

# North American **Clean Energy**

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## **2012 SOLAR BUYERS GUIDE**

### **Maximizing Your Return on Wind Investments**

Collection systems, micro-siting & more!

### **VHT Electronics & Geothermal Wells**

### **Unlocking the Potential of Wood-based Energy**

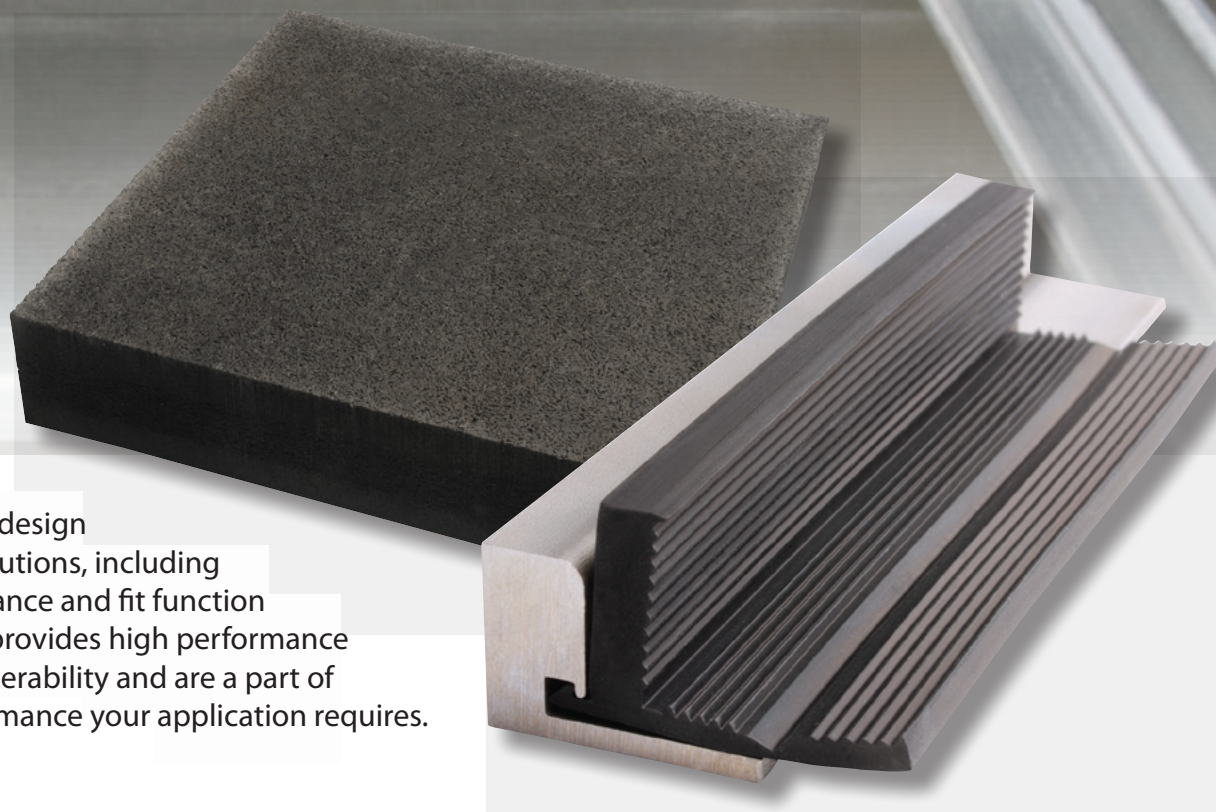
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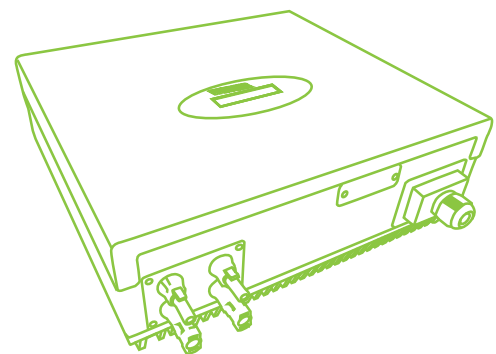
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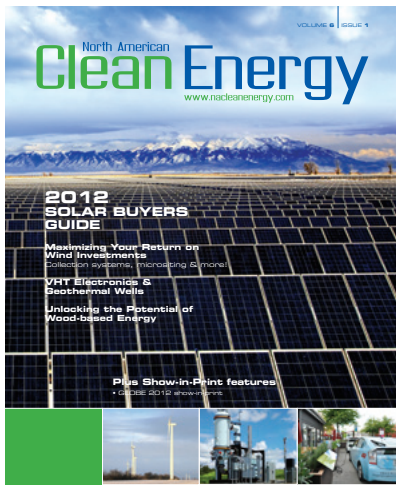


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A solar power project Array Technologies did with SunEdison in Alamosa County (Hooper), Colorado.

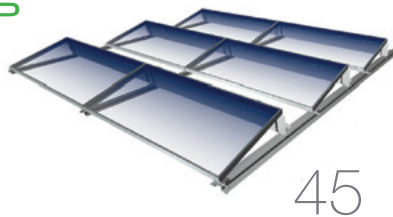
Photo courtesy of Array Technologies and SunEdison

Array Technologies | www.arraytechinc.com

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Photo by Michelle Moore

**HAPPY NEW YEAR! WELCOME TO 2012.** We, at *North American Clean Energy*, would like to start off the year by asking for your stories—those of a positive, altruistic nature! If your company is involved in donating, constructing, or contributing renewable energy sources to those who need it, essentially making the world a better place, please let us know so we can share it with our readers. Residential solar company Sungevity, for example, recently announced their “Every Child Has a Light” program, where they’ll donate a solar light kit to a school in need in Zambia for each residential solar panel installation in the US (read more in our news section below). Got a similar story or a charitable resolution for the New Year? Let us know how your company is paying forward renewable energy!

We’d also like to focus on all the possibilities 2012 has in store, though it seems there’s still much uncertainty. With the end of Section 1603 and concern over expiring Production Tax Credits (PTC) at the end of this year, some reports are promising while others are less so when it comes to the months ahead.

For one, solar power is predicted to get even cheaper. According to SunRun, the installed cost of solar dropped by more than 30% in the past year, and prices will continue to decrease. Modules could drop an additional 20% by the end of 2012, putting solar energy in reach for more American families ([www.sunrunhome.com](http://www.sunrunhome.com)).

However, PV equipment spending for thin-film panels and modules is forecast to decline. Based on findings from “Solarbuzz Quarterly,” financial challenges are forcing solar PV

companies to shift their focus from seeking market share, to a return to profitability ([www.solarbuzz.com](http://www.solarbuzz.com)). Research from Bloomberg New Energy Finance further attests that the US renewable energy sector must attract new investors and make use of unique tax-based financing structures in the next 18 months, or risk a sharp drop in new projects (more report details are on page 20, and for additional solar predictions, turn the page!).

With the looming expiration of the PTC overhead, the American Wind Energy Association (AWEA) forecasts a busy year: “Under-construction numbers are up; 8,400 MW were counted at the end of the third quarter in 2011. Expect them to continue to surge as 2012 gets underway” ([www.awea.org](http://www.awea.org)). But, a recent report from Navigant Consulting found that if Congress allows the PTC to expire, jobs in the wind industry will be cut in half—resulting in a loss of 37,000 American jobs and a one-third cut to American wind manufacturing jobs, while private investment in the industry would drop by nearly two-thirds.

This issue, we look at maximizing returns in wind energy collection systems (page 10), wind micro-siting (page 12), and consider cleantech investments in China (page 8). We also delve into the development of new, very high-temperature (VHT) electronic components, which can greatly benefit the geothermal industry (page 73). According to the Geothermal Energy Association (GEA), geothermal power production is predicted to increase in the years ahead, with a number of geothermal projects coming online in 2012 and 2013. Tax credits for geothermal energy and biomass currently hold through until the end of 2013.

