be terminated in the field, saving time and costs. It is supplied pre-assembled, so that no additional parts are required. The SUNCLIX connectors do not need any special tools, and are compatible with conductors of 14 to 10 AWG. Simply insert the conductor, close the spring cage with finger pressure or common pliers until you hear the click and tighten the cable strain relief grommet. The plug connectors comply with DIN EN 50521 and have IP68 protection. www.phoenixcontact.com/sunclix

**ENGINEERING** 



#### KUKA Systems Corporation North America

KUKA Systems is an international supplier of flexible production systems to the automotive, aerospace, renewable energy, and other industries where automated processes add great value. KUKA Systems' workforce designs and builds products and systems to automate production. In the energy field, KUKA supplies engineering services, automated production modules, processing machines such as wafer saws and stringers, as well as customized, turnkey production lines for the PV, solar thermal, and wind power industries. Its portfolio includes robotic cells to perform every task associated with assembling and testing PV panels. KUKA Systems offers North American customers two businesses in one: a major global supplier of advanced alternative energy production technologies and a US-based integrator with demonstrated expertise in adapting those technologies for local use

www.kukanao.com



#### Quanta Renewable Energy Services

Quanta Renewable Energy Services (QRES) brings scale, scope, and a high safety record to the industry. A staff of photovoltaic, medium-voltage AC, and high-voltage interconnection specialists apply more than 70 years of combined experience to ensure successful projects. Building on the success of more than 95 MW of solar PV projects completed or under construction, QRES applies best practices to smoothly transition projects from engineering consulting services to EPC contract structure to commercial operations. The QRES engineering and design team constructs and delivers solar PV projects from pre-project planning through commissioning, start-up, and operation. This comprehensive offering streamlines and minimizes contractor coordination with one source.

www.quantaservices.com



#### **Global Finishing Solutions**

Global Finishing Solutions specializes in manufacturing custom spray booths, ovens, and finishing systems for liquid and powder coating of large equipment. From large and complex systems to basic systems, Global Finishing Solutions applies the fundamental logic of solution-driven system engineering to custom fit their products to requirements They are professionals in consulting, design, engineering, manufacturing, and installation, and will ensure each system meets the specialized needs and performance required.

www.globalfinishing.com

#### LORD Corporation

LORD Corporation has expertise in developing and manufacturing solar energy solutions for a diverse range of applications, such as thermal management materials, product assembly adhesives, vibration control systems, and sealants. www.lord.com/solarenergy

#### **FINANCIAL SERVICES**



#### **Greenpower Capital**

Greenpower Capital has relationships with a multitude of institutional and private investors that represent over \$30 billion in funds for solar and wind projects. Greenpower has an Early-stage Developer Buyout Program, wherein the developer can stay in the project or opt out. Projects should have site control and executed PPA. Greenpower's Leasing Program provides flexible lease terms for smaller systems of 100Kw and up. Greenpower's Equity and Debt Finance Programs can provide a developer with equity investment or debt financing. The Full Project Acquisition Programs are designed to purchase completed projects with the investor contracting for purchase prior to construction—100% of construction funds can be advanced in most cases, with final take-out purchase at COD. Projects should be shovel-ready with PPA, interconnect agreement, system design, EPC contract, and the necessarv approvals.

www.greenpowercap.com

#### **LIGHTNING & SURGE PROTECTION**



#### ENERGY CAPITAL

#### PNCEF - Energy Capital

PNCEF Energy Capital LLC is a premier source of funding for the renewable energy industry. PNC has the financial capacity and industry expertise to provide strategic solutions for client's renewable energy needs. For example, PNC can provide tax equity and/or debt through a number of structures including PPA and direct lease models, operating, or capital leases. With clients including developers, end-users, and panel manufacturers, PNC has a solid history of successful execution nationwide. While PNC's focus to date has been on solar and energy efficiency deals, the bank is committed to renewable energy in all sectors. As the renewable energy industry continues its dynamic growth, PNC is a steady player in the current market, and for the future.

www.pnc.com



#### 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 solar, wind, fuel cells, geothermal, and hydropower. The firm is advising on several conventional and renewable power projects internationally including transactions in solar, wind, and biomass in Europe, 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 over 29 years of experience in closing energy projects. TDJ provides tailor-made capital solutions to its clients. The firm also advises clients on corporate finance, capital raising, and M&A transactions. **www.taylor-dejongh.com** 

#### **INSURANCE**



#### **GCube Insurance Services, Inc.**

For over 20 years, GCube has been providing insurance services for renewable energy technologies around the globe. They offer specialized focus and underwriting authority for construction, property, and casualty insurance programs for commercial-scale solar projects. They understand the multi-dimensional nature of power generation projects and help clients identify, quantify, and mitigate risk efficiently and economically while achieving their business objectives. **www.gcube-insurance.com** 

#### LEGAL SERVICES

#### Borden Ladner Gervais LLP

Borden Ladner Gervais (BLG) has the largest Electricity Markets Group of any law firm in Canada. Their lawyers have in-depth experience in the development, construction, and operation of renewables and alternative energy projects including solar, wind, waterpower, geothermal, biomass, biofuels, cogeneration, and district energy projects. Their experience and dedication have resulted in BLG being ranked in the top tier of Canadian law firms in the power sector by Chambers Global 2010. www.blg.com

#### CITEL, Inc.

CITEL, Inc. has expanded its surge protector line to include models DS60VGPV and DS50VGPV, VG TECHNOLOGY. These surge protectors are designed with a patented hybrid Metal Oxide Varistor (MOV) + Gas-filled Spark Gap (GSG) surge protection circuit, which dramatically increases the life expectancy of the surge protector and eliminates working current and leakage current. Designed for the most severe applications, DS60VGPV is a Heavy Duty DC surge protector, rated to withstand a direct lightning strike (10/350us waveform) as defined by ANSI/IEEE C62.41-2002 and IEC 61643-11. It is typically installed at the DC input to the inverter of a solar power system. For more general duty applications, DS50VGPV is surge rated at 40kA 8/20us, and engineered to protect against indirect lightning, AC utility grid surges, and internally generated switching transients and faults. These din rail mount devices can be integrated into a PV combiner box or standalone enclosure.

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#### Dean Martin

President, R&D Energy Solutions - Ontario, Canada

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**DEHN** Inc.

DEHN's unique SPD is now UL 1449 3rd Edition compliant specifically for DC application on 600 and 1,000 V PV systems. This device is intended for use on the DC system to protect systems components such as inverters and others connected to combiner boxes from the effects of lightning caused surges and transients. DEHN has developed and introduced the DEHNguard M YPV-SCI for operating at PV generated DC voltages by incorporating a switched fused circuit in parallel to the MOV discharge circuit, permitting the internal disconnect to operate arc free. DEHN just celebrated its 100th-year anniversary in 2010, serving the electrical industry in research, design, manufacture of products, and offering technical expertise to minimize the effects transients caused by lightning and other sources. www.dehn-usa.com

# The Power of PV Systems Testing in The Palm of Your Hand...



The new HT line of portable test instruments for PV system efficiency and I-V curve trace analysis are ideal for module manufacturers, PV system installers and test labs alike, for both laboratory and in field PV module-string and end to end PV system performance testing.

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- Module & String Efficiency Testers
- AC Power Quality Analyzers (Single & Three-Phase)
- Megger Insulation Safety Meters
- Solar Radiation Sensors (Direct & Global Irradiance)

HuksefluxUSA also offers an extensive range of ISO Class solar radiation sensors and turnkey solar monitoring solutions for DNI, Global Insolation and Plane of Array solar irradiance measurement.





#### ERICO

ERICO is a global designer, manufacturer, and marketer of precision-engineered specialty metal products serving niche markets in a diverse range of electrical, construction, utility, and rail applications. The company is headquartered in Ohio, with a network of sales locations serving more than 25 countries and with manufacturing and distribution facilities worldwide.

#### **MOUNTING SYSTEMS**



#### **AP Alternatives**

AP Alternatives is a manufacturer of modular solar racking systems for commercial and utility scale projects. They have created and patented the "Solar Paver System," an automated installation system for utility scale groundmount solar arrays, which greatly reduces installation time, labor, and costs. By using factory production automation, they produce process/quality controlled modular racking with solar modules pre-loaded into the racking and delivered to the field pre-wired. With no fasteners required, the Solar Paver System is capable of array construction at a rate of 10 MW in 22 days, with a field crew of 12—with the panel-to-panel wiring and cable management complete, ready for simple home-run wiring in integrated wire management trays. AP Alternatives also offers a modular flat roof racking system, the "Flat-Rac," with the zero-fastener feature that can be configured project specific for high-density roof mount arrays. www.apalternatives.com



#### **Cooper B-Line**

This highly flexible solar rooftop mounting system offers a high degree of labor savings for a reduced cost per watt and lower total installation costs. Highly adaptable, the system supports virtually any solar PV panel type or size, and can be landscape or portrait mounted. www.cooperindustries.com



#### **OPEL Solar, Inc.**

OPEL Solar, Inc. is a designer, manufacturer, and marketer of high-concentration photovoltaic modules and a line of, single and dual axis, precision solar trackers. OPEL Solar's two innovative product lines provide innovative solar solutions for industrial and commercial applications. OPEL Solar's solutions reduce energy production costs while improving the overall system's performance. OPEL Solar's highly efficient and cost-effective products make solar power generation a viable, non-polluting alternative for an increasingly broad range of solar energy applications.

www.opelsolar.com





#### **PanelClaw**

PanelClaw offers ballasted flat roof and ground-mount racking solutions with just three components. Simple design innovations, including integrated ballast and roof protection, enable their partners to maximize array construction speed and realize substantial savings. PanelClaw's rail-less flat roof solutions feature low platform loads (~4 psf) and single module design flexibility, allowing their partners to overcome common installation challenges-including extremely wavy roofs or unforeseen roof obstructions. PanelClaw's ballasted ground-mount system eliminates the need for heavy machinery or significant ground prep for projects in sensitive environments, or at locations where ground penetration is not possible. PanelClaw supports their partners with a commitment to provide exceptional support, which includes a full complement of engineering services. With over 50 MW of projects deployed in 2010, PanelClaw offers products to deliver savings and service on any project. www.panelclaw.com



#### S-5

The challenge has been in how to attach PV modules to standing seam metal roof systems without jeopardizing roof material and weather-tightness warranties. The answer is the newly improved S-5-PV Kit, which secures the framed PV modules without penetrating the roof's surface. The S-5-PV Grab now has broader ears, making installation easier and more precise, while the S-5-PV Stud is longer to accommodate frame thicknesses from 1.3 to 2.5 inches (32 to 64 mm). The universally directional mounting disk features four under-disk hooks to help with wire management, has strategically placed holes for zip-tie connections, and comes with a module guide to make module placement easier. A 30-year power source on a 30-year roof, along with S-5! zero penetration technology, creates the most sustainable roof system available www.S-5-solar.com

40 | JANUARY/FEBRUARY 2011 nacleanenergy.com



#### Schletter Inc.

Schletter is an internationally recognized manufacturer of a diverse product mix including solar mounting systems for small to utility scale applications, waste management solutions, and customized bracket manufacturing. Worldwide, Schletter operates sales and manufacturing facilities in 11 countries—creating local jobs, reducing shipping distances, and offering improved delivery streams to its customers. Globally the Schletter company has designed, developed, and produced PV mounting systems for more than 5 GW of installed module capacity on roofs and ground-mounted systems. In addition, Schletter produces profile designs for special uses, waste collection systems for recyclables, as well as many other aluminum applications. **www.schletter.us** 

Bright Thinking in Solar

#### Unirac, Inc.

Unirac Inc. has demonstrated strong momentum with its ISYS Roof Mount, a product that continues the company's innovative approach to creating PV racking solutions that address customers' needs and budgetary requirements. The ISYS Roof Mount is a non-penetrating roof mount solution that requires no ballast blocks or concrete in its assembly. It is positioned above roof obstacles, resulting in significant cost savings and preserving roofing integrity. The configurable design accommodates  $0^\circ$  to  $30^\circ$  module tilt to satisfy most solar capture requirements, and offers universal PV module attachment capability. ISYS Roof Mount also utilizes Unirac's patented I-beam components that demonstrate excellent strength-to-weight ratio, and can withstand basic wind speeds up to 120mph. In terms of time and cost efficiency, ISYS Roof Mount offers outstanding value. With an installation rate of 2kW to 2kW per man-hour, it is one of the fastest and easiest roof mounts available

www.unirac.com



#### **Next Generation Energy**

Next Generation Energy is an integrator of renewable energy products and services for residential, commercial, and utility scale applications. With full service system design and best-in-class products, Next Generation Energy is uniquely qualified to deliver solar thermal and PV solutions that reduce cost, increase performance, and create meaningful economic opportunities for customers. **www.ngeus.com** 



#### **Quick Mount PV**

Quick Mount PV makes code-compliant flashed mounting systems that attach solar systems to composition, wood shake, and tile roofs. New and existing roof warranties are maintained by meeting all building codes and protecting the structure with proper waterproofing. The all-aluminum flashing and standoff block combined with stainless steel hardware give the product a 50-year life. Designed by installers for installers, Quick Mount PV easily works with all leading racks. Composition and shake mounts are ICC certified for strength, quality, and waterproofing. Made in the USA. **www.quickmountpv.com** 



**Unistrut Energy Solutions** Unistrut Energy Solutions is an essential partner to solar integrators, solar panel manufacturers, and mounting systems providers. Their value proposition is simple, yet effective, focusing on five key elements of the solar project that are critical to the mounting structure: technical support, product profiles, in-house fabrication, pre-engineered solutions, and installation. A series of pre-engineered solutions have been developed for both roof- and ground-mount applications. They can be utilized straight from the drawing or customized to fit a specific project requirement. Whether requiring one or all of Unistrut's capabilities, they can support any solar project and are able to provide a full-range of resources.

www.unistrutenergy.com



# Protecting the benefits of **the sun**

#### Reliability or affordability. Why choose?

The sun has a lot to offer. And Upsolar is filtering the benefits like never before to bring you the best. We're able to deliver a wide selection of photovoltaic modules, thanks to a wealth of innovation and expertise. Backed by upstream R&D, rigorous component qualification, a cost-efficient China-based production platform, stringent quality control, and downstream system-output evaluation, Upsolar can offer you a perfectly adapted solution for all your residential, commercial or utility-scale projects.





www.upsolar.com

Delivering safe solar

#### PERFORMANCE MONITORING / TRACKING SYSTEMS



#### Apogee Instruments, Inc.

Apogee Instruments, Inc. has been making high-quality, inexpensive pyranometers for more than 10 years. In that time, solar power companies have relied on the performance of these sensors to accurately monitor their PV panels. Some features of Apogee sensors are: self-cleaning head, fast response time, accurate readings at low-sun angles, independently verified to accurately match PV panels, rugged design for continuous outdoor use in all climates. Standard and custom voltage outputs are available.

www.apogeeinstruments.com/clean-energy



#### **ArgusON**

ArgusON is an SPX brand with 11 years of experience offering remote asset monitoring and management services. The company currently provides 24/7/365 manned monitoring and site management services for more than 29,000 locations in North America, in various industries including commercial solar PV installations. Their expertise has enabled customers to significantly reduce operations and maintenance costs and improve ROI. SPX is a Fortune 500 global supplier of products and services to multiple industries including power generation, distribution, and more. ArgusON Solar Power Management System can help users become more efficient at installing and operating solar PV systems. **WWW.arguson.com** 



#### **Campbell Scientific**

Campbell Scientific now offers turnkey packages for solar-resource assessment and performance monitoring for commercial, utility scale, or R&D applications. Choose from a wide variety of meteorological sensors, telecommunication options, and power supplies. With over 35 years of experience and 150,000+ units sold, Campbell Scientific data acquisition systems have the flexibility and reliability to fit any project's needs. www.campbellsci.com/solar-energy



#### CARLO GAVAZZI

CARLO GAVAZZI provides an extensive range of solar power solutions and metering devices including their revolutionary Eos-Array, which is a system comprised of individual modular elements that, when interacting with one another, provide remote monitoring and efficient local control to the solar plant. It can also be interfaced to a web-server that supervises and controls the whole installation, acquiring information from Eos-Array groups, PV inverters, energy meters, and/or interface protection. www.gavazzionline.com/solar