Whatever the future brings, it’s bound to be an interesting year. Be sure to start it out right by checking out our 2012 Solar Buyers Guide (page 21). Enjoy the read, and remember to send us your charitable renewable energy stories (email: [mfroese@nacleaneenergy.com](mailto:mfroese@nacleaneenergy.com)).

*Michelle Froese*

news bites



**Renewable energy continued growth in 2011**

According to the most recent issue of the “Monthly Energy Review” by the US Energy Information Administration (EIA), with data through September 30th, 2011, renewable energy sources continued to expand rapidly while substantially outpacing the growth rates of fossil fuels and nuclear power.

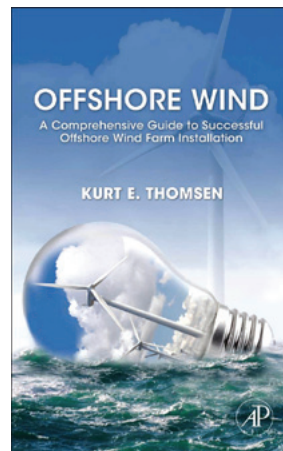
For the first nine months of 2011, renewable energy sources (such as biomass/biofuels, geothermal, solar, water, wind) provided 11.95% of domestic US energy production. That compares to 10.85% for the same period in 2010, and 10.33% in 2009. By comparison, nuclear power provided just 10.62% of the nation’s energy production in the first three quarters of 2011, or 11.10% less than renewables.

Looking at all energy sectors (e.g. electricity, transportation, thermal), renewable energy output, including hydropower, grew by 14.44% in 2011 compared to 2010. Among the renewable energy sources, conventional hydropower provided 4.35% of domestic energy production during the first nine months of 2011, followed by biomass (3.15%), biofuels (2.57%), wind (1.45%), geothermal (0.29%), and solar (0.15%).

“Notwithstanding the recession of the past three years, renewable energy sources have experienced explosive rates of growth that other industries can only envy,” said Ken Bossong, Executive Director of the SUN DAY Campaign. “The investments in sustainable energy made by the federal government, as well as state and private funders have paid off handsomely underscoring the short-sightedness of emerging proposals to cut back on or discontinue such support.”

*The SUN DAY Campaign is a non-profit research and educational organization to promote sustainable energy technologies as cost-effective alternatives to nuclear power and fossil fuels.*

*The US Energy Information Administration released its most recent “Monthly Energy Review” on December 23rd, 2011. It can be found at: [www.eia.gov/totalenergy/data/monthly/index.cfm](http://www.eia.gov/totalenergy/data/monthly/index.cfm)*



**An offshore guide to wind power**

One small offshore wind farm can produce more power than a whole coal plant, or a nuclear reactor. However, few people have experience getting an offshore wind farm up and running. “Offshore Wind: A Comprehensive Guide to Successful Offshore Wind Farm Installation,” by Kurt E Thomsen is the first-ever roadmap to successful offshore wind installation. It provides a ready reference for wind project managers, teaching them how to deal with complications on site.

Published by Elsevier Science & Technology Books, the book also guides financiers, who can use the text to find those pivotal questions to ask petitioning wind project developers, whose planning stages can be improved by the book’s advice on how to avoid wasting money by scoping out and mitigating potential problems up-front. Wind turbine manufacturers will also benefit from insights into design optimization to support cheaper installation and hauling, thereby incurring lower project costs and helping developers establish a quicker route to profitability.

**Elsevier Science & Technology Books**  
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**Solar solutions for Zambian communities**

Residential solar company Sungevity recently announced the “Every Child Has a Light” program, which enables customers to give solar while going solar. In partnership with Empowered by Light, a non-profit organization dedicated to improving lives through renewable energy technologies, Sungevity will donate one solar light kit to a school in need in Zambia for each residential solar panel installation in the US.

Currently, many Zambian citizens have difficulty accessing lighting and are left to rely on dangerous and toxic kerosene lamps. Helping Zambians replace kerosene with solar will allow them to bypass the usage of fossil fuels altogether, contributing to the improvement in the health of citizens and the environment.

**Sungevity** | [www.sungevity.com/everychildhasalight](http://www.sungevity.com/everychildhasalight)

## Predictions for the solar industry

Wondering what 2012 will bring in terms of solar energy? Consider the following...

### 1. The first solar infrastructure products meeting industry-wide performance standards will come to market.

In 2011, the International Code Council's Evaluation Service (ICC-ES) reviewed and adopted the first criteria for modular framing systems used to support photovoltaic modules in the US. Although thorough standards exist in module manufacturing—there are many codes in place for electrical components—there's no unilateral standard for solar infrastructure, until now.

This has allowed individual project contractors to interpret information differently, leaving room for dramatic miscalculations. However, in 2012, we'll also see mounting systems available that comply with the ICC-ES Acceptance Criteria (AC428), which contains solid guidance for the structural evaluation of racking components.

### 2. Pre-fabricated, pre-assembled arrays will become prevalent.

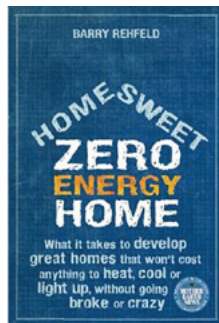
Processes such as parallel efforts and pre-assembly increase installation speed. Currently, most building is done in the field by hand, but pre-fabricated, pre-assembled arrays will become prevalent, minimizing building time in the field and maximizing efficiency in project completion after the permitting process. By reducing the expense of field labor and increasing factory production, overall project cost will drop while installation time becomes shorter.

### 3. TCO will replace cost per watt as a measuring stick.

Cost per watt is a false measurement. In 2012, expect to see more focus on total cost of ownership (TCO) to paint a more accurate pricing picture. The best way to lower TCO is to standardize on solar infrastructure engineered to be easy to install and maintain. High-value products should be built to last for decades under extreme weather conditions. Companies should offer long-lasting warranties that cover performance, rather than defects, thereby lowering the cost of replacing parts or system failure. Lowering TCO over the lifetime of an array and expediting ROI will spur the expansion of the solar market.

Predictions courtesy of Marcelo Gomez of Unirac.

Unirac | [www.unirac.com](http://www.unirac.com)



## A zero energy home

A practical guidebook, "Home Sweet Zero Energy Home," by Barry Rehfeld identifies all the pieces of the zero energy puzzle, explaining how zero energy homes are possible, livable, and affordable. Focusing on real costs and savings, this book takes an in depth look at: site selection and passive design; insulation; windows, doors, and building materials; heating and cooling; appliances and electronics; as well as financial resources and incentives. Even current homeowners and buyers will gain valuable tips on taking smaller steps toward reducing their energy use in existing homes and buildings.

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– Steve Hopkins, Project Manager,  
Fischbach & Moore



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# Part I: Fund Structures for Venture Capital & Private Equity Cleantech investments in China

By Edward Epstein

China's economy and its policies to become a global leader in the renewable energy industry are attracting the country even more foreign investment. Venture capital and private equity firms (VC/PEs) are riding this new wave of foreign investment by establishing funds that are specifically dedicated to investments in China. The following will discuss some of the fund structures used and/or considered by VC/PE funds investing in Chinese cleantech and renewable energy companies.

## Offshore funds

All foreign investments in China, including investments by foreign VC/PEs, are subject to approval according to investment policies set out in the Catalog for the Guidance of Foreign Investment Industries ("Catalog"). The Catalog categorizes industries as either encouraged, permitted, restricted, or prohibited to foreign investment. Encouraged industries are those in which the Chinese government would like to attract more foreign capital, technology, and experience.

Cleantech and renewable energy have, in general, been encouraged under the Catalog, and this policy has recently been reinforced by the "Catalog of Guidance for Industrial Restructuring"—promulgated by the Chinese National Development and Reform Commission (NDRC), which became effective on June 1st, 2011. The door is currently open for foreign VC/PE investments in the cleantech sector in China.

Foreign VC/PEs have historically invested in Chinese companies through an offshore foreign currency denominated fund using offshore structures. A simple example of an offshore fund's direct investment into a Chinese company is illustrated in Chart 1.

A foreign fund investing in China is typically established in a foreign jurisdiction, such as the Cayman Islands, in the form of a limited partnership. This fund may invest in the Chinese target company through various offshore, single-purpose investment vehicles (SPVs). In recent years, the offshore investment structure for an investment usually includes a few SPVs established in favorable offshore jurisdictions, with a Hong Kong holding company for the Chinese target company. Such a structure allows the investor to take advantage of, among other things, favorable tax treatment and easier offshore exits for the investment by either IPO or sale.

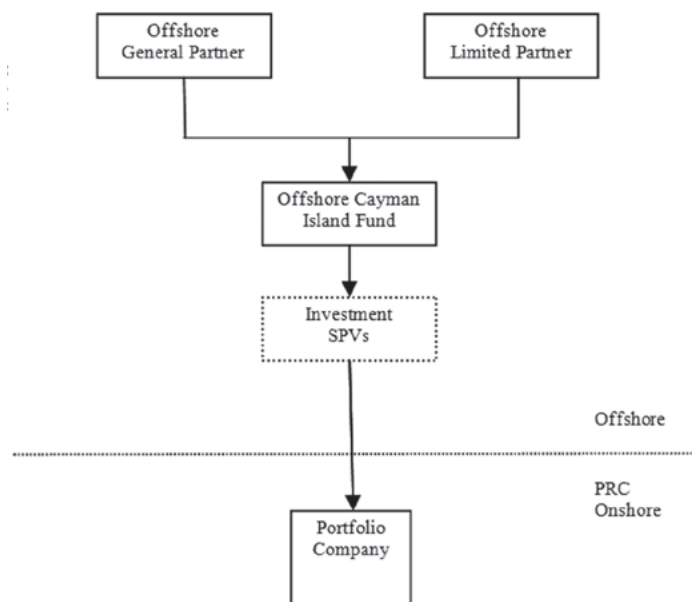


Chart 1: Investment by Offshore Fund

## RMB funds

New legislation has opened a crack in the door for foreign VC/PE firms and investors to establish onshore Renminbi (RMB) funds. The framework for RMB funds in China has developed piecemeal, based on various regulations issued at different times, which has resulted in structures and practices that lack logical consistency. Given the variety and complexity of different RMB fund structures, two RMB Fund structures, which are more applicable to the cleantech and renewable energy industries, will be reviewed.

### • Foreign Invested Venture Capital Investment Enterprise (FIVCIE)

FIVCIEs are regulated by the Administrative Measures on Foreign Invested Venture Capital Investment Enterprise (effective March 1st, 2003), and can take the form of either pure RMB funds or sino-foreign RMB funds under a corporate or partnership structure (for FIVCIEs, the regulation establishes a quasi-limited partnership structure). Under the FIVCIE Measures, fund managers can raise funds from offshore and onshore investors, and establish onshore RMB-denominated funds. The management of FIVCIEs may be delegated to a Chinese domestic management company, a foreign invested enterprise, or an offshore entity. Foreign fund managers appreciate this flexibility because it allows them to manage funds from an offshore entity, without the additional time and cost of setting up an onshore entity in China. Some qualified FIVCIEs can also enjoy certain incentive policies, including tax benefits.

FIVCIEs are limited, however, in that the legal structures of these funds are inflexible and can, in principle, only invest in high-tech or new-tech companies. This investment restriction sometimes precludes funds that invest in companies outside of this scope from using this structure. But, this limitation may not affect cleantech or renewable energy investors as some of these investments can qualify as "high-tech or new-tech companies," fitting within a fund's investment strategy. For example, the private equity arm of Quam Limited, a HK listed financial services company, has recently set up a FIVCIE fund in China, using a limited partnership structure to invest in greentech/cleantech and life science companies.

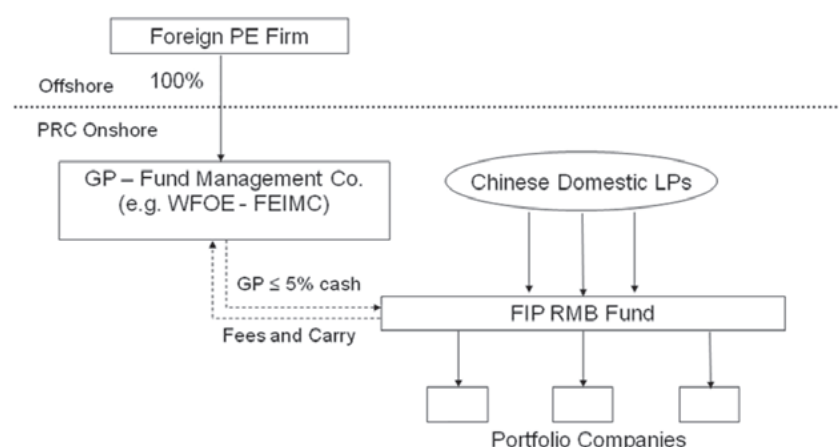


Chart 2: Basic Shanghai RMB Fund Structure



### • Shanghai Pilot Program for Foreign VC/PE Firms

To promote foreign VC/PE investments in China, the Shanghai government issued the Implementation Measures on the Pilot Program for Foreign-invested Equity Investment Enterprises in Shanghai (the “Shanghai PE Measures”), which became effective on February 1st, 2011. Shanghai is the first city in China to create such a pilot program, and it’s anticipated that Beijing and Tianjin will issue similar measures. Shanghai has taken the lead on this pilot program as it’s envisioned to be the financial center of China.

The Shanghai PE Measures allow foreign VC/PE firms to establish funds and manage investments in China through the establishment of a foreign-owned management company called a foreign-invested equity investment management enterprise (FEIMC). The FEIMC can be wholly owned by the foreign VC/PE and established as a WFOE.

The fund established under the Shanghai PE Measures must have a minimum capital commitment of US\$15 million, and can be established as a foreign invested partnership (FIP), which includes general partnerships and limited partnerships (a form typically used and desired by offshore VC/PEs). If the fund is established as an FIP, then it would only need to be registered with the local branch of the State Administration of Industry and Commerce (SAIC). The longer and more complicated approval of the Ministry of Commerce (MOC) is not required.

The fund established under the Shanghai PE Measures can either be:

- i) A fund with only local Chinese investors or limited partners (other than the FEIMC, which is foreign owned); or
- ii) A fund with both local Chinese and non-Chinese investors or limited partners. Herein, VC/PE firms can establish funds in China to raise foreign and local capital for investments.

To qualify under the pilot program to bring in foreign limited partners into the onshore RMB fund may be challenging, given the requirements as to asset size and relevant investment experience. Plus, the Shanghai PE Measures are designed to attract qualified foreign institutional investors, such as the following funds: sovereign wealth; pension; endowment; charitable; funds of funds (FOFs); as well as insurance companies, and banks.

With respect to a fund with only Chinese investors, a qualified FEIMC may invest into it, converting foreign currency of up to five percent of the committed capital of the fund. Significantly, the fund will still be treated as a “pure” domestic RMB fund, which

means that its investments won’t be subject to the foreign investment Catalog, and it will be treated like a Chinese domestic RMB fund. As a result, it won’t require MOC approval. The basic fund structure with only Chinese investors under the Shanghai PE Measures is illustrated in Chart 2.

If a fund is established with Chinese and non-Chinese investors, the fund will be subject to the Catalog and require MOC approval, as well as other applicable approvals for each investment like an offshore fund.