#### Kipp & Zonen

To maximize the effectiveness of a solar energy system, it's important to know how it is performing. A Kipp & Zonen pyranometer accurately measures the solar radiation available to a system in real time. Comparing this with the power generated allows users to calculate the efficiency of the system. A drop-in efficiency indicates the need for cleaning, ageing, or a fault, allowing for scheduled preventive maintenance and a monitored return on investment. Test laboratories around the world use these pyranometers to test and certify PV cells for power plant projects. The output of the cells is compared to the solar irradiance measured by the pyranometer. These pyranometers are also a precise solution for site selection and prospecting of the optimum location for a solar plant. Together, with a sun tracker and pyrheliometer, the complete system calculates the actual solar radiation on site. Customers can accurately decide on location and direction of view for the solar panels or thermal set up

www.kippzonen.com

# Schneider Electric at Renewable Energy World Conference

#### March 8-10, 2011

Tampa Convention Center Tampa, Florida Booth 1448

Schneider Belectric

# **New** Schneider Electric Renewable Solutions

> Large Scale Utility and Small Commercial
 > Small Commercial and Residential
 > Off-Grid and Battery-Based

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#### Yokogawa Corporation of America

Yokogawa's HXS10 SolStation is the first application specific controller produced by a major automation vendor for solar tracking applications. The SolStation combines proven control technology used in power plants throughout the world, with specialty features such as high-operating temperature (up to 70°C) and National Renewable Energy Lab's (NREL) Solar Positioning Algorithm (compute sun position with 64bit accuracy). The SolStation has a flexible function block programming environment that allows for rapid development of control logic to fit the specific needs of a tracking system. The SolStation features standard Ethernet communications (RS485 and RS232 option) with support for Modbus (Client/Server, Master/Slave) communications to supervisory systems and weather stations. SolStation is ideally suited for PV, CPV, and CSTP tracking applications. HXS10 features a standard three-year warranty. www.HXS10.com



#### **Cone Drive Gearing Solutions**

Cone Drive Gearing Solutions provides solar tracking drives for CSP power generation systems, and has developed a precision solar tracking drive design scalable to any mirror surface area. The key to the design is Cone Drive's true double enveloping worm gear technology. With a Cone Drive, the worm "wraps around" the gear, putting up to 10 times more teeth in contact than conventional worm gearing. The total torque load is distributed among more teeth, increasing durability, precision, and efficiency. The overall tracking drive gear ratio can be 100,000:1 or larger, providing extremely high-resolution mirror movements. The tracking drive accuracy is maintained throughout the power generation system lifetime. The custom design of the tracking drive focuses on providing the lowest cost solution while exceeding application performance specifications. **www.conedrive.com** 



#### **ERCAM SOLAR TRACKING SYSTEMS**

Founded in 2000, ERCAM Group develops and manufactures fixed structures (with automatic angle regulation), as well as single and dual axis trackers for the PV industry. They also offer clients turnkey solutions, and have recently consolidated their presence in North America by opening an office in California. Their products are cost-effective, easy to install with minimum maintenance. ERCAM Group has tested and installed more than 80 MW for some of the most prestigious firms in the global solar economy.

www.ercamtrackers.com



#### Lufft USA

The WS301 and WS501 are the latest additions to the Lufft line of innovative WS weather stations with intelligent microprocessors. The sensors are designed to reduce costs by integrating multiple climate parameters into one precise flexible sensor.

The new sensors are named the WS501 and WS301, and will measure global irradiance in addition to wind, temperature, humidity, and air pressure (WS501) or temperature, humidity, and air pressure (WS301). The climate parameters are extremely accurate and calibrated to internationals standards of quality and accuracy IS017025/9001. Data is transmitted via digital stream or analog channels.



PV Trackers is an optimal solution for ground-mounted commercial and utility scale solar projects. In comparison to a fixed-rack system, PV Trackers PVT 6.0DX dual-axis trackers increase MWhr production around 40%. Other services provided by PV Trackers include: site evaluations; project feasibility studies; installation training; commissioning support; as well as remote site monitoring and 24/7 security. PV Trackers' headquarters, which houses an advanced research and development facility, is located in Central Oregon with manufacturing done domestically in the US.

www.pvtrackers.com





# Discover the value behind the panel

To us, the true value of a panel lies in the electricity it generates. In independent tests around the world, our panels have proven their superior energy performance. Choosing Trina isn't just a quality purchase; it's a sound investment. With Trina Solar panels, you get **the best \$/KWh**.

www.trinasolar.com

#### **PV DISTRIBUTORS**



#### AS Solar Inc.

AS Solar Inc. distributes experience, quality, and endless energy. Based in Ontario, they are the North American subsidiary of the AS Solar Group, the world's largest distributor of complete solar PV systems for residential, agriculture, and commercial markets. Their global buying power secures the top names in PV products and the best prices for their network of dealers, installers, and project developers. They offer extensive training, product, and sales support to their dealer partners, and multiple warehousing and logistics facilities ensure timely supply of in-demand products. This year, they are launching an exclusive maintenance and monitoring plan that ensures maximum returns from a solar system.



#### Green Sun Rising Inc.

Located in the southern-most part of Canada, Green Sun Rising offers a wide portfolio of solar products and services. Ranging from distribution and installation of turnkey solar PV systems and solar thermal systems to the installation of solar hot air collectors, Green Sun Rising implemented the first grid-tied PV in Windsor, Ontairo. The company is also supplying their own solar tracker and solar mounting system under the brand names Tracker4solar and mounts4solar. Both brands originate from proven German designs, and have been successfully localized. Green Sun Rising offers residential and commercial projects, large and small, with a strong commitment to quality and performance.

www.greensunrising.com



The difference between Magnetek's E-Force® Solar Inverter and the competition is night and day.

- IEEE 1547 compliant
- Over 97% efficient at rated power
- 1MW system rating
- Shelter enclosure option
- Optional MV transformer and switchgear
- Optional utility grid support features
- Adjustable lead / lag power factor for VAR support
- Low voltage ride through (LVRT)
- Optional PV string isolation switch with visible disconnect for each string (Ontario code compliant)
- Optional utility-grade power meter
- Ask about Magnetek's patent-pending technology enabling energy harvesting in low-light conditions

Magnetek's modular grid-tied E-Force Inverters turn DC power produced by photovoltaic systems into clean, utilitygrade, distributed AC power. The E-Force's compact, field-proven design increases the power harvested from renewable sources, reduces the time and cost of installation and assures a long service life. Magnetek's 20 years of renewable energy experience assures you of the most advanced, proven power control technology available. Harvest More Green with Magnetek.



FORCE





#### **Session Solar**

Session Solar is a national wholesale solar distributor, project developer, and racking manufacturer. They are the daughter company of SolarMarkt AG, founded in Freiburg Germany over 25 years ago, by an installer for installers. Session Solar understands the varied needs of solar professionals and responds with quality products, competitive pricing, quick turnaround, and exceptional service. **www.sessionsolar.com** 



#### SunWize Technologies, Inc.

SunWize Technologies is a North American wholesale distributor of PV systems and components (including modules, inverters, and BOS) to installers serving the on-grid residential/commercial and off-grid residential markets. They have two distribution centers, one on each coast, which hold one of the industry's largest inventories and provide same-day shipping to over 1700 customers. In addition to wholesale distribution, SunWize also installs residential and commercial PV systems, designs and integrates off-grid industrial systems, and manufactures specialty modules for unique applications. The company is backed by the reputation and stability of parent Mitsui & Co. Ltd, one of the world's largest and oldest trading companies.



#### Eagle Solar

Eagle Solar provides integrated and rack-mounted solar solutions for residential and commercial applications. Their expert team will help manage the process from engineering to rebate paperwork, with net-of-rebate pricing and the most advanced integrated PC solution available. A 25-year power production warranty and solar system monitoring are included; and leasing/PPA financing solutions available from several providers. **www.eaglesolar.com** 



#### ecoSolargy, Inc.

As a vertically integrated manufacturer, ecoSolargy provides a full line of photovoltaic products and solutions that are proven in both performance and quality. With an annual manufacturing capacity of 500 MW, advanced processing, and renowned automation, their engineers use PV manufacturing technology to produce top of the line PV solar modules. ecoSolargy's mission is to promote the progress and technological breakthroughs in the PV industry. The research and development team at ecoSolargy is devoted to improving the quality of products by lowering the production cost and pushing forward technological innovation.

www.ecosolargy.com



#### **DEGERenergie Inc. Tracking Systems**

DEGERenergie is a manufacturer of solar tracking systems. Its market position is based on the unique patented Maximum Light Detection (MLD) technology. The overall energy yield of solar power plants with MLD tracking is up to 46% higher than that of rigid systems. With more than 35,000 systems installed in more than 40 countries, DEGERenergie offers its customers all product-related solutions www.degerenergie.com



#### Invensun

Invensun Sundragon series of modules makes solar energy accessible to everyone. Invensun designs and manufactures some of the most cost-effective solar modules on the market. Their Sundragon series of modules is perfect for any project whether residential, commercial, or industrial. High quality, efficient, reliable and environmentally friendly best characterize these modules www.invensun.com

#### **PV INSTALLERS**



#### **Ascent Solar**

Ascent Solar recently introduced a new WaveSol Light five-meter long module to complement their current portfolio of building integrated (BIPV) and building applied (BAPV) photovoltaic product portfolio. The new WaveSol WSLB 3200-190 is the highest powered, five-meter long, flexible, and lightweight CIGS module available in commercial production today. With its large format (5.0m X 0.6m), high power (320 Watts), high voltage (up to 190 Volts), and high specific power (50 Watts/kg), this new CIGS monolithic integrated module is specifically designed to meet the needs of large-scale commercial rooftop installations. WaveSol Light five-meter modules provide unique attributes that reduce BOS costs and ease of integration into roofing components. www.ascentsolar.com



#### Patriot Solar Group

Headquartered in Michigan, Patriot Solar Group engineers and manufactures solar tracking systems, including: fixed pole mounts; single- and dual-axis trackers; controller solutions; and, ground mounts for large, commercial or utility scale projects. Patriot Solar Group also distributes solar panels of all sizes, inverters, on- and off-grid systems, and a full range of consumer solar products. The company is dedicated to providing the highest quality solar products and materials for home and commercial use that support renewable energy. Its manufacturing processes are based on automotive quality standards to ensure high quality and reliability the first time.

www.patriotsolargroup.com

# **RED IS THE** NEW GREEN.



#### Available in 20 countries on 6 continents worldwide,

Rolls offers the broadest product line of deep cycle, low maintenance and maintenance free batteries for the Renewable Energy market. From large-scale storage to small village electrification, our flooded or AGM storage batteries deliver the power you need every time. Each is backed by our industry leading warranty, solid reputation and 97% recyclable at end of life. Green just got a whole lot meaner.





Superior Cycling | Dual-Container Construction | Widest Range of Specs Largest Liquid Reserves | Easiest to Install | Longest Life Span | Premium Warranties Т. 1.800.681.9914 E. sales@rollsbattery.com www.rollsbattery.com



#### **Pfister Energy**

Pfister Energy specializes in the professional design and construction of turnkey renewable energy systems for commercial, industrial, and institutional facilities. As a total solutions provider, Pfister Energy offers customized alternative energy systems with an emphasis on building-integrated applications. They implement the latest technologies and create systems that make sense for property, including: photovoltaics, daylighting, energy efficiency, solar lighting, solar thermal systems, as well as wind turbines, fuel cells, rainwater harvesting, green roofs, and geothermal systems. Pfister Energy delivers these innovative, onsite power solutions and energy efficiency measures so that clients can save energy, control costs, and generate an excellent return on investmentwith a payback in as little as three years. www.pfisterenergy.com

#### **Power-One**

Currently, the second largest manufacturer of solar power inverters globally, Power-One's Renewable Energy Solutions has seen remarkable growth, opening two new manufacturing facilities in North America. The Power-One Aurora brand of renewable energy power inverters offers best-in-class performance and reliability along with a global customer care package. **www.power-one.com** 



#### **Rosendin Electric**

Rosendin Electric has established itself as an EPC (engineering, procurement, and construction) contractor of mid- to largescale solar PV systems for commercial, government, and utility customers throughout the US and Canada. Project sizes range anywhere from 100kW to 200+MW PV and CPV systems in any mix of rooftop, ground-mount, single- and dual-axis tracker and/ or canopy-based installations. With over 19 MW of project installation experience to date, over 25 MW in construction and over 300 MW in development, Rosendin Electric provides turnkey expertise and EPC capabilities to develop the most efficient and cost-effective solar solutions.

www.rosendin.com





#### Shenzhen Topray Solar Co. Ltd.

Topray Solar group is a publicly listed company in China. They have been a professional manufacturer of solar cell and solar panel since 1992. Products include solar panel of both thin-film and crystalline technology from 40W to 280W. All solar panels are UL 1703 certified. www.topraysolar.com

#### The SolarPathfinder Company

The Solar Pathfinder Assistant software utilizes the essential detailed solar irradiation data drawn from the site analysis, and compiles the information in a customizable reporting format. Originally furnished for ecological and PV applications, the Assistant software now services the growing thermal technologies industry. Often called the "lesser known" solar sister, solar thermal applications financial return on investment excels her PV counterpart.

www.solarpathfinder.com



#### SPG Solar

SPG Solar is a developer of distributed solar projects for large, government, and public energy users. Located in California, SPG Solar is helping to meet rising energy demand by developing clean power using solar systems located where they are needed most—at the site of the user. SPG Solar currently manages more than 1,500 solar system installations coast-to-coast. www.spgsolar.com

#### **PV MANUFACTURERS & EQUIPMENT**



#### Amtech Tempress Systems

Amtech Tempress has been active in the solar industry since 1969, and are a supplier of: POCI3/BBr3 Diffusion & CVD furnaces, ranging from small batch laboratory equipment to full size production equipment; cassetteto-cassette automatic wafer handling for the furnace equipments; PSGR-S Dry Etch PSG Removal equipment; and, inline PECVD deposition equipment. All their equipment is serviced and installed through the company's worldwide network in the PV industry. To achieve a competitive way for customers to manufacture solar cells, Amtech Tempress has developed an advanced roadmap to optimize their systems. Process improvements, system integration optimalization, reduced downtime, and reduced cost of ownership are key ingredients for their equipment manufacturing line. www.tempress.nl



#### Day4 Energy Inc.

Designed in Canada and manufactured around the world, Day4 solarMODULES incorporate significant technological advances designed to accomplish one thing—provide more energy in daily operations and over the lifetime of the product. The proprietary and patented technologies provide key advantages over conventional crystalline PV module technology and are perfectly suited to perform exceptionally well in challenging environments, each and every day. Launched in 2010, Day4 solarSYSTEMS is an innovative turnkey franchise program enabling businesses to manufacture and sell Day4 solarMODULES in their market.

www.day4energy.com



#### **DEK Solar**

DEK Solar is a global provider of advanced technologies and process support to the solar cell manufacturing sector with solutions that include printing equipment platforms, precision screens, and materials applications used in the film coating, current-collector patterns deposition, and metallization of bus bars in PV substrate production. DEK Solar technologies include the PV1200 line, a complete metallization solution featuring the DEK PVP1200 screen printer to deliver six-sigma repeatability at class-leading accuracy of ±12.5 micron. The company's technology portfolio also includes its latest breakthrough, the Eclipse high throughput metallization solution incorporating multiple print heads operating in parallel to eliminate downtime. Based on an innovative modular design, Eclipse enables manufacturers to easily scale production to 1200, 2400 or 3600 wph, installing extra print capacity when demand dictates www.deksolar.com





#### Edwards

The GXS dry pump is designed to support pumping requirements for silicon ingot manufacturing and laminator applications in the solar industry. The GXS provides optimized thermal control and dust handling capability needed to meet the pumping challenges encountered in these processes. The high atmospheric pumping speed capability of the GXS also enables faster chamber pump down, reducing cycle times and improving throughput. www.edwardsvacuum.com



#### HUBER+SUHNER

The new HUBER+SUHNER model NS3 Smart Junction Box system is based on proven RADOX quality and provides integrated SolarMagic technology from National Semiconductor, enabling optimal maximum power point (MPP) operation. The NS3 junction box minimizes the impact of environmental (shading, dirt) and system mismatch (modules, string-to-string imbalance) that degrade system performance and efficiency. Through the integrated SolarMagic electronics, system current and voltage mismatch is corrected, ensuring the maximum efficiency of the PV system can be fully utilized during the entire life of the installation. The smart junction box is designed for high-performance PV modules, and can easily be connected to the back of the module either manually or in an automated process.

www.hubersuhner.com

#### HuksefluxUSA Thermal Sensors



#### **Hukseflux USA**

The new Hukseflux SR12 Pyranometer is the only laboratory validated COTS First Class pyranometer, which meets and exceeds the ISO-9060 Pyranometer Standard, specific to 'Solar Energy Test' applications. The directional response of each SB12 is validated upon manufacture and documented in writing to ensure the highest possible measurement certainty on the measured solar radiation resource. Each SR12 is equipped standard with a Pt100 platinum RTD temperature sensor, enabling in-situ process correction of even the slightest temperature dependence bias (via dynamic slope correction algorithm), regardless of operating temperature. Available SR12 options include a factory calibrated built in 4 – 20 mA current transmitter with galvanic isolation, permitting extended sensor signal cable lengths without the possibility of signal degradation, or EMI noise-related effect. For cost-effective, high-accuracy solar irradiance measurement, the Hukseflux SR12 First Class Pyranometer is deal

www.huksefluxusa.com



#### LEYBOLD OPTICS USA Inc.

LEYBOLD OPTICS is a manufacturer and worldwide supplier of innovative thin-film vacuum deposition equipment and processes for solar applications using PVD (evaporation and sputtering) and PECVD. With continuing technical advances, their machine portfolio and process know-how covers all aspects of solar thin-film technology for rigid and flexible web substrates. Systems are available for R&D, pilot production, and large-scale manufacture in custom and standard designs. **www.leyboldoptics.com** 



#### Lumin Solar

Lumin Solar is a manufacturer of high-efficiency photovoltaic solar panels. Their high-efficiency, Canadian-made panels are manufactured end-to-end at their facility in Ontario, and fully comply with the Domestic Content requirements of the Ontario FIT program. Lumin Solar panels are suitable for use in grid-tied and off-grid applications, and consist of high-efficiency monocrystalline cells in a 6 x 10 cell layout, transforming into higher panel output. Every Lumin Solar panel is thoroughly tested to measure power performance and meet the reliability and safety standards set out by CSA and UL 1703 standards. Whether for industrial, commercial, or residential use, Lumin Solar assesses customer needs and demands for solar energy to deliver the best possible solution.

www.luminsolar.com

#### Pluggable solutions for solar energy

# contacts are green.

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

Our PST 40i1 connector series now includes a panel mount version in addition to the field-assembled connectors. This connector's low resistance and high quality construction assure reliability of your solar installation. Ingress protection to IP 68 ensures safe operation in difficult environments. Wieland's PST 40i1 connectors meet UL and CSA standards.