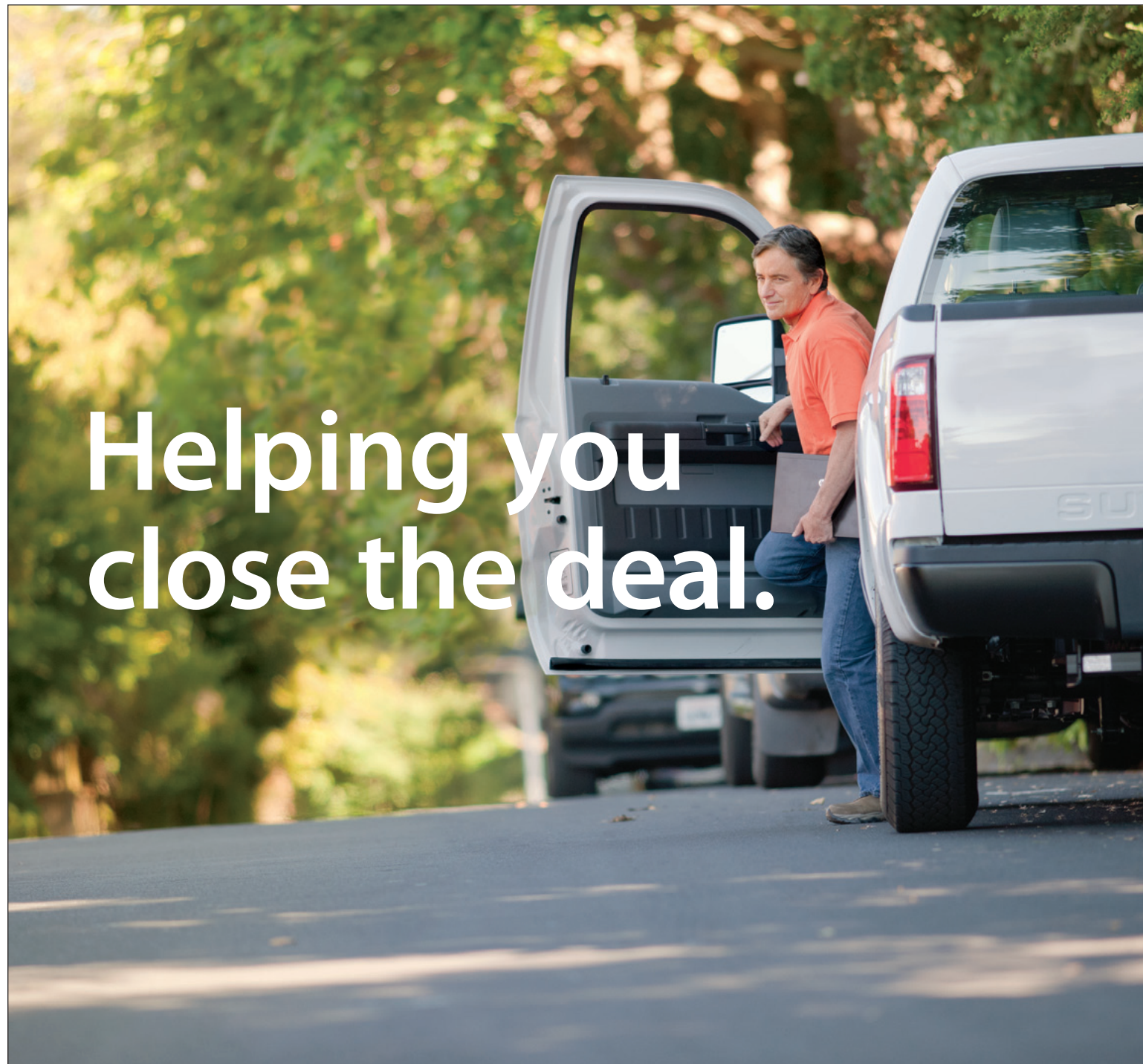
### Don’t miss Part II next issue: Regulations on VC/PE firms in Beijing & Tianjin



*Edward Epstein is the Shanghai office managing partner for Troutman Sanders.*

*Troutman Sanders is based in Atlanta and has 13 offices across the United States, with offices in Hong Kong and Shanghai. They have been doing business in China since the 1980s.*

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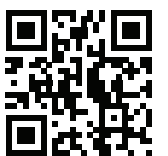


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## Maximizing Return on Investment in Wind Energy Collection Systems

Gary Zahalka

In 2006, the United States government made wind energy a priority for the administration with a goal of 20% of usable energy being derived from wind by 2030. Since this projection, more than 250 GW of wind energy has been installed in the US, with the peak occurring in 2009. A desire for energy independence, low CO<sub>2</sub> emissions, and creation of jobs were all factors in the growth of this market. Cable industry analysis has projected flat installations for 2012, with a strong surge in wind energy installations projected for 2013 and 2015.

A good understanding of the importance of maximizing the return on investment is critical to the success of a wind farm. The perseverance of the energy industry requires continued innovation for improving reliability and efficiency to produce more competitive wind power-generated electricity. Having electrical design engineers involved in the early stages of project development results in system reliability and efficiency being addressed in the design and selection of materials.

The reliability of collection systems is based on the life expectancy of the wind energy farm infrastructure components. Improving system reliability can lead to lower operation and maintenance expenses, and fewer forecasting penalties paid to the market. Improved reliability can also lead to a perceived public image for a company, and defer or eliminate the need for future capital expenditures. The goal of improving collection system efficiency is to minimize the amount of losses to help turn every watt generated into revenue for that wind farm.

The traditional collection system architecture includes two underground feeders, each with approximately 25 MW per feeder. A typical 100 MW wind farm would have four feeders with up to three turbines linked to each feeder. This varies depending on the wattage for each turbine, which can range from 1.5 MW GE to 3.0 MW GE per turbine. The topology

starts with the turbine that enters a step-up transformer to increase the voltage to 35,000 volts. There is an in-and-out connection on each generator step-up transformer, so the power flows back up through the collection system to the substation to deliver it out to the system. A typical wind farm includes the turbines, step-up transformers, underground collection system, and sometimes a sectionalizing cabinet (also called a junction box), which is how the system connects and delivers power back up to the substation. A grounding transformer is also included to protect the equipment from being damaged.

The typical collection system components, including the main power transformer, feeder breaker, underground cable, overhead collection systems, sectionalizing cabinets, generator step-up transformers, and turbines, come in a variety of types. Because each type offers its own advantages and disadvantages, it's best to work with an electrical engineer to determine the specific needs in the development stages of a project. For example, a silicone steel core transformer is less expensive initially, but can lead to more loss in energy versus an amorphous metal core. The amorphous metal core costs more up front, but leads to dramatically fewer losses. The same holds true for transformer types—the more expensive the transformer, the lower the loss.

## Software tool evaluation

GL Renewables Certification has started a project to evaluate the LMS SAMTECH software tool "SAMCEF For Wind Turbines" (S4WT). The software by LMS SAMTECH provides an integrated solution simulating the complete dynamic behavior of wind turbines under realistic wind conditions. The objective of this project, in conjunction with the major player in the CAE industry LMS SAMTECH, is to validate and to certify S4WT for the computation of aero-elastic wind turbine design loads according to the certification standards of GL Renewables Certification.

As an initial key element for wind turbine development and design, aero-elastic simulations provide the mechanical load assumptions on the different turbine components, which can be expected during the turbine's lifetime. GL Renewables Certification, with its long-term experience in the certification of wind turbine loads, will carry out detailed comparisons between in-house aero-elastic software tools and SAMCEF for Wind Turbines (S4WT).

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Early examination of wind farm components offers a better chance to maximize the return on investment and minimize losses. Keeping losses down yields a higher amount of energy delivered to the grid, providing more revenue for the wind farm. Another example of increasing the efficiency of a wind farm is upsizing the typical underground 345 kV cable conductor. This comes with a higher initial cost, but can reduce the loss significantly, delivering more dollars to the grid. Overhead collection system installations—partial or full—are a lower initial cost at a much higher loss ratio than that of a typical underground collection system.

If an engineering firm is involved early on in the project development process, they can help purchase the generator step-up transformer and the main power transformer to maximize the return on investment for those pieces of equipment. With the assistance of various types of data, including the owner's financial model, wind resource information, and the power curve for the turbine, it's possible to determine the geographic location of the turbine and layout the overhead/underground collection system. Calculations can be determined for the cost of the installation and the cost of the annual energy loss.

Comparing the net present value, determinations can be made to up-size or change equipment based on this amount. Final collection system design recommendations can then be made by the electrical engineer for a maximum return on investment. Proper wind farm planning will lead to informed decision-making on investment opportunities and higher profitability, specific to one's needs.

*Gary Zahalka is the VP of Generation, Planning, and Renewable Energy for Ulteig Engineers, Inc.*

*This article stems from a collaborative presentation produced by The Dow Chemical Company and Ulteig.*

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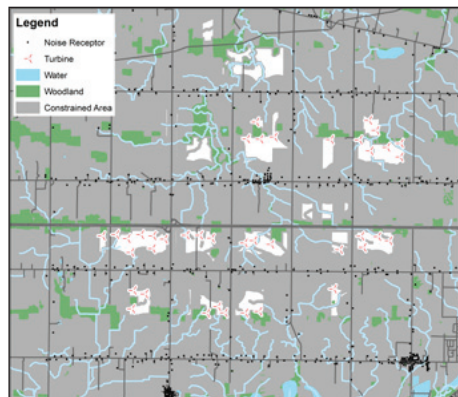
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# Cumulative Constraints Analysis

Smart use of data key to success in micrositing

By Danny da Silva & Paul Pengelly



Wind farm in Dufferin County, Ontario, Canada.

**IMAGINE A MOUNTAINEERING TEAM** wanting to make a name for themselves by making the first ascent to a peak by a route that's never been traveled before. Planning will be key to the team's success. Some of the potential routes they first try start out in a promising way, but turn out as impassable dead-ends. Other possibilities eventually merge into routes that are technically demanding, and present various risks that need to be carefully reviewed by the team. Only after many tries does the team define a route to the top that becomes their claim to fame within the mountaineering community.

Wind project siting is much like this: among the many possible sites for a development and its individual turbines, there are some sites that are a complete no-go—an impassable, high-risk route. The “easy” sites may have already been taken or are already under development. Unlike the challenging, high-risk routes, easy sites are like climbing routes that are already well established.

Then, there are sites that are so overlaid with constraints—proximity to residences, shorelines, archaeological sites, oil or gas wells, electrical transmission corridors, rail lines, pipelines, or rare species habitat—that they appear to be high-risk routes as well. But, maybe they don't have to be. These sites are like the climbing routes that have never been attempted before, and take skill to pioneer. A big part of success in wind project development consists of finding these challenging but possible sites, and knowing how to develop them in a profitable manner.

This is where micrositing comes in. Micrositing, or finding the specific locations of a project's turbines and other elements, can help a developer keep a project compliant with the numerous constraints that might apply. Micrositing can provide an edge that allows a developer to access sites that caused their competitors to give up.

## Cumulative constraints mapping

Much like finding a route to the top of a mountain, information is key in wind power development. Experience shows many proponents start out with a data set that's too limited. Developers might determine whether a site has enough wind resource, clear areas for locating turbines and other infrastructure, and then start their leasing process and mapping—only to find the constraints they ignored are now prohibiting the use of the land they've leased. Perhaps an archaeological site or rare-species habitat was missed or not marked on the maps. As a result, what was once a noise-compliant layout, now requires turbines to be moved altogether. Or, maybe additional studies to support the location of turbines within a constrained area are now needed.

It's far better to map out all the constraints in a project area, and use them in combination with noise modeling, early in the planning process. In this, developers are aided by the power of current Geographic Information Systems (GIS) technology, in which computerized maps and data can be overlaid to find areas where a lack of constraints make siting possible. With these sites identified, this power of this approach can be realized once combined with noise-modeling programs, which can utilize the GIS constraint information to help develop a compliant layout.

Cumulative constraints mapping requires having access to a wide range of expertise, whether internal or external, and either from one larger firm or assembled from an array of niche service providers. Depending on the jurisdiction, this might involve professionals qualified in archaeology, ornithology, aquatic and terrestrial biology, shadow flicker, visualization, acoustics, as well as other fields. Knowing what resources to bring in, and having the experts work as an integrated team, is a key part of success in working on particularly challenging sites.

Often, it's necessary to determine what data sets exist, find which of several government organizations have the data, and what policies govern its use. The information may be in several different scales and formats, and there are often data gaps to be filled in.

Combining and overlaying data means that a map showing locations of oil and gas wells, for example, can be overlaid with others showing electrical corridors, rail lines, and residential buildings. GIS expertise is also valuable in evaluating potential locations for the project's access roads, power lines, transmission corridors, transformers, and other infrastructure to support the turbines.

Having access to the right specialized resources means a project developer is more likely to have the necessary data to determine, early in the process, which areas must be avoided.

#### Below the data's surface

Developers may get unpleasant surprises when they find data they're working with is out-of-date, inaccurate, or conflicts with a noise-compliant project design. Part of the answer of dealing with such issues comes in "ground-truthing" the data. This might involve driving along the roads in a potential project area to check for recent changes to gain information that can only be acquired close up.

For instance, a building shown on a high-resolution satellite image might turn out to be a barn or an equipment shed, rather than a house as it initially appeared. This could mean enough space is available to allow the siting of a turbine or part of the infrastructure. Or, a drive-by might indicate that a dwelling is one-storey rather than two, and in some jurisdictions this may reduce project constraints; again, opening up more of the map to potential development. Community consultation is also part of the ground-truthing process, which involves meetings with local stakeholders. They could point to a watercourse that didn't show up on the maps, so that a road can be re-routed early in the planning process to avoid it, rather than having to bridge it later on.

In the early stages of project planning, often too much attention is focused on the location of the turbines. This is understandable, as the potential of the resource can vary widely over a project's area. Nevertheless, it's also important to ensure it's possible to reach each turbine with the required infrastructure, and to determine the siting of other project elements such as transformers and substations.

#### Discover the possibilities

Combining all the data in GIS can result in an image that indicates areas that are completely off-limits, areas where

development is acceptable, and areas where development may be possible if further work is completed. A rare-species study or archaeological test dig can confirm the presence of historic resources. In this way, the map becomes part of the planning process.

Micrositing is an exacting, iterative process. Sometimes it shows that moving a proposed location of a turbine just a few meters at a time will maintain a project's infrastructure outside a no-go area, while still resulting in a noise-compliant design that's economically sustainable. The payoff, of course, is in being able to develop a project in an area with a strong resource, where there may be less

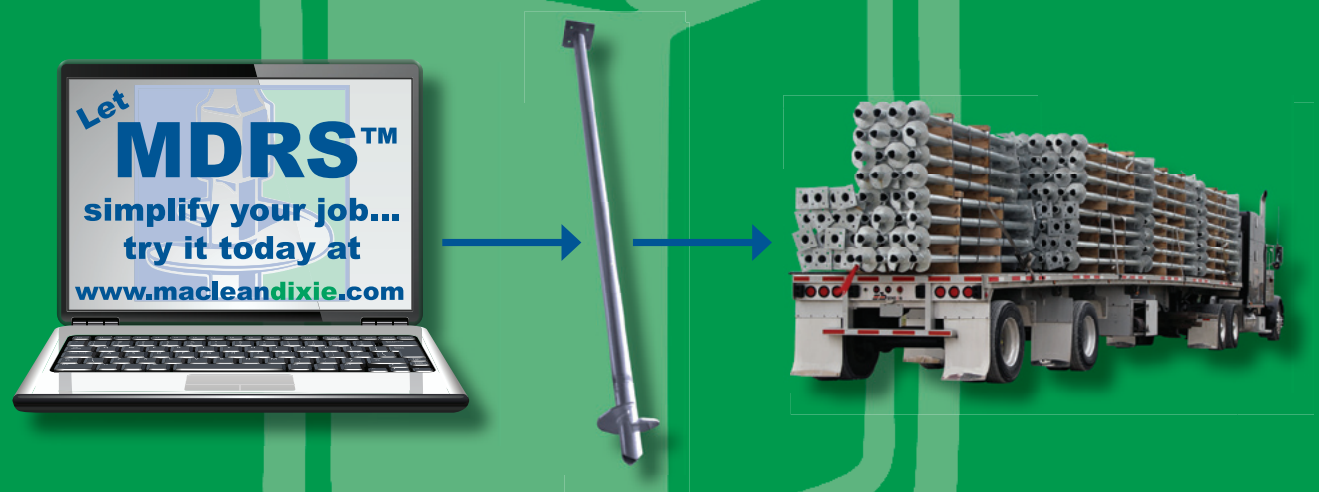
competition for leases, because other "mountaineers" tried, found it too difficult, and turned back.