**Count on Wieland –** 

We're ready for

the revolution.





www.wielandinc.com

*Wieland Electric offers 100 years of innovative technology.* Visit us at Solar Power International 2010, Booth # 1400



#### MAGE SOLAR USA, LLC

MAGE SOLAR USA, LLC, a subsidiary of the international MAGE GROUP, uses the Group's 35 years of know-how to develop optimally coordinated systems solutions. Their complete system solution consists of the MAGE POW-ERTEC PLUS Mono and Poly Crystalline Solar PV modules, inverters, and balance-of-systems for solar PV projects. Because MAGE SOLAR adheres to the highest standards of quality, they offer one of the strongest power output guarantees in the industry, include: five-plus watt power tolerances; 30-year 80% power guarantee; 12year 90% power guarantee; 10-year product warranty; high power output/sq ft; UL, IEC, TÜV Certification; and, CEC and FSEC Listed. www.magesolar.com

ASO | Solar Fuse and FSO Fuseholder Combo





www.schurterinc.com/new\_fuses

Provides low short circuit current and overvoltage protection up to 1000 VDC in solar strings, inverters, battery charges and combiner boxes.

- Standard midget size 10.3 x 38 mm
- Quick-acting according to UL 248-14
  Current rating ranges from 1 to 30 A
- Breaking capacity 20kA
- Touch-safe fuseholder mounts on DIN rail, or accepts 8-14 AWG standard wire; 1-, 2-, or 3 poles available





#### **PLANSEE**

With innovative target geometries and new material compositions, PLANSEE contributes to more efficiency of thin film solar cells. They offer more speed: monolithic rotary targets made of molybdenum don't require a backing tube, avoiding contamination of the layer with the backing material. Furthermore, they are less temperature sensitive and can be sputtered with up to 30 kW/m. They also offer more energy: sodium is an important factor for the efficiency of CIS/CIGS solar cells. By sputtering a layer of sodium-doped molybdenum, the amount of sodium in the absorber layer can exactly be controlled and reproduced. For this process, PLANSEE offers MoNa sputtering targets with full density, high purity, and a uniform and fine-grained microstructure. www.plansee.com



#### Sapa Extrusions – North America

Sapa Extrusions offers aluminum profiles and is a key supplier to the solar industry. Sapa's Renewable Energy Organization provides solutions to all solar market segments including PV mounting systems, module frames and components, concentrated solar power collectors, inverter housings and components, and heat sinks for inverters. Sapa's North American Technical Center works with clients to establish finished designs for innovative custom features and improved end-use applications. Their resources include custom extrusion design, finishing, and fabricating. They help optimize the value of products, affording customers a competitive advantage in the marketplace

www.sapagroup.com/solar



#### **Schneider Electric**

As a global specialist in energy management, with operations in more than 100 countries, Schneider Electric offers integrated solutions across multiple market segments, including leadership positions in energy and infrastructure, industrial processes, building automation, residential applications, and more. The Schneider Electric Renewable Energies Business offers development, manufacturing, and marketing of advanced power electronic products and systems for the renewable markets. The company's products convert and control raw electrical power from any central, distributed, renewable power source into high-quality power required by the electricity grid. Their pre-wired integrated solution provides a complete equipment package designed to meet the growing demands of large-scale grid-tie solar farms and commercial rooftop solar installations. It is a complete solution for electrical distribution, automation, security, monitoring, and control that can be customized to meet their customer's demands. Schneider Electric is focused on making energy safe, reliable, efficient, and green.

www.schneider-electric.com



#### Schurter Inc.

Schurter 's new DC filter, series FMER SOL is designed for use on the DC side of the inverter in PV systems and other DC systems. EMC standards impose strict limits on the noise generated from solar panel lines downstream from the grid. Using FMER SOL filter on the DC side of the inverter ensures EMC compliance. The FMER SOL is rated 25 A to 1500 A at 55°C ambient temperature, at voltages up to 1200 VDC. The filters also carry cURus and ENEC approvals up to 75° C ambient temperature, with corresponding reduced rated currents. Offered in both standard and medical M5 versions, the filters are equipped with screw clamps for types up to 150 A and copper bars for types upwards of 250 A. www.schurterinc.com



#### **Schunk Graphite Technology**

Schunk Graphite technology and associated members of the global Schunk Group manufacture a complete line of products used in the production of photovoltaic wafers. These include wafer carriers and boats for coating processes, a full line of furnace components for crystal growing. As well as purified products and those containing either pyrolytic carbon or silicon carbide coatings. Schunk manufacturers the materials used in these products and works with customers to optimize products for the greatest efficiency in their processes. Schunk Graphite Technology supports their broad offering of products with sales, customer service, and technical experts across all of North America. www.schunkgrahite.com

SolarWorld

#### **SolarWorld Americas**

SolarWorld is America's largest solar manufacturer 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 proven to produce more energy than other major brands. SolarWorld Sunkits factory customized systems make installation easy www.solarworldusa.com



#### **Trina Solar Limited**

Trina Solar Limited is an internationally recognized manufacturer of photovoltaic modules. Their high-quality PV modules provide cost-competitive electric power for residential, commercial, and utility scale applications worldwide. They are committed to improving the competitiveness and efficiency of solar energy and developing a sustainable PV industry. Trina Solar produces both monocrystalline and multicrystalline, with power outputs ranging from 165W to 290W. Adapting their product range to meet market demands allows them to provide customers with a broader range of solutions

Trina Solar has a strong, vertically integrated business model, and produces their own ingots, wafers, cells, and modules in-house. The control and efficiency achieved from this integrated value chain helps to continuously improve the production process, as well as ensure high-quality products to end customers.

www.trinasolar.com



Ablytek Co., Ltd.



#### ATAS International, Inc.

ATAS International, is a manufacturer of metal roofing, wall panels, accessories, and energy efficient building envelope technologies. ATAS offers sustainable systems for commercial and residential buildings that include products coated with cool pigmented paint, a transpired solar collector, and thin-film, building-integrated photovoltaic panels. ATAS products may contribute to LEED credits, be rated by the CRRC and be ENERGY STAR qualified. www.atas.com



#### **Bekaert Advanced Coatings NV**

Bekaert is a total solution provider for rotatable sputter equipment, working closely with customers to upgrade from planar to cylindrical rotating technology. Bekaert offers a unique combination of sputter hardware, rotatable targets, and sputter electronics for all PV applications. Their customized, state-of-the-art total solution for sputtering consists of: rotatable magnetron technology; rotatable sputter targets (AZO, HP Si, ITO, Mo, Ag, Al, NiV etc.); sputter electronics; as well as, magnet bars, gas distribution, automation, and control system. All sputter hardware components can be customized and integrated in each existing or new coating line. The wide portfolio of high-quality, one-piece rotatable targets is produced in high volumes, in all dimensions (lengths up to 152", standard or dog bone-shaped), and with all existing fixations.

and crystalline-based. Most products can be customized; ODM or OEM business is also welcome. www.ablytek.com

#### all4-GF

all4-GP (North America) Inc. is part of all4 Holding Ltd. (Switzerland), and is a technology orientated business focused on providing manufacturing equipment and process solutions for the solar energy field. The strength of all4-GP is that they offer complete front-end process sequences, turnkey back-end production lines, individual R&D, pilot process solutions, and full production needs tailored to their customers' specific requirements—with the flexibility to be integrated with any automation integrator. Together, with their partners, all4-GP is in the position to offer complete or individual process solutions for all major solar technologies. Their featured product is a sun simulator Ecosun 10L, which works with a new LED technology from Ecoprogetti.

Ablytek is a solar module manufacturer. Products include standard modules, solar car sunroof, BIPV, and solar roof tiles in CIGS



#### **ALMATEC Maschinenbau GmbH**

The E-Series line of solid plastic air-operated double diaphragm (AODD) pumps from Almatec, Kamp-Linfort, Germany, has been designed to meet challenges found in solar- and photovoltaic-cell manufacturing. E-Series pumps feature solid-block construction, which increases their strength and life cycle, while eliminating many maintenance concerns. The housing of the Almatec E-Series pumps are constructed in polyethylene (PE) and PTFE. Both materials are ideal for solar-cell production. PE pumps are used for the abrasive silicon carbide slurry. PE has a very high abrasion resistance, which is, for example, seven times higher than polypropylene (PP). The E-Series pumps made of PTFE, which has an excellent chemical resistance, are used for the chemical supply (acids, caustics) within the solar-cell manufacturing.

www.almatec.de



#### Amerimade Technology Inc.

Amerimade Technology designs, engineers, manufactures, and supports a broad range of wet processing equipment for etch, clean, electroplate, pattern develop, and strip applications and across a variety of markets. Their PV focus is on polysilicon filament etch, and PV applications requiring unconventional wet processing techniques.

www.amerimade.com

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#### **Burkle North America, Inc.**

Bürkle provides system solutions for the manufacture of solar modules including Single-Opening Laminators—Model: "e.a.sy-Lam," and Multi-Opening systems—Model: "Ypsator" for the encapsulation of crystalline and thin-film solar modules, as well as coating lines for the application of liquid coating materials, foil cutting, lay-up, and handling equipment. Also offered are Turnkey Back-End lines for the production of thin-film and crystalline modules.

www.burkleusa.com



#### centrotherm photovoltaics AG

centrotherm photovoltaics AG is a technology and equipment provider for the photovoltaic sector. With more than 30 years of experience and a proven technology platform on almost all levels of the PV value chain, the company continually develops new technologies while implementing modern production systems and efficient processes. centrotherm's product and services portfolio starts at the early stage of producing silicon as a raw material. It also covers the planning and development of silicon factories, engineering, and key production equipment. Furthermore, they equip top solar companies, as well as new market entrants with turnkey production lines and key equipment with guaranteed performance parameters. www.centrotherm.de



#### Comdel Inc.

Comdel designs and manufactures RF and DC power supplies and process instruments used in solar cell, thin-film, and plasma processing photovoltaic applications. Products include RF generators, auto-match impedance monitors, multi-channel synthesizers, and electrostatic chuck power supplies—with frequencies from 20 kHz to 80 MHz and higher and power levels ranging from 100 watts to 100,000 watts. With flexible power delivery solutions, the broadest frequency ranges available, rapid prototyping, and safety compliance, they provide responsive support and product solutions from offices worldwide. **www.comdel.com** 



#### **Dark Field Technologies**

Dark Field Technologies designs and builds patented high-resolution laser and camera systems for 100% on-line, real-time, automatic inspection of thin-film PV coatings on glass/metal/ plastic substrates, uncoated and coated glass and plastic film. NxtGen systems represent the confluence of laser and camera technologies and are the most powerful systems available, while delivering this performance for the lowest cost. They have also introduced the world's first Solid State Scanner, NxtGen SSS, which requires no maintenance and is 100% solid state. NxtGen SSS has no light bulbs, and offers the lowest energy draw of any system available as no cooling is required. In addition, 100% on-line, real-time, automatic inspection of Haze measurement and Scribes are also their specialty. NxtGen is designed and built in the US. www.darkfield.com



#### **Deposition Sciences, Inc.**

Deposition Sciences, Inc. (DSI) provides high-efficiency thin-film coatings for photovoltaic applications. With improved spectral performance, they are also cost-efficient and environmentally robust and reliable. Optical thin-films and thin-film coating technology have played an important role in PV power generation. Thin-film coatings offer many benefits to PV systems and solar cell manufacturing including material cost, spectral performance, and environmental robustness of solar cell production. www.depsci.com



#### **Despatch Industries**

Despatch Industries is a provider of thermal and processing equipment for advanced photovoltaic production, including the best-selling metallization firing furnace. Combining Despatch expertise with that of solar manufacturers inspires flexible, next-generation technology that integrates seamlessly into production lines. A global support network allows Despatch to provide service and technical expertise to customers on a local level. Industry leaders rely on Despatch for maximum cell efficiency, increased uptime, and reduced operating costs. www.despatch.com



EBARA Technologies, Inc.

EBARA is a global innovator and local provider of vacuum pumps and advanced exhaust management solutions for semiconductor, PV, thin-films, and R&D. They offer dry vacuum pumps, turbomolecular pumps, point-of-use abatement, field services, as well as parts cleaning services.



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# Skyline Steel, Inc.



#### FlexLink Systems, Inc.

For 30 years, FlexLink has provided production logistics solutions to worldwide assembly and manufacturing industries. FlexLink provides components, functional modules, turnkey systems, and service support to its customers in more than 60 countries. Their deep knowledge of material and information flow management solutions in the solar industry allows FlexLink to leverage efficiency in production and provide gentle and clean handling of cells, modules, and inverters. www.flexlink.com



#### Ingeteam Inc.

Ingeteam designs and manufactures grid-connected and standalone inverters, offering customers solutions for the equipment of PV plants, adapted to suit their specific control and generating requirements. With a 600 MW production capacity in Spain, and 500 MW production capacity in the US, Ingeteam offers the following product range: inverters with output powers ranging from 2.5 to 630 kw for grid-connected systems and integrated solutions for utility scale projects (up to 1.5 MW with MV transformer included); hybrid inverters for stand-alone systems; string boxes; and, a range of tools for inverter interconnection and display of the system parameters via web or PC. At Ingeteam, they have extensive experience in the design and supply of grid-connected inverters for large-scale PV farms. **www.ingeteam.com** 



#### JP Sercel Associates, Inc.

JP Sercel Associates, Inc., (JPSA) provides advanced laser micromachining systems and services to customers worldwide in the solar, LED, semiconductor, MEMS, and biomedical industries. Established in 1994, JPSA designs and builds fully integrated, industrial systems for 24/7 high-volume production, flexible R&D systems for universities and research facilities, along with submicron accuracy beam delivery and automation equipment. JPSA's PV-5000 is a fully automated laser system that enables thin-film solar panel manufacturers to set new benchmarks in cost and solar energy conversion efficiency due to JPSA's unique proprietary laser technology. The PV-5000 delivers unprecedented throughput, accuracy, and flexibility in a state-of-the-art industrial laser system. The system's multibeam laser beam delivery system speeds panel processing to an astounding 12 meters per second. The system's highly accurate and repeatable laser scribe placement maximizes the active area used in the panel to convert sunlight into electricity, boosting the panel's efficiency.

www.jpsalaser.com



#### KACO new energy Inc.

KACO new energy is one of the most significant global manufacturers of grid-feeding solar inverters. Since 1999, the company has delivered solar PV inverters with a cumulative power of more than two gigawatts. Taking a pioneering role in the field of photovoltaics, KACO new energy has been the first company to initiate CO<sub>2</sub>-neutral production of its blueplanet inverter series. **www.kaco-newenergy.com** 





Mersen offers safe and reliable electrical protection solutions that help protect your solar power investment. Any installation, whether it's a stand-alone solar array with a back-up battery system or a grid-connected PV system, is vulnerable to fault currents and/or lightning. Today, fuses and surge protective devices are the most effective ways of protecting the wiring and electrical equipment in a PV system. Fuses protect the cables between strings of modules from over-current damage. The faulty circuits are isolated, allowing the system to continue generating power. But that protection must be designed and tested for the specific features of solar power applications. Turn to Mersen, for protection components designed for solar power generation and distribution including, Helio Protection fuses, fuse holders, heatsinks.