*Danny da Silva is an associate and the power sector lead in the Acoustics, Noise, and Vibration Engineer practice. Paul Pengelly is senior GIS analyst in the Geographic Information Systems practice. Both practice out of Golder Associates' Ontario office.*

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Left image: Typical terrain at Coyote Crest.

Bottom image: Site quarry.



## Seeing the Turbines for the Trees

### Case study: wind project to share space within a timber farm

By Paul Fisher, Blair Loftis & David McClain

Wind farm developers are a creative group. In recent years, these bold thinkers have found ways to develop and deliver power from wind turbines located in patches of barren deserts and atop rocky mountain peaks. Now, one project is looking to the forests of the Pacific Northwest with the Coyote Crest Wind Park. Once developed, Coyote Crest will produce up to 117.5 megawatts (MW) of wind power on a 3,755-acre lease area of Weyerhaeuser's active McDonald tree farm in the Willapa Hills of Washington. The completed project will have a distinctly unique look and feel as compared to previous wind farm projects.

The Willapa Hills range in elevation from sea level to more than 3,000 feet, a geographic environment that doesn't typically lend itself to the development of a traditional wind farm. The geography combined with ongoing timber operations requires that the 47 turbines—each producing between 1.5 MW to 2.5 MW—be spread across an eight-mile ridge of undulating roads and hilltops.

It's up to geotechnical and civil engineers to find a way to move the turbines to the appropriate site using existing narrow, steep, and windy timber roads, while optimizing the turbine foundations and developing the underground distribution network—all without interrupting the ongoing timber operations or removing any existing trees.

#### The high road

The ridges of the Pacific Coast mountain range on the McDonald timber farm are ideal for wind power generation because of the prevailing high-speed winter winds from the Pacific Ocean that whip through the area. Because the prevailing winds in Doty, Washington are strongest in the winter season, the Coyote Crest project is known as a "winter peaker." Optimal turbine output is found at wind speeds of approximately eight miles per hour (mph) to 16 mph, and the timber ridges on the Coyote Crest project site experience average wind speeds of 20 mph.

Two years of detailed environmental and engineering design studies were completed prior to moving forward on the detailed site design and analysis effort. Geologic mapping and

hazard surveys, geotechnical investigation, topographic surveys of roads and turbine sites, and design of an access road system were all completed after the studies were conducted.

One of the most difficult challenges in constructing this wind project lies simply in getting the turbines to their sites. As part of the agreement with Weyerhaeuser, the contractors can use the existing logging roads to get to the turbine sites, but cannot disrupt the timber operations during construction or operation.

However, the roads are designed for 80-foot-long logging trucks and are not conducive to the heavier, low-clearance trucks that deliver 183.5-foot turbine blades, or the crawler cranes used to assemble the turbines at the site. The steep vertical and horizontal curves with tight turning radii common along the McDonald timber farm logging roads proved challenging, as well.

The civil engineering team worked closely with the developers to determine which roads needed to be widened and/or reinforced to accommodate the crawler cranes and the weight of the turbine components. Individual blades can weigh more than 12 tons, and tower components 70 tons or more, which significantly exceeds the logging trucks' weight. The roads also need to support travel during winter conditions.

In parallel with the civil design, a team of engineers is performing the geotechnical analysis for the wind turbine sites and power distribution system locations. In addition, this geotechnical analysis of the wind farm site will identify hazardous conditions such as potential slope failures adjacent to access roads, which will require design improvement.

#### Bedrock beginnings

The turbine towers, rising approximately 330 feet high, with blades about 250 feet in diameter, will be anchored into a platform of concrete and steel rebar. The need for anchors will depend on geologic conditions found in the Willapa bedrock. Because the wind direction is strongly affected by the topography and a tendency for wind gusting, the turbines must be spaced by computer modeling, giving special consideration to slope,

location, accessibility, timbering activities and, of course, wind flow and inter-turbine wake effect.

Once the engineering team selects the turbine sites, they must perform a geotechnical investigation to determine the best foundation types. The Willapa Hills are predominantly shallow bedrock; therefore, the wind turbine foundations will rest on either a mat (pad) foundation or bedrock anchor foundations.

The geotechnical team will drill exploration borings, excavate test pits, and conduct geophysical tests, such as multi-channel analyses of surface waves, to better understand the subsurface geology, slope stability, and variable bedrock strength. The region's shallow bedrock should allow for bedrock anchoring foundation for turbines and decrease the amount of concrete required for foundations.

Fully understanding and identifying the characteristics of the underlying bedrock will save on the construction costs for this project, as well as ensure the turbines are adequately supported. As an example, strength tests in the laboratory on bedrock samples taken from the site will more exactly determine the type and depth of foundation needed for each turbine. In addition, utility locations and routes may be affected by the bedrock depth and condition. Overall, a good understanding of the strength of the bedrock foundation will lead to a decrease in the cost of the turbine foundations and associated equipment.

The project's transmission line will tie into Grays Harbor Public Utility District's existing transmission lines near Cedarville, which is about nine miles away, and power will flow into the Bonneville Power Administration transmission system that serves Northwest utilities. Transmission distances will be several hundred miles to reach many of the end users. However, the majority of the transmission lines needed are in place for this new power source.

It was recently announced that the project won't be built in 2012 as originally planned. The company could not secure a viable sales solution. It's hoped the developer will be able to secure a power purchase agreement in 2012, and have the project begin construction in 2013. Once operational, Coyote Crest Wind Park will generate enough electricity to power 25,000 homes.

*Blair Loftis is the global director of renewable energy for Kleinfelder. Paul Fisher, PE, is a civil engineer with Kleinfelder. And, David McClain is vice president and general manager of EverPower's northwest operations.*

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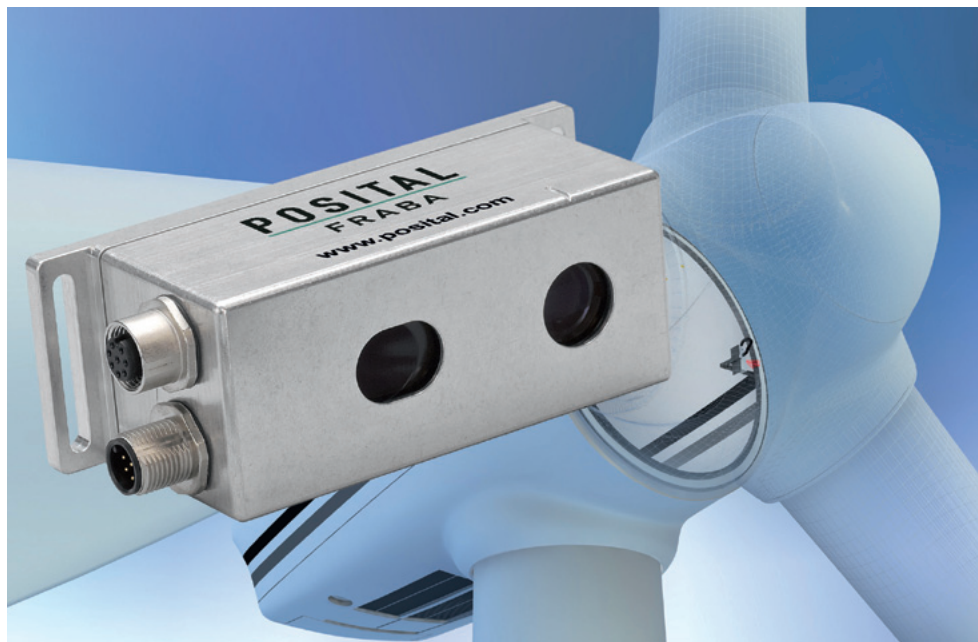
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# Understanding Encoders