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#### **Mustang Solar**

Mustang Vacuum Systems offers ORION Roll to Roll deposition systems. Substrate: up to 10,000 feet in length, 1000mm wide flexible substrates, configured with 1-10 deposition sources for precision and speed. Deposition zones are individually configurable for PVD sputter, evaporation, co evaporation, and sublimation enabling the next-generation of thin-film technologies. www.mustangsolar.com



#### **OPTI International**

Founded in 2006, OPTI-Solar is a global solar power solution provider with ISO 9001 certificate OPTI-Solar designs manufactures, and markets solar power business for distributors. In addition. OPTI-Solar offers dedicated technical support and quality assurance for over 280 distributors in over 50 countries. As a solar power manufacturer, they develop all different ranges of power products to fit demands in each region. Their grid-tied inverters offer user-friendly and cost-effective solar solutions. The durable design endures harsh environments, and the wide range of accessories allows for easy monitoring in any weather. In addition to the solid design, OPTI-Solar provides a five-year warranty. Flexible design based on any requirements makes this grid-tied inverter series a reliable choice, which ensures the best energy harvest. To vertical integrate panel and inverter industrial chains, to shorten time to market and provide quality solar power system solutions, OPTI-Solar has been building experience from many successful cases around the world. www.opti-solar.com



**Pfeiffer Vacuum** Pfeiffer Vacuum offers High Pumping Speed Turbopumps, which have high pumping speeds for both light (H2, He) and heavy gases (Ar, CF4), and can achieve high throughputs for heavy gases. In addition to PV and semiconductor technology, these pumps have Protection Class IP 54 and SEMI S2 for industrial applications. The integrated drive electronics can be directly connected to the mains AC power and reduce the need for costly cabling. Moreover, a variety of communications options, including Profibus and DeviceNet, are available. The use of innovative electronics has doubled the service life of the drives, and run-up time has been significantly reduced due to optimized motor drives and cooling efficiency. This means the pumps are now able to go into service even faster. Plus, remote and sensor functionalities allow analysis of pump data, such as temperatures trends.

www.pfeiffer-vacuum.com



Precision Glass & Optics (PG&O) Precision Glass & Optics (PG&O) offers thin-film, anti-reflective (AR) optical coatings for photovoltaic manufacturing. Increase PV performance, productivity, and solar cell efficiency with advanced optical thin-film coatings from Precision Glass & Optics. www.pgo.com

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an internationally regarded team of business executives and PV

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#### **SEMI PV Group**

PV Group represents SEMI member companies involved in the solar energy manufacturing supply chain. Their mission is to advance industry growth, support continuous efficiency improvements, and promote sustainable business practices through international standards development, market data, events, public policy advocacy, and addressing environment, health and safety issues. www.pvgroup.org



#### **Sensors Unlimited - Goodrich ISR Systems**

Sensors Unlimited - Goodrich ISR System's SWIR Cameras, which are ideal for PV inspection, are high-resolution, short-





#### VAT

VAT provides vacuum valves technology worldwide. VAT products include a vast array of standard valve products and custom design capability for customer-specific applications. Valve products include: gate valves, angle valves, transfer valves, pressure control system, isolation valves, butterfly valves, as well as angle and inline valves and bellows. VAT valves are used in a variety of applications including, but not limited to: semiconductor, PV, high-energy physics, lasers, optics, accelerators & synchrotrons, R&D, government and university labs, and more. www.vatvalve.com

#### **RESEARCH, DEVELOPMENT** & TESTING



#### Wabash MP

Wabash MPI is an international manufacturer and supplier of compression molding presses, liquid injection molding, vacuum molding, transfer molding, ASTM, composite molding, laboratory, and R&D presses. A series of all electric compression presses are also offered. Wabash provides standard, special application, and custom presses to meet customer's specific requirements.

www.wabashmpi.com

#### **RESIDENTIAL / SMALL OFFICE SOLAR PV**



#### SunWize Technologies, Inc.

SunWize Technologies, Inc. has incorporated the microinverter system from Enphase Energy into the new generation of its popular Grid-Tie System packages. These systems are available for immediate delivery. SunWize Grid-Tie System packages are complete, pre-engineered residential and small commercial solar solutions that come with permit-ready documentation and a compre hensive installation manual. These new generation Grid-Tie System packages consist of modular building blocks that can be combined to create one or more branch circuits, and a system of any size. They feature the SANYO A Series monocrystalline 215, Trina Solar TSM-PA05 polycrystalline 225 or SOLON polycrystalline Blue 225 combined with UNIRAC SolarMount racking, and either the M210 or M190 microinverter from Enphase Energy. The Enphase Energy Envoy communications gateway for remote system monitoring is available as an option. www.sunwize.com



#### The Energy Store

The Energy Store is committed to bringing affordable and renewable energy systems to residential homes and commercial properties in Canada. Through solar generation with commercial and house solar panels, wind power, and increased energy efficiency, they decrease environmental footprints and lower energy costs. By use and promotion of renewable energy resources, furthering the cause of environmental responsibility, and reducing their collective carbon footprint, they seek to be part of creating a new and sustainable life. The Energy Store has a dedicated group of professional solar analysts providing site assessments for solar and wind power. All advisors have been through a rigorous training program, and are extremely knowledgeable in all areas of home energy generation and efficiency

www.theenergystore.ca

#### **SOLAR ASSESSMENT &** FORECASTING



#### **3TIER**

3TIER provides assessment and forecasting for solar, wind, and hydro projects of all sizes. Trusted by top developers, operators, and financiers around the world, they maximize the value of renewable resources while mitigating the risks of their inherent variability. 3TIER uses sophisticated NWP modeling systems, satellite image processing algorithms, in-house expertise, and reliable delivery mechanisms to forecast both the short-term intermittency and the long-term availability of renewable energy. Their global solar and wind datasets are the most advanced resource datasets ever created, and their techniques are scientifically based and supported by the global research community. www.3tier.com

#### **SOLAR COLLECTORS / INVERTERS**

# American Superconductor

#### **American Superconductor** Corporation

American Superconductor (AMSC) offers a range of proven solutions for the renewable energy industry. AMSC's SolarTie Grid Interconnection Solution combines two of the company's proven and proprietary technologies - D-VAR STATCOM solutions and PowerModule power converter systems—that today are connecting over 15 gigawatts of renewable energy to the grid. By coupling best-in-class power converter capabilities with AMSC's dynamic reactive compensation technology, the SolarTie is the industry's first fully optimized solution for utility scale solar PV power plant developers. The SolarTie provides instantaneous detection, accurate response, and immediate results, ensuring efficient energy production and precise grid management. This solution incorporates sub-cycle detection and response times to grid disturbances of less than 16 milliseconds, enabling solar power plants to meet local grid interconnection requirements with a single solution.

www.amsc.com



#### Delta Energy Systems (Germany) GmbH

Delta is offering four new models of reliable grid-connected solar inverters: SOLIVIA 2.5, 3.3, 4.4, and 5.0 NA G4 TR. Each offers a nominal output power ranging from 2.5 to 5.0 kW. The SOLIVIA solar inverters from Delta feature a durable die-cast aluminum chassis and NEMA 4 enclosure rating. They operate within a wide temperature range, up to 122° F (50° C) with full power output (without derating) due to integrated industrial-grade components. This ensures high yields even for installations in warmer climates. The inverters are suitable for all commonly used solar modules (also for thin-film and rear-side contact PV modules) due to the implemented galvanic isolation and the integrated DC wiring box that accommodates either positive or negative DC grounding. www.solar-inverter.com/na



#### Fronius USA, LLC

Fronius offers innovative and reliable commercial-scale PV options. Fronius is known for their long-lasting residential scale PV inverters, which are enhanced by the IG Plus and CL lines that provide PV inverters for small and large-scale commercial installations. Larger IG Plus models range from 10 kW to 12 kW, and the CL is available in 36 kW, 48 kW, or 60 kW output configurations. Both highly efficient inverter lines incorporate smart, integrated MIX technology to maximize energy harvest even on cloudy days, are field programmable, and offer a standard 10year warranty. The innovative CL system is modular, designed for planning flexibility, with a durable housing for 9, 12, or 15 identical power modules. Individual power modules will continue to operate in the unlikely event one module needs service. www.fronius-usa.com

#### **SOLAR FASTENERS**



#### **Pivot Point Incorporated**

The new SLIC Pin from Pivot Point Incorporated is a pin and cotter all in one, and is well suited to solar panel and solar frame assembly. The SLIC Pin affords fast and secure joining, and greatly speeds assembly compared to alternatives such as a pin and cotter, pin and clip, or bolt and nut. The pin can be made from numerous materials and finishes to suit individual applications. **www.pivotpins.com** 

#### SOLAR GLASS ENCAPSULANT



#### **Guardian Industries**

Guardian provides high-efficiency mirrors and low iron glass for concentrating solar power applications. Guardian's EcoGuard Solar Boost laminated parabolic mirrors are designed to provide best-in-class solar reflectivity and concentrating efficiency. Guardian also offers conductive coated glass, low iron glass, and fabricated glass for thin-film and silicon wafer PV, as well as thermal hot water applications. Guardian is a diversified company headquartered in Michigan, with facilities worldwide and positions in float glass, fabricated glass products, fiberglass insulation, and more. **www.guardian.com** 



#### Specialized Technology Resources, Inc.

Specialized Technology Resources, Inc., a wholly owned subsidiary of STR Holdings, stabilizing polymers since 1944, has redefined the conventional understanding of photothermal degradation, and used this knowledge to engineer the most stable photovoltaic adhesive encapsulants in the PV-solar module business. The STR encapsulant product line named Photocap is the global industry standard for ethylene vinyl acetate (EVA) and thermoplastic encapsulants, offering the highest adhesion on glass, metal, and other module substrates. Photocap encapsulants' attributes range from standard cure to fast cure in lamination cycles, thermoplastic moisture barriers, and all-in-one back sheet designs. Photocap encapsulants are an environmental protection package for siliconwafer-based technology and thin-film solar panels.

#### www.strsolar.com

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NewEdge, CS6PX, available in 200-250W polycrystalline and CS5A all black frame 170-195W monocrystalline. This

revolutionary rail-less module dramatically reduces installation time and costs.

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www.canadiansolar.com

Verse

#### **SOLAR HOT WATER**



#### **EZINC METAL SAN. TIC. A.S.**

EZINC is recognized for delivering high-quality, costeffective solutions for residential and industrial applications of solar energy. EZINC has a huge marketing network, and offers a general product range of: solar collectors: thermosiphon solar water heaters; storage tanks; mounting solutions; as well as, accessories. The company's production facilities are progressing under the same plant. www.ezinc.com.tr | www.presolarnet.com



#### **Free Hot Water**

Free Hot Water is a source for high-quality solar hot water products and smart design solar thermal solutions. Free Hot Water manufactures and distributes solar thermal products including solar hot water collectors, components, pre-engineered systems, solar storage tanks, heat exchangers, circulator pumps, controllers, pump stations, pre-insulated flex hose, tools, radiant heat components, sealants, adhesives, and more. More than 1,000 items are available with a full line of solar hot water products available online

www.freehotwater.com



#### **K-Flex USA**

K-Flex USA, a manufacturer of elastomeric thermal insulation, delivers long-lasting cost and energy savings with K-Flex Solar Twin System – ST, a quick and safe solution for insulating heat transport piping on new or retrofit solar hot water systems. Designed to minimize heat loss and simplify installation of fluid recirculation lines connecting solar panels and the water storage tank, K-Flex Solar Twin System - ST includes flexible stainless steel tubing covered with high-temperature rated insulation, a UV- and mechanical- resistant jacket, embedded temperature sensor wires, as well as a complete range of fittings and mounting accessories. www.kflexusa.com

#### SOLAR INTEGRATION



#### **EcoFasten Solar**

EcoFasten Solar custom engineers and manufacturers water-tight roof bracket systems providing secure attachment points for solar panels conduit and other roof-mounted products. Their roof attachment designs have evolved from decades of roofing experience. Products include Eco-65, Eco-44, Green Fasten, Quik-Foot, Simple Seal, and Solar Snow Fence. They manufacture an attachment solution for every type of roof, which has been extensively tested in their facility, as well as in the field (engineering reports are available on their site). EcoFasten Solar serves the commercial, industrial, municipal, government, and residential sectors. Sharing a location in Vermont with sister company Alpine Snowguards, all products are 'Made in USA' from recycled materials and are ARRA compliant. www.ecofastensolar.com

#### **AllWest Energy**

AllWest Energy has been dedicated to solar and wind energy for more than a decade in Arizona. They offer renewable energy systems for residential and commercial applications, and have designed over 1,300 state of the art solar systems that are affordable, dependable, and attractive. A new AllWest Energy Solar Electric System complements the architechure of a home and provides an environmental friendly power source that can be depended on. www.allwestenergy.com



#### **Dovetail Solar and Wind**

Dovetail provides solar electric (PV), solar thermal, and wind systems for new and existing commercial, residential, farm, and non-profit buildings. Established in 1995, Dovetail is one of the Ohio region's oldest and largest installers with several office locations. They enable organizations and individuals to become more sustainable while saving money on their utility costs with safe, reliable, high-quality renewable energy systems. They have installed over 2 MW and 185+ systems, all built to be clean, safe, low maintenance, and durable. Dovetail will design the optimum solution for a project. www.dovetailsolar.com



#### EnergyLaminated.com

EnergyLaminated.com has developed a patented, transparent, laminated glass that produces electricity directly from lightnatural or artificial. Unlike conventional rooftop solar applications, which only produce four hours of energy per day, Energy Glass is integrated into new and existing building designs, such as curtain wall applications, that produce energy 12 hours per day. Direct sunlight is not needed; thereby, allowing all four sides of a building to store energy, which is then converted to electrical requirements. In most cases, a building can sustain itself 24/7 in an emergency environment. Combined with existing security laminates. EnergyLaminated.com can provide design solutions to fit your specific requirements. www.energylaminated.com



#### MidNite Solar Inc.

MidNite Solar's Classic MPPT Charge Controller substantially increases the flexibility, features, and range currently found on MPPT controllers. With Arc Fault Detection, this controller is the safest controller available. The Classic 150 ranges up to 96 amps, the Classic 200 up to 79, and the Classic 250 up to 63 amps. The Classic set-up wizard will get projects up and running in no time for solar, wind, or hydro. www.midnitesolar.com



#### **Smart Solar Solutions**

Smart Solar Solutions is an Arizona-based full service designbuild firm specializing in turnkey PV (Solar-Electric) Power Systems for commercial applications. Their mission is to enable companies to reduce and stabilize their energy operating costs by making a smart investment in clean, reliable solar energy. They provide customers everything needed to take control of their energy future including: 1.solar power system design 2.financing 3.procurement 4.installation 5.commissioning and monitoring services from a single source. They offer complete customer support and guarantee that systems installed by Smart Solar Solutions operate and perform to expectations. Smart Solar Solutions is licensed, bonded, and insured for both commercial electrical and general contracting in the State of Arizona.

www.smartsolarpv.com

#### **SOLAR SCREEN MANUFACTURING** FLEXcon

For more than five years, FLEXcon has been a reliable, global supplier of solar module backsheet solutions for the photovoltaic industry. As a result, they have developed an intimate understanding of what module and encapsulant producers are looking for in backsheet protective laminates, and they are delivering what's required www.flexcon.com/pv

#### **SOLAR SUPPORT STRUCTURES**



#### **Applied Energy Technologies**

Applied Energy Technologies (AET) is a global provider of solar racking solutions that meet the needs of any type of solar installation. AET designs, engineers, and manufactures solar racking solutions with a focus on low-cost, high-quality products that minimize assembly time. Every product is meticulously engineered and taken through an exhaustive product development process. With 25+ years of product development and engineering experience, AET has a solid disciplined approach and a "customer first" mentality. Benefits of AET Racking Solutions: racks for all panels available on the market; industry leading installation time; fewer parts to order; no cutting or drilling required; no heavy equipment required; and, full layout and loading analysis for every project. www.aetenergy.com



\*To learn how visit www.S-5-solar.com/nace or call 1-888-825-3432.





#### **Baja Construction**

Baja Construction, established in 1981, is a construction company engaged in the business of pre-fabricated, preengineered high-tensile, light gauge steel structures that serve as the mainframe of a solar energy facility. They design, engineer, supply, and install Solar Support Systems-an integral component of a solar ground-mount, solar carport and/or solar RV & Boat Storage solution. Baja is a nationwide company with its own in-house engineers, operating with extensive experience in engineering and building light gauge, high-tensile steel structures. Baja's Solar Support Systems are being built at schools, train stations, fitness centers/sports complexes, shopping malls, medical facilities, office buildings-essentially any place where a parking lot is a location for solar shaded parking that can generate power to offset energy costs, or generate revenue from a Feed-in-Tariff. www.bajacarports.com



#### **Con-Tech Systems**

Con-Tech Systems' time saving, single step CTS/TITAN Hollow Bar IBO Injection Bore Micropile System is well suited for anchoring solar collectors. The system has inherent advantages over conventional driven pile and helical pile systems, and has proven results in exhibiting a more economical and technically more reliable foundation solution 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. This innovative system also provides highly improved grout/ground friction 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, which allow for higher production rates, and they offer efficient anchoring solutions for transmission towers and wind turbine foundations.

www.contechsystems.com



#### MacLean-Dixie

MacLean-Dixie Helical Foundations feature a complete line of cost-effective steel earth foundation products for commercial, residential, and marine applications. MacLean-Dixie provides products for remediation and new construction projects including end-bearing deep foundations, helical screw tension anchors, and helical tieback systems. MacLean-Dixie Strength Squared square engagement cast coupling system provides higher strength, lower cost foundation system that forms perfect male-to-female fit on all of its foundation systems. MacLean Dixie is a business unit of MacLean Power Systems and includes the Joslyn and Dixie brands, which have supplied anchoring systems since the 1920s. www.macleandixie.com

#### \_\_\_\_\_ Skyline Steel



Skyline Steel has been a steel support powerhouse since 1983, providing solar carports and rooftop racking systems for under 30 cents per watt. Many of their solar support system designs have received national recognition. Because Skyline Steel designs and fabricates all of their systems in-house, they offer an unbeatable competitive advantage delivering maximum coverage at minimum cost. Skyline Steel's solar services division is committed to providing clients with the best solar support consulting, design, and fabrication by approaching every project with a focus on aesthetics, functionality, cost, and structural engineering.

www.skylinesolaraz.com

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Solar Nick Figone (415) 981-2811 nfigone@ene.com Wind Mark Schmitt (716) 684-8060

mschmitt@ene.com **Geothermal** David McIntyre (619) 696-0578 dmcintyre@ene.com

Biomass/Waste-to-Energy Robert Santa Maria (716) 684-8060 rsantamaria@ene.com

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

Energy Efficiency Mark Casell, LEED-AP, CEM (716) 684-8060 mcasell@ene.com

Transmission Jennifer Rouda (415) 981-2811 jrouda@ene.com



#### Solaire Generation, Inc.

Solaire Generation's patented structures and systems elegantly transform parking lots into solar power plants. The company designs, engineers, fabricates, and installs their structures. Solaire Generation is recognized by Fortune 100 companies and the US military as an innovator in the market for elevated solar structures. They have a proven track record of satisfying the most rigorous quality, safety, and execution standards. They have built the largest commercial solar parking project in the US—a 3.6 MW corporate campus installation, on time and on budget.

www.solairegeneration.com



#### Solar FlexRack

The Solar FlexRack has revolutionized rack-mounting systems for solar arrays. Because of its unique pre-assembled unfolding design, one unit can be installed by a three-man crew in five minutes or less, as compared with installation times of 45 minutes with a six-man crew for competing products. The result: labor savings of up to 40%. The Solar FlexRack is available in a variety of configurations for ground-mount, roof-mount, and carport installations. It also accommodates thin-film and framed panels.

www.solarflexrack.com



#### Sun Storage

Sun Storage is a manufacturer of solar PV frame and racking systems, and complete solar packages for utility, commercial, municipal, and residential applications including grid-tied, off-grid, and specialty application options. The company provides versatile and popular pre-engineered ground-mount Building Integrated Photovoltaic (BIPV) systems, while servicing industry demands for roof-mount systems and racking components. Product lines stretch from a 2kW residential array to multi-megawatt power plants. Adaptive, innovative, and forward-looking, Sun Storage prides itself on excellent products, made entirely in the US. All residential and specialty products are architecturally appealing, while commercial systems are simple, robust, and cost effective. **www.sunstorage.org** 

#### SOLAR THERMAL MANUFACTURERS & EQUIPMENT



#### A. O. Smith Water Products Co.

CIRREX from A. O. Smith is a leap forward in solar thermal water heating and is one of the greenest solutions available to homeowners today. Up to 70% of its energy comes from the sun, not from the power company, which can significantly reduce a homeowner's utility bills in addition to helping protect the planet. CIRREX is an all-in-one system, which simplifies specification and installation for the contractor. Its solar thermal collectors can generate as much energy as traditional PV solar panels at one-eighth the cost. Tank sizes range from 76 to 120 gallons—and with solar thermal technology, a larger tank actually makes the system more energy efficient and cost friendly. CIRREX has an ENERGY STAR-qualified, Solar Energy Factor of 2.



#### PAW GmbH & Co. KG

In 2010, PAW successfully improved its logistics in North America and will further enhance its efforts in 2011 to better meet its customers' demands. Having focused on the solar business initially, PAW will now start supplying this market with its hydronic heating products. PAW hydronics will be available in DN20, DN25, and DN32. The product range covers different types of modular heating circuits, which can be applied for several purposes in hydronic heating. These modules can all be readily integrated on a distribution manifold, which comes in different sizes (2-fold to 6-fold) to allow for high customizability of hydronic heating systems.

www.paw.eu



#### Viessmann Manufacturing Co. (U.S.) Inc.

Viessmann is a manufacturer of innovative fossil fuel and renewable energy hydronic heating systems. Their complete line of solar thermal systems for residential or commercial applications includes flat plate and vacuum tube solar collectors, pre-fabricated pumping and heat transfer stations, solar control units and communication accessories, DHW storage tanks with internal heat exchanger coil, mounting systems, and system accessories. Designed with the experience of more than 30 years in the solar industry, and constructed from only the highest quality materials, all components of these solar systems have been carefully design matched to ensure superior performance and reliability over the lifespan of the system. Viessmann solar collectors and residential system packages are SRCC and CSA certified.

www.viessmann-us.com | www.viessmann.ca





#### SEA Groups Ltd.

SEA Groups Ltd. is a manufacturer providing solar energy technologies and products, with an emphasis in solar thermal applications, affordable solar water heater, solar space heating, solar pool heating, and solar air conditioning for domestic and commercial purpose.

www.sea-groups.com



#### **Solar Panels Plus LLC**

Solar Panels Plus LLC offers Buy American Act compliant evacuated tube solar thermal collectors to dealers and installers across the US. The SPP30A collectors are manufactured in Ohio, primarily from US-based materials. The collectors have been successfully installed in a number of government projects and are also available for commercial and residential applications. www.solarpanelsplus.com



#### **Steca Elektronik GmbH**

Steca Elektronik GmbH is as a supplier of products for the solar electronics industry. Steca sets the international standard for the regulation and control of solar energy systems, as is involved in the three market segments of solar thermal, PV grid connected, and PV off-grid. In conception, development, production, and marketing, the company is committed to the highest quality standards.

www.steca.com



#### tekmar Control Systems

The Setpoint Difference Control 157 uses variable speed pump operation to get more heat from a solar thermal system—even on less than ideal days. During mild solar radiation days, variable speed pumping provides a higher amount of heat transfer when compared to on/off pump operation. An added benefit is the reduced electrical consumption that results from running at lower pump speeds. A second pump output on the 157 can provide for a wide range of applications including back-up heating, external heat exchanger circulation, or booster pump operation for drainback systems.

www.tekmarcontrols.com

#### **SOLAR THERMAL SYSTEMS**



#### **ART TEC, LLC**

ART TEC, LLC manufactures a line of simple, affordable differential temperature controllers designed specifically for residential solar thermal systems in which the pump is powered by a solar panel or DC power. The new model DTC-D controller features a display of current temperatures day and night. This is possible due to the internal battery that is charged from the solar panel—which allows users to review recent high and low temperatures and adjust settings at any time including differential, max temperature, and freeze protection modes and alarms. **www.arttecsolar.com** 

#### TESTING / CERTIFICATION



#### **Camstar Systems, Inc.**

On the Camstar enterprise platform, SolarSuite encompasses manufacturing execution, quality management, supply chain quality, process planning, equipment integration, and operational intelligence—all in a closedloop learning process that helps users bring innovative technology to market sooner with higher product quality and leaner operations. That means a lower cost per watt for technology, and an accelerated grid parity. With unprecedented functional, transactional, and supply chain scalability, SolarSuite meets needs today and over time. With Camstar: remove manufacturing variability; increase internal and supplier process visibility; and, continuously improve design and manufacturing. **WWW.Camstar.com** 

#### STIEBEL ELTRON Simply the Best



#### **Stiebel Eltron**

Stiebel Eltron SOLKITS 2 and 3 thermal solar systems are Energy Star Rated and have SRCC OG300 system certification. Each solar closed-loop system includes SOL 25 PLUS flat plate collector panel(s) and mounting hardware, SB/SBB storage tank with heat exchanger(s), pump station with expansion tank, temperature/pressure gauges, pressure relief and check valves, as well as a controller unit with corresponding sensors. Stiebel Eltron has over 30 years of experience in the thermal solar business, and also offers an industry leading 10-year warranty on all of their solar panels and tanks. www.stiebel-eltron-usa.com

#### EagleView Technologies, Inc.

EagleView Technologies offers a solar 3D roofing report for integrators and installers to calculate solar exposure, roof square footage, and panel placement by utilizing extremely accurate measurements for pitch, square, and lineal footage. The detailed, accurate 3D image of the building allows EagleView to generate diagrams such as rafter lengths, grid layout, solar orientation, and azimuth. These diagrams provide the foundation installers need to streamline the estimating and installation process for solar applications. www.eagleview.com



#### Valentin Software, Inc.

Valentin Software, Inc. has been providing solar professionals with PV and solar thermal design, simulation, modeling, and sales software since 1988. Their PV\*SOL and T\*SOL software programs are known worldwide for their power, accuracy, and ease-of-use. PV\*SOL and T\*SOL software is used by customers in over 70 countries to design, analyze, and sell residential, commercial, industrial, district-wide, and utility scale systems. **www.valentin-software.com** 



#### **Cincinnati Sub-Zero**

CSZ manufactures a large selection of environmental test chamber designed to accommodate various solar modules and panels for testing all three sections of the IEC 61215 and 61646 temperature cycling, humidity freeze, and damp heat test specifications. Available with a temperature ranges down to -45°C to 190°C, and humidity range from 20% to 95% RH. Dedicated damp heat chambers are also available for 85°C/85% RH testing. Sizes range from small, benchtop chambers to full, walk-in rooms. These state-of-the-art environmental chambers incorporate CSZ's patented Tundraâ system used for cooling down to -45°C with only one compressor—ideal for solar panel testing. Using only one compressor can help to lower initial, ongoing energy and operating costs. Documented energy savings of 47% to 66% are obtained by using CSZ's Tundra system. Other benefits of the system include increased performance, ease of service, and reduced maintenance costs.

www.cszindustrial.com







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#### **ETA International**

For over 32 years, ETA has met industry's emerging technologies demands. ETA's Small Wind Certification offers practical assessments in wind energy generation under 100 kW. The Photovoltaic Certifications provide assessments in solar system installations. The Commercial Wind Technician (CWT) is a maintainer of wind farms. The ETA International Alternate Energy Hybrid Integrator is professionally trained and certified in the skills necessary to find integrated solutions for generating and managing power using multiple alternative resources. Each focus includes a tiered career track for individuals to expand their knowledge in alternative energy fields. www.etainternational.org



#### **Q-Lab Corporation**

Q-Lab Corporation provides quality, affordable weathering products and services. Conducting accelerated weathering tests allows users to make informed decisions about product durability in a reasonable timeframe. Q-Lab's line of weathering test chambers includes the QUV Accelerated Weathering Tester, the world's most widely used weathering tester, which provides the best simulation of moisture and short-wave sunlight for accelerated physical property testing. The Q-Sun Xenon Test Chamber is a weathering and light stability tester that realistically reproduces and accelerates damage caused by full-spectrum sunlight. Additional features, such as water spray, are available to simulate unique environments.

www.q-lab.com



#### Atlas Material Testing Technology LLC

Atlas now offers grid-tied PV testing and monitoring allowing for real-life durability/performance in the two benchmark locations of Phoenix, Arizona and Miami, Florida. Also offered are other niche climates, such as a high altitude/cold climate. Testing can be complemented with a suite of Atlas' PV testing capabilities, including: IV curve measurement, thermal imaging, digital imaging, visual inspections, custom data acquisition design and installation, and empirical weather and sample temperature reporting. Atlas will work with client-provided engineering or provide engineering support to ensure that the array design is properly installed and permitted by local utilities and governing bodies. www.atlas-mts.com

#### TOOLS



#### Rennsteig Tools, Inc.

For 30 years, Rennsteig has been manufacturing tools in Germany and the US to the highest standards anywhere. Their precision cutting, stripping, and crimping tools are specifically engineered for the wires and terminals specific to the solar industry. They have the knowledge, skill, and capacity to meet any customer specifications. Rennsteig's Professional Solar Crimp Kit allows users to fabricate their own PV-cable. They offer tools for all major manufacturers. **www.rennsteig.us** 



#### **Solmetric Corporation**

Solmetric Corporation manufactures solutions for solar installers, including products for site evaluation and shade measurements, system design, and electrical testing. Specific solutions include the Solmetric SunEye, the Solmetric PV Designer software, and the PVA-600 PV Analyzer.

www.solmetric.com

#### **TRANSPORTATION / LOGISTICS**



#### Union Pacific Railroad

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 solar and wind industries. They offer customers a total logistics solution with shipment visibility to support efficient supply chains. Whether it is to move solar panels/troughs/ dishes or wind energy components, UPRR and UPDS have the solution. Shipping by rail is inherently more economical and greener than truck—Union Pacific can move a ton of freight 830 miles on a single gallon of diesel fuel, the equivalent to 400mpg in an automobile.

www.up.com/wind | www.upds.com

#### **UTILITY SCALE SOLAR/PV**



#### **Advanced Energy**

Advanced Energy offers innovative power and control technologies for high-growth thin-film manufacturing and solar-power generation. The company recently acquired PV Powered, which provides grid-tied PV inverters that have set new industry standards in reliability and efficiency. As a combined company, PV Powered's commercial and residential-sized inverters and Advanced Energy's Solaron utility scale inverters now offer the most complete line of inverters-from 2kW through 2 MW, all targeted at reducing the levelized cost of energy (LCOE). Advanced Energy's SiteGuard PV Solar Maintenance Service, featuring the SafeGuard 99% uptime guarantee, has been extended to cover all of their commercial gridtied inverter products, including the entire PV Powered product line. Advanced Energy is headquartered in Colorado with dedicated manufacturing, support, and service locations around the world

www.advanced-energy.com



#### **Canadian Solar**

Canadian Solar NewEdge CS5A-MX and CS6P-PX modules with Zep Compatible frames are revolutionizing solar installation. The solar modules are rated among the top for PTC efficiency and are interoperable with the Zep System, enabling ultra-rapid, rail-free installation and the industry's most reliable grounding system. It is so revolutionary as it cuts installation time in half, dramatically reducing installation costs. Features include ultralow parts count reduces complexity; a new standard for safety with hyper-bonded grounding matrix; auto-leveling and alignment; and, theft resistance. www.canadiansolar.com



#### Hydro

Hydro is a supplier of support structures for utility scale CSP frames and PV unit installation mounting systems for the renewable energy sector. With a solar unit committed to delivering innovative energy solutions, Hydro provides: technical, design, and concept prototyping support; extrusion, fabrication, and finishing of frame components; raw material management, and component procurement; warehousing, kitting, and JIT delivery. www.hydro.com/northamerican/solar



#### CG Power Solutions

CG Power Solutions (formerly MSE Power Systems), a highly focused solution provider, has extensive experience interconnecting renewable energy projects to the grid. Their solar team provides full EPC capabilities to design, build, and automate utility scale solar PV power generation systems. They are currently involved in several installations including a 6 MWdc project in Pennsylvania with design/concept, complete installation and a total plant EPC wrap, site civil/structural design work, and overall project management. In addition, they are engineering a 278 MWdc project in southern California that establishes 99.360 solar modules across 140 acres. CG Power Solutions' foray into solar is a natural extension of their proven success in wind, where the company is responsible for connecting over 22% of current US wind power. www.cgpowersolutions.com



#### **JAC-Rack Solar Mounting Systems**

JAC-Rack offers solar support system with roof-, ground-, and ballast-mounting systems custom-designed based on what's required. They provide innovative designs and features that make installations faster, easier, and more profitable, with quality not easily found elsewhere. Vertically integrated, JAC-Rack maintains complete control over every aspect of its performance—from comprehensive solar products design and engineering capabilities to extensive manufacturing facilities and direct delivery and technical support. This highly developed approach delivers tighter quality control, faster response, and lower costs. Their warranty is also one of the best in the industry. www.jac-rack.com