## Small devices that play a large role in wind turbine efficiency

By Christian Fell

**THERE'S MORE TO A WIND TURBINE** than meets the eye. From afar, if you didn't know better, it's nothing but a tower and rotor. Up close, a cross-sectional view reveals it to be so much more: a mass of technologies—large and small—some uniquely adapted for wind energy production. There's a generator, of course, but also sensors, connectors, control cabinets, motors, cables and couplers, many of which are likely to be improved upon as the expansion of wind power globally spurs innovation throughout the supplier base. Over time, an operator should expect to realize incremental efficiencies and cost savings by incorporating some of these enhancements.

That's certainly true of encoders. Though they can be smaller than a fist, these industrial measuring devices play an outsized role in turbine performance and safety. Encoders are an integral part of the control system that maximizes the generation of electricity by optimizing the aerodynamics of the turbine in response to fluctuating wind conditions. The latest non-contact optical and magnetic encoders offer cost and efficiency gains over older types of motion sensors, and open the door to improvements in the capabilities of turbine control systems.

A turbine control system has two main functions: yaw and pitch. Yaw control keeps the turbine pointed directly into the wind, based on feedback to one or more motors from an anemometer or wind sensor mounted on the turbine body. Typically, these motors that change the orientation of the turbine are equipped with a rotary encoder to register rotations of the drive motor shaft and, hence, the turbine nacelle points. Pitch control involves using other small motors to align the turbine blades in response to changes in wind speed. Motion sensors play an essential role here, feeding back data on the pitch angle of each blade. They also have an important secondary role in helping the control system slow or stop rotation in unsafe wind conditions by adjusting the angle of the blades to a neutral position.

### Non-contact encoders outperform

This measurement data must be extremely accurate, and consistently so. In fact, this is so critical that turbine manufacturers usually incorporate multiple speed monitoring sensors on their rotating components as a failsafe strategy. One such conventional approach is a rotary encoder connected directly to the rotor shaft, and a proximity sensor that fixes on the passage of specially machined features on rotating components. However, these technologies have proven susceptible to errors, and they are costly to install and maintain.

Recently, a European wind turbine maker tried a new approach. It field-tested the latest generation of non-contact optical encoders to measure the rotational speed of the rotor.

If they performed well, they were to be deployed as backup to shaft-mounted proximity sensors. These non-contact encoders thoroughly outperformed the proximity sensors, prompting this manufacturer to deploy them as its primary speed monitoring technology, with proximity sensors as the backup.

Non-contact optical encoders require little or no surface preparation in the area where velocity is measured; whereas, proximity sensors require the incorporation of specially machined features around the circumference of the rotor shaft to trigger the sensor. The encoder, with its 2D camera focusing on the revolving hub, delivers excellent accuracy and dynamic responsiveness to changing rotor speeds. Since there's no physical contact between the sensor and moving object, dirt or other surface contaminants won't degrade measurement accuracy. Non-contact encoders are easy to install and maintain, are extremely durable, and will perform reliably for many years (which also makes them ideal for a retrofit when it comes time to renew the control systems in older machines).

### Technology to boost performance

Given their exceptional accuracy and dynamic response, this new generation of non-contact optical encoders could allow turbine manufacturers to introduce enhancements like individual pitch control for each blade, so as to make continual adjustments to compensate for variations in wind speed. Such subtle changes in blade alignment would provide a worthwhile, incremental improvement in turbine performance.

With their lack of moving parts and well-sealed packaging, non-contact optical and magnetic encoders are proving to be highly reliable motion sensors in harsh operating environments. The newest magnetic encoders are especially well suited for offshore wind farms, manufactured with heavy-duty stainless steel enclosures that protect the measurement components from great temperature fluctuations (-40° F to +185° F | -40° C to +85° C), high humidity, salty liquids, and high-pressure water spray (up to IP 69K ratings). They can be self-powering, using Wiegand effect technology to keep track of the number of rotations, and are available with popular analog or digital electrical interfaces like SSI, CANopen, RS232, and more. Analog versions make excellent replacements for traditional potentiometers, offering superior accuracy, reliability, and longevity.

*Christian Fell is VP, Position and Motion Sensors of Fraba Inc., Hamilton, New Jersey.*

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*Left image: Rotary encoders are used to control turbine orientation and blade pitch.*

*Right image: POSITAL OPTIPACT's Optical Motion Sensor, which provides accurate rotor speed measurement.*

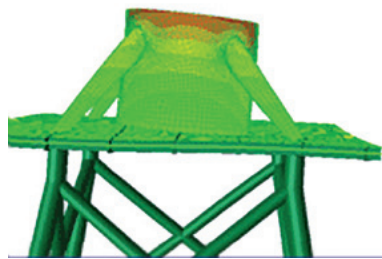




## Medium-speed wind power generators

ABB is introducing a semi-integrated permanent magnet generator. The new generator design offers a reliable solution for multi-MW offshore wind turbines. The semi-integrated, medium-speed generator covers the power range up to 8 MW and more. In this new modular design, the generator and medium-speed gear are integrated via a flange connection. Using separate drivetrain components results in low lifting weights and enables dismounting for servicing. For OEM's, the new semi-integrated design offers a fast route to serial production of large, offshore turbines. Medium-speed solutions deliver many benefits. A slower speed design is more reliable for large offshore powers, and MS PMGs are also compact in size and offer low top-head mass. Low weight means easier logistics, as well as lower tower and foundation cost. MS PMGs offer the highest efficiency (>98 %) of any commercial wind generator design. Efficiency is also high at partial loads in low wind conditions, enabling the largest annual production of kWh's.

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## Offshore wind turbine analyses

DNV is launching new design software for strength and fatigue analyses of offshore wind turbine structures: Sesam GeniE Wind. The new Sesam software has been extended with a tailor-made solution for structural strength analysis of offshore wind turbine structures, addressing the industry's need to account for the combined effect of wind and hydrodynamic loads. The analysis functionality offered is in accordance with the DNV Offshore Standard DNV-OS-J101 Design of Offshore Wind Turbines.

The Sesam package is applicable for analyses of wind turbine structures for any depths, from shallow water mono piles to tripods, jacket structures, as well as concrete gravity based structures for larger depths. With GeniE Wind, DNV offers an interface for easy import of time domain wind forces from commercial aero-elastic codes. The imported wind forces may be combined with the hydrodynamic forces from waves and current generated in Sesam, and merged to produce a single time series for structural analysis. Furthermore, fatigue analysis using the rain-flow counting methodology (RFC) from multiple time domain analysis, representing different short-term environmental (sea and wind) states is offered.

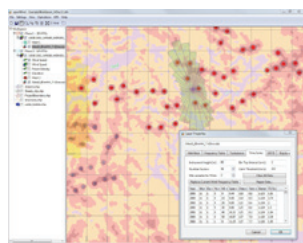
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## Pitch control system

Windurance introduces the new Servo Pitch LRU pitch control system for utility-scale wind turbines. The system utilizes modular, Line Replaceable Units (LRU's). The ultimate in modularity provides for ease of manufacturability and serviceability. With 100 MW of the new systems already globally commissioned, the Servo Pitch LRU's are designed to ease installation of the pitch system in wind turbines—in a fast and uncomplicated manner. Windurance experience combines high-reliability and low-maintenance for a robust pitch system. The Servo Pitch LRU was recently certified High Temperature (50° C) and High Humidity (100%RH) by a third-party agency. Simple diagnostics and verification tools speed turbine assembly, commissioning, service, and maintenance operations. The diagnostic software provides quick identification of any required service actions. The standard maintenance interval for the system is five years, with an option for a 10-year interval.