#### Magnetek, Inc.

Magnetek's modular grid-tied E-Force Solar Inverters turn DC power produced by PV systems into clean, utility grade, distributed AC power. The E-Force's proven design increases the power harvested from renewable sources, reduces the time and cost of installation, and ensures a long service life. Magnetek's 20 years of renewable energy experience assures the most advanced, proven, power-control technology available. Features include: IEEE 1547 compliant; over 97% efficient at rated power; 1 MW system rating; shelter enclosure option with optional MV transformer and switchgear; optional utility arid support features: adjustable lead/lag power factor for VAR support; low voltage ride through (LVRT); optional PV string isolation switch with visible disconnect for each string (Ontario code compliant); and, optional utility grade power meter

www.magnetekrenewableenergy.com



#### **Satcon Technology Corporation**

Satcon develops innovative power conversion solutions and provides system design services for utility scale renewable energy plants. Featuring the widest range of power ratings in the industry, Satcon inverters provide the critical bridge between clean energy sources and large-scale power grids, helping companies meet the rising demand for clean energy with unparalleled efficiency and profitably. Rugged, reliable, and backed by worldclass warranty and support programs, Satcon solutions are chosen by businesses and utility companies to convert renewable energy into efficient and stable power. www.satcon.com



#### White Construction

White Construction is no stranger to renewable energy power construction projects. Having become one of the primary contractors in North America in wind power construction, White Construction has channeled the same expertise and focus on customer satisfaction to the leading growth sector in renewable energy: solar power. White Construction offers a complete range of services to clients for solar power projects ranging from groundmounted PV to solar thermal projects. As an established self-performing contractor, White Construction can handle solar projects from engineering and procurement to completed construction. This turnkey approach has proven its value in over 4000 MW of wind power construction and over 5000 MW of gas turbine construction across Canada and the US.

www.whiteconstruction.com

#### **Bridgewell Resources LLC**

Bridgewell Resources offers complete solar system solutions for the residential, commercial, and utility marketplace. Their sales professionals work with electrical, roofing, commercial, and utility contractors, as well as distribution purchasers to supply components/products, provide design aid, and assist with largescale, grid-tied energy system installs. They offer solar panels and systems, Building-Integrated Photovoltaic (BIPV) products, and ground-mount solar farms. Invertor and racking system options are available. Bridgewell Resources' complete lighting system solution includes a pole, panel, connection box, battery, and LED cobrahead.

www.bridgewellres.com



**Control Techniques** 

Control Techniques provides technology and service for highefficiency power conversion and control solutions for PV energy systems. Control Techniques' solutions are backed by manufacturing and engineering centers, globally. Control Techniques currently manufactures more than 12 MW of inverters per day worldwide. Their unique, intelligent, and scalable grid-tie

inverter technology utilizes cost-effective, mass-produced modules that are proven to provide reliability and efficiency. The design, which includes compact dimensions, assured performance, proven reliability, and built-in redundancy ensures optimum efficiency across varying radiation intensities, typically achieving 97% to 98%. Control Techniques is part of Emerson Electric, and has over 125 years of experience in technology and engineering, creating solutions for the benefit of customers. www.emersonct.com



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#### **Hydro Solar Solutions**

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#### **Northwind Solutions**

A dedicated renewable energy industry services company, Northwind Solutions was formed in 2004, initially providing construction services in industrial wind. Along with wind, the company now provides services for the following solar-related categories: utility scale ground-mount; single unit ground-mount technologies: as well as commercial roofton. Northwind provides the following services to project developers, asset owners, and OEMs: project operations and maintenance; service and repair: construction services / construction management: project commissioning; consulting services; and, crane and rigging requirements.

www.northwindsolutions.com



#### **PermaCity Solar**

PermaCity Solar offers specialized energy solutions. The company ensures its clients minimize their carbon footprint and maintain a long-term, competitive advantage by installing solar power systems engineered to significantly reduce energy costs. PermaCity Solar has demonstrated particular expertise in designing and installing its systems atop large commercial buildings, government institutions, and homes. The company believes that on-site clean energy generation can be achieved through the implementation of solar systems that utilize environmentally friendly and energy efficient building materials in a cost-effective manner. Since 2006, PermaCity Solar's commercial division is partially owned by Mangan, Inc., specialists in engineering and automation. www.permacity.com



#### **Renewable Energy Systems** Americas Inc.

RES Americas has been developing, constructing (including third party construction), owning, and operating renewable energy projects since 1997. RES Americas encompasses all the necessary expertise to create renewable energy projects. They have constructed over 4,100 MW of renewable energy projects, with another 1,100 MW under construction and approximately 10,000 MW under development. Their in-house expertise ensures a smooth transition from development, construction, through to operation, ensuring budgeted costs are met, and the project is completed on time. www.res-americas.com



#### SkyFuel, Inc.

SkyFuel, Inc. makes an advanced, glass-free parabolic trough solar thermal collector, called the SkyTrough. SkyFuel solar collectors harness solar radiation to produce steam for electricity generation and industrial applications, and are highperformance, low-cost, as well as utility scale. SkyFuel is also developing next-generation, high-temperature parabolic trough and linear Fresnel systems. www.skyfuel.com



#### **SMA** America

SMA America's utility scale Sunny Central 800CP solar inverter, which earned the Intersolar PV Award 2010, is the first outdoorrated, single device with a nominal capacity of 800 kVA and 98.6% efficiency. With a compact, weatherproof design, it can be installed almost anywhere, providing integrators with a variety of configuration options. SMA's patented OptiCool system allows the Sunny Central 800CP to reach full power in ambient temperatures up to 122° F. In temperatures below 77° F, its peak continuous power is 10% higher: 880kVA. Integrated grid management features include remote control of active and reactive power; automatic over-frequency response; automatic power factor adjustment; power curtailment; and, low-voltage ride through. SMA America is taking orders for the Sunny Central 800CP, which will be available for delivery this year. www.sma-america.com



#### SOLON Corporation

SOLON Corporation offers a unique combination of PV module manufacturing and power plant expertise to the NA marketproviding complete turnkey PV systems solutions from design and construction to financing and operation. SOLON's modular Velocity MW solar power plants are designed to maximize kWh with the fastest realization of grid-connected solar electricity. Features include large SOLON modules, single-axis tracking, modular 1 MW blocks, centralized power conversion box, advanced SCADA system for remote monitoring and maximizing uptime, streamlined installation and reduced permitting time, as well as easily scalable to 100 MW+. All Velocity solar power plants combine high-efficiency components with proven design and construction to reduce energy costs. Innovative financing through SOLON's power purchase agreements provides the immediate benefit of lower electricity rates with no upfront investment-just a monthly solar electricity fee with predictable rates over the life of the contract.

www.solon.com

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#### **USA WIRE & CABLE**

USA WIRE & CABLE is first in solar cable and is the largest supplier in North America of the most efficient connector on the market: Amphenol's H4 connector. Their PV wire is currently the most widely used, installed on approximately 15% of the world's modules-along with millions of feet installed in PV projects throughout North America. USA WIRE & CABLE offers a massive inventory and exceptional service for all cable and connector needs www.usawire-cable.com

#### **OTHER | Custom Automation**





#### **Isthmus Engineering &** Manufacturing

Isthmus Engineering & Manufacturing provides custom automation solutions for solar industries, including thinfilm and crystalline PV. CPV. and solar thermal. Isthmus creates custom automation solutions not otherwise available in the marketplace, resulting in higher efficiency, improved quality control, and lower manufacturing costs. Isthmus' automation solutions encompass a range of manufacturing technologies including robotic integration, machine vision, custom material handling, system integration, custom packaging, web handling, and other custom processes. Isthmus concepts, designs, and builds each project at their facility in Wisconsin, and all projects are built 100% in-house. Isthmus Engineering & Manufacturing is a worker-owned cooperative. www.isthmuseng.com

#### **Environmental Test Chambers**



#### **Envirotronics**

Envirotronics offers the design, manufacture, and service of environmental test chambers. Their market position in engineering excellence, skilled manufacturing, application specialists, and expert service response allows them to be a trusted provider. Envirotronics' offers a full line of both standard and custom solutions. They have the right chamber for testing applicationfrom small, benchtop units to full-sized drive-in chambers. Whether testing requires temperature, humidity, thermal shock, altitude, HALT/HASS, corrosion, sand and dust, or other type of environment, Envirotronics has the answer. Envirotronics is IS09001\_ANSI/IS0/AS0\_09001 certified and A2LA Accredited www.envirotronics.com

#### **Microblasting Equipment for PV** Manufacturing



#### Comco Inc.

Comco Inc. manufactures micro-abrasive blasters, which provide solutions for the solar industry. Micro-abrasive blasting is an effective method for edge deletion on solar cells. It can also be used to texture delicate wafers without causing microcracks. Other applications include cutting slots, holes, and apertures in thin, fragile substrates and contouring or beveling edges of silicon power devices to expose a junction, or for removal of paper diffusion mask residue and metallization layers on wafers www.comcoinc.com

#### **PV Materials—Backsheet**



#### Madico

Madico offers a variety of backsheet constructions and colors to meet the specific requirements of solar panel designs. Their Protekt Technology includes multi-layered laminates designed for PV solar panels. They are one of the most cost-effective and environmentally friendly backsheet options on the market today. Protekt is a suite of eco-friendly backsheets that provide solar panel makers with maximum power, bond strength, weather resistance, as well as aesthetically pleasing design options. All backsheets are based on the lean and efficient use of the best materials available. Each conforms to the utmost level of performance, reliability and conformity to IEC, UL, and industry standards.

www.madicopv.com

#### **Power Transformers**



#### Virginia Transformer Corp

Virginia Transformer is "an engineering firm that makes transformers." With a 40-year history in custom design, VT is a US power transformer manufacturer with the broadest product range in North America. Their three manufacturing facilities produce transformers for every conceivable application-utility. industrial, commercial, alternative energy, transit, and specialty markets. Superior quality, short lead times, expert engineering, cost optimization, if a power transformer is required. Virginia Transformer makes whatever is needed. www.vatransformer.com

#### Security & Theft / Loss Prevention



#### **Bryce Fastener**

Loss prevention fasteners keyed as a lock for exclusive security. Each Bryce Fastener is like using a padlock at every installation point, and is considered to be the first line of defense against solar theft. www.brycefastener.com

#### **Solar Marketing / Public Relations Front Page Solar Public Relations**

Front Page Public Relations provides PR and media relations services for local, regional, national, and global business-tobusiness accounts for energy efficiency (Demand Side Management), solar power and thermal, renewable energy, information technology, and other high-technology industries. www.frontpagepr.com

#### **Thermal Imaging / Cameras**



#### FLIR Commercial Systems, Inc.

Thermal imaging systems, from FLIR, assist the solar industry in quality control in PV cell manufacturing and in predictive maintenance programs within solar installations. Identifying defects in solar cells requires efficient, cost-effective test and measurement methods to characterizing performance and electronic structure. Using lock-in thermography techniques

the processed signal from a thermal camera's detector can yield quantitative measurements of I-V characteristics associated with localized shunts, calculate the reduction in cell efficiency, and map saturation current density and ideality factor over the entire cell. Fewer defective cells leaving the factory results in less downtime, improved performance, and increases solar's viability as a major energy source. Common on-site uses of thermal imaging include evaluating power output and identifying bad connections, soiled or shaded PV cells, shunt or series resistance and crystalline non-uniformities. Pro-active thermal imaging surveys of solar installation can identify problem areas, preventing offline incidents and reducing operation costs. www.flir.com/thermography/americas/us

#### **Solar Racking Systems**



#### **Skyline Steel**

Since 1983, Skyline Steel has been designing unique and innovative covered parking systems and solar support structures. Their complete turnkey operation allows them an unbeatable competitive edge to provide customers with maximum coverage at minimum cost. Skyline Steel's solar services division is committed to providing clients with the best solar support consulting, design, and fabrication by approaching every project with a focus on aesthetics, functionality, cost, and structural engineering.

www.skylinesolaraz.com

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# Geothermal Energy: New Opportunities for Energy Independence

Site assessment vital for geothermal production projects

By Jeffrey Benegar

Why is geothermal energy undervalued as a renewable energy source when the United States is struggling to reduce its dependence on fossil fuel? Successfully used around the world for more than a century, geothermal energy can provide a baseload of power, in contrast to the intermittent resources of wind or solar. And, with over approximately one-half the world's existing generating capacity in the US, a recent MIT report concluded that if all types of geothermal programs were utilized, the nation's energy needs could be met 2,000 times over.

Still, from 1998 to 2008 geothermal energy grew at only 3% a year in the United States.



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

As your plans for solar, wind and renewable energy projects emerge, put the energy of our lawyers to work for you. For more information, contact:

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Changes are on the horizon in the geothermal energy market, however. A recent report by the Geothermal Energy Association noted that, in 2009, the total installed capacity of geothermal energy in the US grew by 6%, with a 46% growth last year in developing projects. This large increase is due to changing tax policies, regulations, and stimulus funding. Geothermal sites take approximately three to five years to develop, so a key to success is a thorough understanding of the feasibility for energy production. Conducting a comprehensive site assessment prior to site development provides developers with a technical basis for understanding the extent of potential geothermal production and project risks/rewards.

#### There are three primary sources of geothermal energy:

- **1.** Dry steam reservoirs, which can provide the steam directly to a power plant;
- 2. Hot water reservoir used in "flash" power plants; and,
- **3.** Lower temperature reservoirs, which produce electricity in binary (heat exchanger) system power plants.

Typical depths of these formations may be as much as two miles below ground surface. Considerable challenge exists in identifying and evaluating these reservoirs. Site assessment and modeling can help identify suitable reservoirs for economically feasible geothermal production.

Site assessment is a step-wise process that begins with a review of existing data and information at the site, near-site, and regionally. This review should include existing wells, geologic reports, maps, and cross-sections. Existing wells can provide valuable information including formation penetration, open interval, bottom-hole temperature, water quality, dissolved gases (e.g. methane), and other pertinent data to assess the area and formations for geothermal production. Well logs, as well as core logs and geologic reports and studies, also provide important information with respect to lithology, structure and thickness, the identification of marker horizons, and faults that help define the extent of the reservoir. Key reservoir parameters (e.g., permeability, porosity) can be estimated from the data reviewed during this phase.

The next step in site assessment is the synthesis of the existing data into a conceptual model. This provides a consistent framework for presenting an overall understanding of the site and the potential for geothermal energy production. The key components of the conceptual site model include the structure and thickness of the reservoir, overlying and underlying formations of interest, the location and type of faults present, and key hydraulic properties such as permeability, porosity, and temperature. The conceptual site model can also identify data gaps and help direct future data collection activities at the site.

Initially, simple volumetric assessments can be made on the reservoir to provide a gross estimate of energy capacity in a reservoir. A more rigorous assessment method involves the use of a reservoir simulation model to better understand the size of the geothermal resource. This includes incorporating the geometry and hydraulic properties of the reservoir(s) being analyzed (calibrated to existing data, if available). The reservoir model domain should be large enough to predict long-term trends of the geothermal resource at a project/regional scale, but should also be local in scale

(e.g. refined grid spacing) to assess and predict shorter-term responses and local features (e.g. production/reinjection during commercial operations, faults/fractures).

The simulation model can provide volumetric estimates of the size of the reservoir and potential storage volumes, but can also provide meaningful estimates of the sustainability of reservoir pressures during geothermal production, production capacities, temperatures, and the effects on production due to faults/fractures. Additionally, the model can be used to answer important "what-if scenarios" to evaluate the economic feasibility of geothermal development. This includes the number of wells needed to meet production goals, optimization of well locations for both production and/or re-injection (if pressure maintenance is needed), and the length of time before pressure or temperature decline renders the reservoir unproductive.

Also, in geopressured reservoirs where hydrocarbons are present, a multi-phase reservoir model can be used to make estimates of the amount of gas that can be co-produced during geothermal production operations, providing an additional source of energy. Geothermal projects can also provide further environmental benefits. Recent consideration on the beneficial reuse of captured carbon dioxide  $(CO_2)$  as the re-injectate fluid during geothermal operations can be assessed using a multi-phase model. This beneficial reuse of CO<sub>2</sub> can help reduce greenhouse gas emissions.

Site assessment and model simulation analysis provide a go/no-go decision on the technical merits of the geothermal production project. This type of analysis provides the investigator an excellent tool for making management decisions before committing considerable time and resources to expensive field activities (e.g. the drilling of new wells). Integrated with subsequent analysis, such as capital and operating cost analysis, cost/benefit analysis, calculation of payback period, installed cost per MWe, Levelized Cost of Energy (LCOE), and Return on Investment (ROI), will dictate if a geothermal project will move forward.

Thirteen states have over 150 geothermal power plants at various stages of development. The MIT report says the potential for geothermal energy is the US is more than 100 GW in the next 50 years. Using comprehensive site assessment tools can help economically develop this important renewable energy resource, and help reduce dependence of fossil fuels.



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Sustainable Productivity





# Producing Geothermal Power Generating more power from the same resource

By Robert D Hunt

Geothermal has recently become the darling of electric power companies because of its dependable, baseload 24/7 power, and because its costs are more competitive with fossil fuel power generation. One way geothermal power is generated is through the direct-drive of turbines by steam from steam fields, such as the Geysers. Another method involves flashing hot water to steam in very hot liquid resource areas. Often the discharge water from the flash unit is run through an Organic Rankine Cycle (ORC) to produce more power. The ORC is also used extensively in low-temperature power generation.

The steam engine was the original ORC unit that used a boiler to vaporize water into steam and produce power. Today, low boiling-point liquid organic fluids are used instead of water, which are capable of operating at much lower temperatures. However, the historic low-efficiency of the ORC process (8% to 12%), due to the large amount of heat energy needed to perform latent heat phase change, has been a major concern for geothermal operators as the power output is low, and the poor ORC thermal efficiency drives up the costs.

So, are there other options? Is there a better way than the ORC to produce geothermal power? Researchers are now evaluating alternative, single-phase power cycles, such as the Stirling and Ericsson cycles, which gain higher thermal efficiency than what can be attained by ORC technology. This is especially important for and pertinent to low-temperature geothermal as it does not contain a great deal of heat energy. If inefficient phase change is a major limiting factor to efficiency, then changing to power cycles that do not perform phase change should be considered for better efficiency.

#### Generating geothermal energy: the choices

The Stirling cycle, used in automobile engines and in the solar thermal power industry (albeit at much higher temperatures than is generally provided by geothermal energy) is a candidate. However, work on the cycle has not reached an adequate level of aptitude or performance because heat exchangers must first be successively

ergy, and requires a very large system for the amount of power produced. The Brayton cycle, used in airplane engines and gas-fired generators, compresses

air into a combustor, adds fuel for combustion that heats the compressed air, and increases its volume to drive a turbine. The Ericsson cycle works in much the same manner, only heat is provided indirectly, making it better suited for closed-cycle renewable energy resources.

heated, then cooled. This is logistically difficult to accomplish, wastes thermal en-

The Ericcson cycle, which remains in the gaseous phase and has an efficiency greater than 40%, has never been applied to geothermal power generation.

Initial study indicates that substantial additional power can be derived from a given geothermal resource using a proprietary modified Ericcson closed cycle as a replacement for an ORC unit. In the proprietary design, a high vapor pressure working fluid is cooled by an internal refrigeration cycle as it is isothermally compressed. Next, indirect heat is added to the cool, compressed working fluid within a heater that provides low-temperature heat energy from a geothermal source (or even a concentrated solar source). This causes the compressed working fluid to expand in volume due to the heat input so minimal gas compression is needed, allowing the process to be quite efficient.

#### Thinking outside the box

What else can be done to increase power output for geothermal power generation? The answer lies in the effect of gravity on the gas-lift process. That's right: gravity. Hydroelectric power generation is produced directly by gravity, even though no power cycle has ever gained additional power from gravity.

Our planet uses gravity in association with thermodynamics. Evaporation of water occurs after thermodynamic heat input and, then, gravity causes lighter-thanair (buoyancy a function of gravity) water vapor to rise high into the atmosphere. Afterwards, the water condenses via thermodynamic heat rejection to complete the cycle—which causes rain that is heavier than the air to fall from the sky, rushing rivers to run down hillsides, and hydrostatic pressure of water behind damns to produce hydroelectric power.

Closed-power cycles can be used to drive the gas-lift process that uniquely taps into the gravitational pull of the earth by making the water column lighter during the gas-lift process. The pressure of the reservoir is a function of the pull of gravity on the geology of the earth. A column of pure water within a geothermal well applies an opposing force to the pressure of the reservoir. When low-density gases displace heavy water, the weight of the column becomes less. But the reservoir pressure is unchanged by the process, and the pressure differential causes the pressure of the reservoir to force the water and gases from the well.

High vapor pressure working fluids, such as CO<sub>2</sub>, can generate thousands of pounds per-squareinch of pressure within a Rankine cycle boiler. So, it does not take any more energy input to pressurize the working fluid deep into a geothermal well than it does to force it into a high-pressure boiler. But the power output of the gas-lift process, in many cases, can be over twice as great due to the effects of gravity, which can potentially double the power output of geothermal power generation by using the process.

#### **Conclusion:** Putting it all together

The ultimate, most efficient geothermal system of the future might be a combination of methods presented, such as an Ericcson cycle powered gas-lift process that stays in the gaseous phase and then gains additional power from gravity, or it may be a totally new power cycle or process that we have not yet even considered. Regardless of the method, it is clear that if geothermal can produce power output significantly greater than it currently does from a given resource, it will unquestionably be by far the lowest cost, most reliable, and most efficient source of renewable energy power generation on the planet.

Robert D Hunt is the chief scientist for *Linear Power Ltd. His scientific paper* titled, "Evaluation of the Effect of Gravity on the Total-Flow Geothermal Power Cycle," presented during the Geothermal Resources Council (GRC) 2010 Annual Meeting is available at the company website.

Linear Power Ltd. www.freepistonengine.net



#### Indoor split geothermal unit

The Tranquility Split Geothermal System consists of the Tranquility Indoor Split Unit (TTS) and the Tranquility Air Handler (TAH). When paired together this series has among the highest efficiency rating of any geothermal system on the market today. The Tranquility split system easily connects to new or existing fossil fuel and electric furnaces, and uses the environmentally friendly refrigerant EarthPure HFC-410A. It exceeds ASHRAE 90.1 and Energy Star 3.0 efficiencies, and meets requirements for the 30% federal tax credit on installation costs.



Designed for the replacement market, quiet indoor installation will fit in any attic, furnace closet, garage, or basement. The TAH units are fully convertible upflow, downflow, horizontal right and left downflow, making them ideal for remote applications such as a crawl space or an attic. Other features include condensate over-flow protection, 230v-115v compatibility, bi-directional thermal expansion valve, control transformer with circuit breaker protection, large removable access panels, and dehumidification mode for high latent cooling. Together, this system is a perfect solution for any new construction or retrofit application. ClimateMaster | www.climatemaster.com



Geothermal drilling connections

Tenaris offers premium connections for geothermal drilling projects, which often involve unconventional wells and challenging designs such as deviated or lean profile wells. Tenaris's comprehensive range of TenarisHydril premium connections help deal with the high temperatures and high loads associated with geothermal operations. The technology outperforms standard connections, which render inconsistent results in geothermal operations and are often unfit to handle bending. Their Blue Series offers extreme sealability, as well as high-fatigue resistance and torque capability. TenarisHydril Wedge Series 500 offers exceptionally high-torque capacity, thanks to its dovetail design. Tenaris | www.tenaris.com



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The non-pressurized QT Flow Center pumping station is a deluxe protection accessory for the closed-loop system. Unlike other pump protection devices, the QT Flow Center includes patented features unavailable elsewhere. For instance, the QT includes a built-in pump protection feature that eliminates the need for a flush cart when filling and flushing a closedloop system when manifolds are indoors. Since it's non-pressurized, it allows users to add fluids, like antifreeze or water, while automatically eliminating air from the closed-loop system. Plus, the top is completely sealed to keep out dirt and air. This means trouble-free operation, easy installation, and fewer callbacks. **GEO-HYDRO Supply, Ltd.** www.geohydrosupply.com

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A s budgets continue to shrink for cities and towns, the prospect of building and financing an energy plant is most likely nauseating to municipal leaders. However, a new trend is beginning to emerge at wastewater utilities where innovative municipalities are teaming up with the private sector to finance and build new biogas utilization facilities and pipelines that convert sewage and sludge into usable energy product.

Nearly all of a water utility's waste can be recycled or reused by taking biogas generated during the sewage treatment process and capturing and refining it. The gases emitted from sewage make it a renewable energy source that can be harnessed and repurposed to be used for energy generation on-site, or even sold as an energy commodity to the open market, creating new revenue streams for cash-strapped cities and towns. The first sewage facility in the United States to refine biogas for the grid went online in September 2010, when the San Antonio Water System (SAWS) and Ameresco, Inc. opened a new biogas facility at the Dos Rios Water Recycling Center. SAWS is the first large wastewater utility to partner with a private sector company to actively sell biogas in the US.

By partnering with a private entity that can provide risk, technical, and financing expertise, a wastewater utility, which is usually owned by the municipality that it serves, can become a self-sustaining energy generator with a relatively low capital investment. Although there are substantial capital investments in equipment and technology upgrades needed to implement projects such as these, through a combination of energy savings, government grants, and utility company incentives, the economics of a biogas facility construction and operation can actually be quite favorable.

In the case of San Antonio, under a 20-year partnership, Ameresco will invest the capital necessary to treat and deliver up to 1060 standard cubic feet per minute (SCFM) of biogas to the natural gas market. In return, SAWS ratepayers will receive a royalty on the sale of the gas, estimated at \$200,000 a year. SAWS invested about \$1 million in pipelines and structures that were constructed, and it expects the biogas plant to have paid for itself in as few as five years. Those funds will help to reduce the cost of SAWS operations and keep rates affordable. This additional revenue stream can

# First Mover Wastewater Utilities Convert Human Biogas into Natural Gas

Five-year payback on biogas plant for a municipality made possible through public-private partnership

By Michael T Bakas

be significant in today's economic climate, and could allow a municipality or owner of a wastewater utility to invest in the efficiency of their operations with minimal risk.

A major metropolitan water recycling center typically treats the wastewater that is collected in a central sewer shed of a city. In San Antonio, 1.1 million citizens produce about 140,000 tons of biosolids each year. Treating these biosolids generates an average of 1.5 million cubic feet of untreated digester gas every day. That's enough gas to fill seven commercial blimps. Digester gas is the product of decomposition of biosolids, sludge, human waste, and industrial waste. For years, water utilities have been clearing off the waste gas and burning it, typically using flares. Now, this methane gas is being captured, transferred to a processing facility, and then injected into a natural gas pipeline where a third-party buyer can purchase the gas in the open market. It is refined to pipeline quality gas specifications.

A new fuel supply provides new opportunities for on-site generation or steam combustion. It could fuel large fleets or public buses that utilize compressed natural gas (CNG), alleviating the need to purchase costly fuel for plant vehicle operations, and minimizing air emissions. In addition, it can be sold to an electric utility, a natural gas power plant, or into a fuel supply contract or power purchase agreement (PPA).

In San Antonio, gas is sold to third-party energy providers. Local subcontractors and operators were hired to build and operate the project. Sewage now treated at Dos Rios is used to generate three environmentally friendly products, which SAWS calls its "recycling trifecta." In addition to the new gas injected into the pipeline, SAWS generates recycled water, improving river quality, and used in place of potable water by industry and manufacturers. About 115 million gallons a day of high-quality recycled water are used at the Riverwalk, golf courses, parks, and commercial and industrial customers. It also generates compost from waste, which is used to improve soil quality. SAWS also generates compost from waste, which is marketed locally to improve soil quality.

In Texas, the Dallas Water Utilities (DWU) biogas plant will generate 4.3 MW of electricity and thermal load to power its own facilities. As an added benefit, the free waste heat from the generators will be used to heat the digesters. The plant will offset

the electricity that the DWU currently pulls from the grid. DWU has the option to sell the generated electricity back into the grid.

By leveraging biogas, a renewable resource that is naturally emitted during the wastewater treatment process, new market opportunities have emerged. With the right technological tools and financing mechanisms, local governments and water utility owners can now make a risk-averse investment in the local economy that is environmentally friendly and beneficial to the customers they serve.

#### Michael T Bakas is senior vice president of Renewable Energy at Ameresco, Inc.

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#### Growers Ready to Put Marginal Lands to Better Use

Reports indicate that growers are ready and willing to produce biomass for biopower and advanced biofuels—and have the land to do so. A survey, by energy crop developer Ceres, Inc., of US growers showed that 71% of respondents were very interested or interested in growing dedicated energy crops. Moreover, 77% said they had under-utilized land on which to establish energy grasses like switchgrass, sorghum, and miscanthus.

Agricultural producers said the ability to diversify their current operations was the most appealing benefit of energy grasses. They were also keen on making better use of their marginal land and spending less time, money, and resources on crop management. In what is considered good news for end-users, growers were solidly supportive of long-term contracts with customers. Over 70% were very interested or interested in growing under contract, and 48% they would anticipate putting at least half their acreage in long-term contacts.

"This is one of the areas where we were interested in learning more about, since reliable feedstock supplies will be critical for new bioenergy facilities to obtain project financing," said Gary Koppenjan who directs communications and product marketing for Ceres. "What constitutes a long-term contract will likely be an area for discussion, but it appears the suppliers and users are on the same page."

Somewhat surprisingly, Koppenjan said growers showed little interest in owning a piece of the bioenergy facility and were more interested in incentives for quality and inflation adjustments, or prices linked to energy prices. Ceres expects to explore this area more in future surveys, he said. Ceres says that the grower enthusiasm for homegrown bioenergy reflected in this survey is being tempered by the slow implementation of Department of Energy loan guarantees, which were authorized by Congress and promoted by the Obama Administration as a cornerstone of its renewable energy policy.

"There's a lot of frustration with the delays in getting the guarantees implemented," said Frank Hardimon, Ceres seed sales director. "If we could get the first several cellulosic biorefineries built, the US would be well on its way to greater energy security and lower emissions, as well as lasting job growth, especially in rural communities."

The non-scientific survey was weighted to growers in the Southeastern United States.

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# The Power of Vaste Innovative dairy fuels green energy microturbines with manure

By Jim Crouse

Digester plant at den Dulk Dairy in Ravenna, Michigan. Waste methane gas from the anaerobic digester fuels a microturbine that produces 30-kilowatts of clean, green electricity and 45-kilowatts of thermal energy used for building heat.

even gallons of milk isn't the only thing an average dairy cow produces each day. It's the "other output," about 10-and-a-half gallons of manure a day that some progressive dairy farmers are using to fuel on-site power for their facilities.

For several years, the den Dulk Dairy in Ravenna, Michigan has converted manure from 1,000 of its cows into 30 kilowatts of clean, green electricity produced by microturbines. In addition, heat from the microturbines is captured and reused to heat the farm's 700-square-foot concrete liquid/solid separator building.

The energy system at den Dulk is called a Combined Heat and Power system (CHP) because electricity and heat are produced at the same time from one fuel source. A CHP system fueled by biogas significantly increases energy efficiencies of an on-site power plant—from about 30% to more than 80% when microturbine technology is incorporated. The result is a significant reduction in energy costs.

At farms, landfills, and wastewater treatment plants around the world, methane gas is a by-product of day-to-day processes. Unfortunately, the methane gas oftentimes is flared or, worse yet, vented directly into the atmosphere. Methane has a greenhouse-gas impact on the atmosphere 21 times that of carbon dioxide. Flaring methane completely wastes its energy value. An ideal environmental solution is to use these waste gases to generate renewable power. This is exactly what the team at den Dulk Dairy is doing. At the dairy, manure is first pumped through an external heat exchanger that heats the material to 100° F, then sends it to a 47-foot-tall, 48-foot wide digester tank. The external heat exchanger actually runs off a portion of the biogas created by the process. The digester at den Dulk is an anaerobic digester, which uses no oxygen in the process. The digester features a continuous stir-tank reactor that mixes the heated manure to break it down, thereby creating biogas.

The anaerobic digester at den Dulk Dairy has several innovative features including equipment to remove toxic hydrogen sulfide from the biogas, pumps built in the digester tank foundation (so that any sediment build-up can be removed without emptying the tank), and separate units for easy operation and maintenance functions. Because microturbines can run on a variety of fuel types—from liquid, natural gas to diesel fuel, as well as biogas—they were the natural choice to create electricity from the biogas.

The Combined Heat and Power system at den Dulk Dairy contains a lowemission microturbine that produces 30 kilowatts of continuous power, and 45 kilowatts of thermal power. In addition, the system features a 2.8 million BTU boiler. Heat exhaust from the microturbine is either pushed directly to the digester



or delivered to a heat exchanger that warms hot glycol. The glycol provides heat throughout the plant, just as the boiler does.

Previously waste from den Dulk, which is home to 3,000 cows and produces 155 million pounds of manure a year, was stored on-site and eventually spread on farm fields across West Michigan. Environmentalists and state regulators say such storage practices cause environmental problems with runoff into rivers and streams.

Microturbine systems, which can range in size from 30 kilowatts up to five megawatts, can be specifically designed to operate on biogas such as methane produced from manure, food waste, landfills, and wastewater treatment plants. Although such biogas fuels contain useable energy, unfortunately, they also have low-energy density and are usually contaminated with other gases, such as hydrogen sulfide.

Microturbines make system design easier than traditional generating technologies because they operate on a wide range of fuel types, automatically adjust to changing energy densities over time, and accept high levels of

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68



#### Liquid ring vacuum pump & compressor

Gardner Denver Nash is pleased to introduce its newest member of the Vectra series of liquid ring pumps and compressors: the NASH Vectra XL 950. Designed to meet the widespread needs of the process industry, the Vectra XL 950 extends Nash's Vectra series to the largest capacity ever—5300 CFM (9000 m3/h). The NASH Vectra XL 950 series features a long, reliable life, high efficiency, and the flexibility to tailor the pump to specific needs.

Features include: low operating speeds that ensure a reliable operating life; vacuum and compressor capability, with vacuum pump operation to 28.5" HgV (50 mbar abs) and compressor operation to 30 PSIG (3 bar abs); o-ring sealing; oil lubricated bearings option; and, single point inlet and discharge connections. The NASH Vectra XL 950 series eliminates the need for manifolds, simplifying process piping, saving space, and reducing the installed cost. ATEX certification pending. **Gardner Denver Nash** | www.gdnash.com



# Whole tree chipper to enhance jobsite productivity

The Vermeer WC2300 whole tree chipper is powered by a 440-hp (328.1 kW) C-13 CAT diesel engine that allows for maximum output while consuming less fuel than higher-powered machines. A six-degree slope of the infeed table lowers the "break-over" point, where long material first contacts the machine, reducing the likelihood of limbs or tree canopy from snagging on the end of the machine. The infeed system features a variable-speed, dual-infeed conveyor chains, a conveyor head pulley with integral grip bars, and an aggressive large-diameter infeed roller with crush capability.

These design elements provide efficient feeding of difficult material types, reducing the number of times an operator has to handle the material. Two drum knife options are available—double-edged or babbitted single-edge cutter knives allowing the operator to select the type of knife that best suits their operation, jobsite, or customer requirements. A compact design allows for more maneuverability and easier repositioning of the machine on the jobsite, especially with the grapple grip collar area on the WC2300 tongue. Machine functions can be controlled remotely using a handheld remote control that also provides real-time machine performance data to aid the operator in maximizing productivity by monitoring and adjusting settings.

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#### Grinder replacement parts

CW Mill Equipment Co., Inc. has a new brand: ARMOR-HOG Grinder replacement parts. ArmorHog provides top quality, high-performance screens, tips, hammers, and other replacement parts for all brands and models of industrial grinders. ArmorHog provides custom-made hammer mill screens and grates for all brands, all configurations, and all models of grinders, and is one of the best choices for grinder tips, bits, strikers, and replacement hammerheads. ArmorHog uses the highest quality parent metal in all of its forgings and has its own unique blend of carbide called NitroGrit, a proprietary blend of carbide found to best suit grinding applications. ArmorHog tips with NitroGrit carbide matrix to provide the best performance and the longest life. NitroGrit can be applied in any custom pattern requested, and is available in a variety of grit levels.

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#### Extreme duty portable grind

Continental Biomass Industries, Inc. (CBI), manufacturer of the Magnum Force Series 8400, introduces the latest addition to their powerful product line: the Magnum Force Series 5400. The 5400 is the perfect machine for the ever-changing market opportunities. It features five interchangeable, fieldswappable rotors, allowing operators to handle virtually any job that comes their way. With its powerful 765 HP CAT engine, operators can go from making high-quality mulch out of trees and stumps to reducing stemwood to custom-size chips by simply swapping rotors and quickly changing screens. With its flexibility and durability, users can even grind contaminated C&D, telephone poles, and railroad ties with the tie plates still attached. The 5400, which is road legal (width and weight), also accepts an optional quick disconnect three-axle dolly providing the portability needed.

Continental Biomass Industries, Inc. | www.cbi-inc.com



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contaminants such as hydrogen sulfide. The microturbine installed at den Dulk Dairy can accept hydrogen sulfide levels as high as 70,000 parts per million. In addition to being clean burning and efficient, microturbines are known for their reliability since they have only one moving part, and have air-bearing technology that does not require any lubricants or coolants. Because of the lack of moving parts and lubricants, maintenance is much less than traditional reciprocating engines. Once a year, a filter change occurs that takes less than six hours to complete. In addition, after every 40,000 hours of runtime, the engine is exchanged, which takes two technicians less than six hours to complete.

This project is being conducted with the Michigan Alternative and Renewable Energy Center and was funded with a \$1 million grant from the Michigan Public Service Commission. The den Dulk farm contributed \$1.2 million for the site preparation required to host the biodigester.

Digesters, especially those that incorporate microturbine technology in a Combined Heat and Power application, are the future of the agriculture industry. Not only can digesters become a distributed generator of electric and thermal power from their waste stream, but they also help farms continue to manage their waste stream in an environmentally responsible manner.

*Jim Crouse is executive vice president of Sales and Marketing at Capstone Turbine Corporation.* 

Capstone Turbine Corporation www.capstoneturbine.com

# A Breakthrough in Clean Energy Technology

Taking advantage of a tremendous energy resource in the earth's atmosphere—just add water

By Fred Masciarelli

he world's appetite for energy continues to grow, as does the technology available to capture energy. A new system has been developed for eco-friendly hydroelectric power generation that facilitates the efficient, systematic transport of water into energy.



#### How it works

This system conveys water vertically, and then siphons it down onto a turbine generator to produce clean, safe, renewable hydroelectric energy. It will not produce direct waste, and will have a considerably lower output level of the greenhouse gas carbon dioxide ( $CO_2$ ) relative to fossil fuel powered energy plants. This hydroelectric system can dispatch electricity safely through an existing grid to the consumer, dedicated freestanding hydroelectric projects, electronic storage devices such as ultra capacitors, hydroelectric backup systems, and portable units for emergency assistance missions and military operations.

All applications can be built on-site or prefabricated off-site and transported to, and later assembled, at the designated location. At the heart of the system is a unique hydraulic pump design.



"The main principle of this system is the combination of input energy from a water pump and gravitational energy, similar to the standard hydroelectric systems," explains Franco Gaspari PhD, assistant professor of physics at the UOIT Faculty of Science. "This allows for the output energy to be greater than the energy expended by the pump. The major innovation in the system is, indeed, the internal and external pump set-up, which brings the water with a relatively high flow at heights three to four times greater than those achieved by similar, standard water pumps."

#### Scientific background

A basic Thermodynamics law (Carnot's principle) states that it is impossible to build an engine that produces more energy than it uses. However, this principle holds for closed system, that is, for those systems that are isolated from external input. This set-up uses input energy from the pump, plus the gravitational field (in the form of pressure). Therefore, the output is still less than the input, but more than the man-made power.

There are similar existing systems that use a combination of water pump and gravitational field. Indeed, city water is usually delivered from a high water tower, which is kept filled by a water pump. Also, hydroelectric systems use dams that are filled overnight by water pumps (during the time of lowest rates for electricity cost), to deliver during peak demands (at highest cost of electricity); thereby, making such a set-up economically viable. However, these systems do not produce more energy than that used by the water pump. This system uses a modification in the design of a low-power water pump to maximize the contribution of the external factors (gravity), and obtain a higher output that the energy used by the pump.

#### **Experimental results**

Preliminary testing conducted on a prototype confirms the advantages of such a system. A modified 3hp water pump (~ 2.2 kW) was used to draw water through a 2.5" tube from a height of approximately 5m. The water was then pumped through a 2" tube to a height of 20m. The total height (head) achieved in this configuration was 25m and a flow of ~ 15 l/s.

Calculations of electricity conversion from the water flux were done using standard industry formulas for commercial turbines. The main parameters used in these calculations are the head (25m, 20 meter from the pump discharge height plus five meters), and the flow (15 l/s). Efficiency losses are dependent on the turbine characteristics. For a 100% efficiency, the output power would be ~3.5 kW. For a (low) 70% efficiency, 2.5 kW would be obtained. Turbines with 85% to 90% efficiencies are available. It is worth noting that consumption tests of the 2.2 kW water pump indicated an actual power of 1.96 kW.

#### Summary

The main functions and components of the system can be summarized as follows:

1. The water pump is a "well" pump that uses the gravitational field to raise the water from a depth (h1) of approximately five to seven meters (ideal maximum limit is ~ 10 meters). *Continued on page 72...* 

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#### A Breakthrough in Clean Energy Technology ...continued from page 72.

The low-pressure side of the pump creates the "sucking" effect to allow the water to reach the pump level.

- 2. The second function of the pump is to raise the water at a certain height (h2). In the patented design, a 3hp pump is able to create a high pressure at the topside of the impeller.
- 3. Furthermore, the return tube goes below the pump level, adding an enhanced siphon effect, thanks to the high pressure from the pump topside, as compared to the output pressure of 1atm.

Power-generating stations can be scaled utilizing multiples of horsepower (pumping capacity of each pump) and number of pumps. Each particular application would determine the appropriate configuration. A one-megawatt configuration, for example, could generate an annual output of 9,743 mWh (70% capacity factor) to facilitate the electricity demands of 812 households\*.

The above configuration was sited to provide perspective relative to a one-megawatt utility scale wind turbine that produces 3,066 mwh of electric energy (35% capacity factor).

Such systems for electrical power generation would be exceptionally useful for local applications. Modular units could be constructed through a variety of configurations within close proximity to meet the specific electric energy needs, resolve any existing transmission line capacity issues, and designed to conform to the surrounding environment.

\*Based on per household electric energy consumption of 12,000 kwh annually.

Fred Masciarelli is vice president of Investor Relations and Marketing at Genesis HydroElectric, Inc. and Strategic Media Council for VMC Media.

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#### **Tidal turbine generator**

BELUGA 9, intended for very powerful currents (up to 4.5 metres per second, or 9 knots, on the surface during spring tides), is Alstom's first tidal turbine generator. When mounted, it will have a diameter of 13 meters and a total height of 20 meters-the equivalent of a six-storey building. It will be suited to sites at depths of 30 meters or more. The tidal electricity generating turbine will undergo its first tests in 2012, in the Bay of Fundy, Canada.

In addition, Alstom has just begun preliminary studies for the development of a second model, intended for sites at greater depths where the tide is less powerful; testing should begin in Brittany in 2013. If all suitable underwater locations were equipped with tidal generators, it would be possible to generate 100 TWh of electricity annually: enough to supply power to 20 million households in Western Europe.

Alstom | www.alstom.com/power



#### **Commercial-scale** wave power

Ocean Power Technologies (OPT) recently revealed progress in its 150kW PowerBuoy project to be deployed off the coast of Reedsport, Oregon in 2011. With the steel structure for its PB150 PowerBuoy completed, fabrication is now under way on the power take-off and control systems, which will be tested out initially on land in the first half of 2011 before ocean trials begin. OPT, looks set to become the first company to deploy a utility scale wave farm in US waters.

The staff of the Federal Energy Regulatory Commission has issued an environmental assessment recommending the licensing of the 1.5 MW Reedsport OPT Wave Park off the coast of Oregon. Ocean Power Technologies Inc. hopes to obtain a license in 2011 for Reedsport, called the "first commercial-scale wave power project in the United States." OPT filed a settlement agreement with FERC in August, outlining proposed terms for licensing the project. The Reedsport project consists of 10 PowerBuoy wave energy converters to be installed in a 35-acre area of the Pacific Ocean 2.5 miles off the coast of Douglas County, Oregon.

**Ocean Power Technologies** www.oceanpowertechnologies.com

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# A Strong 2011 for Clean Technology

nvestments will remain vibrant, and industries to watch will include efficiency, biofuels, nuclear, recycling, and natural gas, clean tech analysis and consulting firm Kachan & Co. predicts a strong 2011 for alternative energy technology. Accordingly, the clean tech sector will continue to attract high levels of investment and foster innovation in new and unexpected areas in 2011. In brief, some predictions include...

### Sustained worldwide VC investment in clean tech

The industry is not on the downside of a bubble, Kachan believes, citing near record venture investment worldwide in 2010, massive funds still being raised by clean tech investors, and expectation that 2011 will bring an even more tangible appreciation of the drivers of cleantech: resource scarcity and the need for greater efficiencies, energy independence, and climate change.

### A return to early stage venture investments

Kachan forecasts a return to early stage venture capital investing in clean energy. Already, in the last few months of 2010, data showed an increase in early stage deals with investors piggybacking less on US government grants and loan guarantees, which had skewed investment into more mature clean tech companies.

"In 2011, venture investment in clean tech will return to what it does best: seeking out emerging early stage technologies and teams that promise good multiples, and will be less influenced by governments putting large amounts of capital to work themselves," maintains Kachan. "Funds are still being raised. And those funds will need to be invested."

### Energy efficiency emerges as the clear rock star of clean tech

"In 2011, look for efficiency to become the clear dominant investment theme as investors continue to seek less capital intensive efficiency plays," claims Kachan, who also expects a winnowing of efficiency companies in 2011, "Partly because of concerns about differentiation, and partly because of the long sales cycles of utilities that are only starting to become understood by startups in the space."

### Biofuel investment could reach former highs

After several years of relatively inexpensive oil, an upswing in biofuels

investment in 2011 is expected specifically, in drop-in biofuels. Cellulosic ethanol, which disappeared from headlines in 2010, may even disappear from investors' portfolios in 2011, citing expectation of the US Environmental Protection Agency lowering its cellulosic ethanol volume requirements. Full text of the 2011 predictions is available at www.kachan.com/cleantech-greentechpredictions-2011-forecast-trends.

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http://infocastnetwork.com/index.php/conference/439	72	American Solar Energy Society	www.ases.org
	51	Apogee Instruments	www.apogeeinstruments.com/clean-energy
22-25 Transmission Planning & Expansion West	38	Applied Energy Technologies	www.AETenergy.com
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24 AWEA Wind Power Supply Chain Workshop	75	AWEA	www.windpowerexpo.org
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WWW.globaloonovon.com	36	Carlo Gavazzi	www.gavazziOnline.com/Solar
<b>31-02</b> Sustainable Environment Technologies 2011	66	CBI	www.cbi-inc.com
Los Angeles Convention Center, LA, California	60 60	Clear Span	www.citel.us
www.energyemciencynews.com/events/	17	Con tooh Systems Ltd	www.clearspan.com
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3.5 PV America	60	Dehn	www.edben-usa.com
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www.pvamericaexpo.com	56	EcoFasten Solar	www.ecofastensolar.com
	55	Ecology and Environment. Inc.	www.ene.com
<b>4-6</b> International Conference on Concentrating PV Systems	65	GEFCO	www.gefco.com
Las vegas, nevada; www.cpv-7.org/cms	22	Greenpower Energy	www.greenpowercap.com
14-15 BiobasedChem Asia	37	Heliene	www.heliene.ca
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MAY	68	Hurst Boiler	www.hurstboiler.com
2-5 International Biomass Conference	59	Hydro Solar Solutions	www.hydro.com/northamerica/solar
America's Center-St. Louis, Missouri; www.biomassconference.com	13	Hytorc	www.hytorc.com/wind3
9-11 Wasta Expo 2011	14	Idaho Dept of Commerce	www.commerce.ldaho.gov
Dallas Convention Center—Dallas Texas	73	Intersolar North America	www.intersolar.us
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13-15 The Wind & Solar Expo 2011	28	Kipp & Zonen	www.kippzonen.com
Timonium Fairgrounds—Baltimore-Timonium	44	Magnetek	www.magnetek.com
www.thesolarandwindexpo.com	20	Milbank Tweed Hadley & McCloy II C	www.mersen.com
15-18 Hydrogen + Fuel Cells 2011	56	Pfister Energy	www.pfisterenergy.com
Vancouver Convention Centre—Vancouver BC: www.hfc2011.com	32	PNC Equipment Finance	www.pnc.com/ef
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16-18 NAWTEC	46	Premium Solar	www.presolarnet.com
Venue TBA—Lancaster, Pennsylvania; http://nawtec.swana.org	71	PV America	www.pvamericaexpo.com
17-21 ASES National Solar Conference	25	PV Powered	www.pvpowered.com
Raleigh Convention Center—Baleigh, North Carolina	45	Roll Battery Engineering	www.rollsbattery.com
www.nationalsolarconference.org	19	Romax Technology	www.romaxtech.com
	54	S-5	www.s-5-solar.com/nace
22-25 WINDPOWER 2011	61	Sapa Extrusions	www.sapagroup.com/solar
Anaheim Convention Center—Anaheim, California	3	Saton	www.satcon.com/solstice
www.windpowerexpo.com	49	Schletter	www.schletter.us
	7, 21, 42	Schneider Electric	www.schneider-electric.com
	26	Schurk Graphite Technology LLC	www.schunkgraphite.com
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	62	Troutman Sanders	www.troutmansanders.com/renewable_energy
	33	TTI Solar	www.ttisolar.com
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