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## Wind farm design software upgrade

AWS Truepower, LLC has released openWind Enterprise 1.3, which further refines the wind farm design process with improved loss and uncertainty estimates. In addition to the ability to optimize for cost of energy and assess deep array impacts, current Enterprise users will receive Time-Series Energy Capture and Effective Turbulence Intensity upgrades, along with a pilot of Time-Scheduling of Turbines. openWind Enterprise was developed for wind developers who need more powerful features—a geographical information systems (GIS) interface, the ability to optimize for cost of energy, assess deep array impacts, and define and analyze strategies for managed shut-down of turbines. These features are designed to help developers save time and meet the requirements of utilities and turbine manufacturers.

**AWS Truepower, LLC**

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### Climb assist system

The recently released IBEX 1000P climb assist system from Power Climber Wind (a division of SafeWorks), sets new standards for portability and durability, offering the same IBEX performance owners have come to expect. The 1000P's portable control box, weighing only 8.5 lbs (4 kgs), is easy to set up: just click, plug, and climb. The robust design is thoroughly lifecycle tested and approved by wind turbine technicians. With the EasyClimb Controller, each user can customize assistance from 50 lbs to 125 lbs (25 kgs to 55 kgs), and can enjoy constant load support regardless of climbing speed in up and down directions. The system is designed to be installed in any wind turbine tower, significantly improving employee health and safety, as well as productivity.

**Power Climber Wind** | [www.powerclimberwind.com/lbex1000P.aspx](http://www.powerclimberwind.com/lbex1000P.aspx)



### Self-retracting lifeline

Capital Safety, home of the DBI-SALA, PROTECTA and UNILINE brands of fall protection equipment, introduces the new DBI-SALA Nano-Lok Self-Retracting Lifelines (SRL). These new SRL's, an addition to Capital Safety's extensive line of self-retracting lifelines, can be used in place of lanyards and can be directly attached to any harness, reducing fall clearances. At only 1.6 lbs, the SRL's are virtually unnoticeable to the user when worn and provide the ultimate work site flexibility. The Nano-Lok SRL's are 15% lighter and 30% smaller than competing products, making them the most compact and lightweight self-retracting lifelines on the market. The lightweight design provides the ultimate comfort and productivity, while still being able to protect workers up to 420 lbs.

**Capital Safety** | [www.capitalsafety.com](http://www.capitalsafety.com)



### Wind monitoring sensor

Onset announced its new Wind Direction Smart Sensor, a research-grade plug-and-play sensor for measuring and logging wind direction data. The easy-to-use sensor, which works with the company's award-winning HOBO Weather Stations, offers years of reliable performance in harsh outdoor environments. Customers will use the wind sensor in a broad range of applications, including wind resource assessment, building energy studies, environmental studies, and more.

The key advantages include: shielded stainless steel ball bearings, which provide optimal reliability and long life; a balanced wind vane, which offers a smooth response to wind changes; a plug-and-play design with no complicated wiring or programming; as well as wind averaging that provides higher accuracy wind data and drip overhang, which minimizes icing. The new Wind Direction Smart Sensor can be used individually, or coupled with Onset's Wind Speed Smart Sensor. By combining the two sensors, customers can collect average wind speed, highest three-second wind gust, and average wind direction.

**Onset** | [www.onsetcomp.com](http://www.onsetcomp.com)



### LED obstruction lighting

Hughey & Phillips' (H&P) new LED-based obstruction lighting solution meets customers' needs for longer-lasting, more energy-efficient fixtures—specifically for the renewable energy and wind power industries. H&P's new HORIZON line L-810 low-intensity products provide an LED-based solution for the FAA L-810 steady burning lights, and can be powered using a solar array for renewable energy applications. The HORIZON L-810 is a steady burn Obstacle Light and is available in single and double configurations operating at a range of 95-277VAC, and in a range of 9-48 VDC. Both configurations are available as new fixtures and as replacements for traditional incandescent obstruction lights. The LED product also boasts a life 15 times longer than traditional incandescent lights and uses approximately 96% less power than standard incandescent lamps. Weather-resistant assembly and housing, and a self-contained wiring compartment protect the lamp from damage due to extreme environments.

**Hughey & Phillips**  
[www.hugheyandphillips.com](http://www.hugheyandphillips.com)

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## A Marketplace for Residential Solar Financing Products Will Drive Solar

By Nat Kreamer

**RESIDENTIAL SOLAR VENDOR FINANCING PRODUCTS** help companies sell more solar. However, the majority of companies selling and installing solar don't have great vendor finance options for their customers. Nor, do the majority of solar finance investors have inexpensive access to deal flow because most providers of power purchase agreements (PPA) and leases have an incentive to extract margin from companies selling and investing in solar. Consequently, the residential solar industry needs a marketplace to ensure companies selling and investing in solar get the most value.

### Investors: Solar as an attractive asset class

Residential solar financing is investing in long-term energy contracts. In effect, consumer electric utility bills are being refinanced by investors. High and/or rising consumer electricity rates mean homeowners can save money, while investors earn attractive returns with residential solar financing. On average, residential solar investments generate high single-digit to mid-teen after-tax returns. Federal tax incentives, as well as local cash incentives, provide substantial "down payments" that reduce an investor's dollars at risk and/or increase returns.

Warren Buffett's recent investments in two solar farms qualify for the same risk reducing and/or return-increasing government incentives. Residential solar investors' risk is further reduced because American homeowners pay their electricity bills promptly and reliably.

Despite the recent recession, to date, residential solar portfolios experience repayment rates similar to those of AAA-rated S&P corporate bonds (50-year average default rate for corporate bond issuers). High returns and low risk make residential solar investments a very attractive, long-term asset class. Unfortunately, residential solar investment suffers from high transaction costs and limited access to deal flow. For example, the typical residential solar investment costs approximately \$500,000 in specialized legal and accounting fees, constituting as much as one percent of the cost of a solar investment, which translates into lower prices paid for solar systems and/or higher financing costs for consumers.

A marketplace that reduces transaction costs and improves access to deal flow will make it easier and more profitable to refinance consumer electricity bills with residential solar power.

### Installers: Access competitive finance products

In order to expand businesses and meet market demand, solar sales companies need access to PPAs and leases offering competitive terms. Yet, approximately 98% of residential solar sales companies have no access to financing. The fortunate installers who are able to secure

financing to offer homeowners often have limited options, and may be required by the financier to sign exclusivity agreements and subsume their company brands—just imagine selling cars and only getting a loan quote from one finance provider.

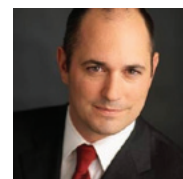
However, a solar finance product marketplace challenges the status quo. In a marketplace, companies selling solar compare a variety of finance products and choose the one that works best for them and individual homeowners. Competition among a broad range of financing products provides better terms for companies selling solar and their customers. Better terms help solar sales companies to expand their businesses quickly.

### Manufacturers: Financing moves inventory

A solar finance marketplace will help spur sales of solar equipment and products benefiting upstream industry players, as well. For example, individual finance products such as leases and PPAs may include pre-packaged solar materials. White-label offerings in the marketplace give manufacturers the opportunity to promote their individual brands, while selling equipment bundled with financing. For instance, major consumer electronics companies that manufacture solar equipment can leverage their brands to attract homeowners, and use financing from the marketplace to help them buy it.

### Conclusion

Refinancing consumer electricity bills creates tremendous value for solar companies, investors, and consumers. Five years ago, the creation of residential solar PPAs and leases represented a giant step forward in democratizing solar. Homeowners with high electricity bills and good credit, who were not able to pay \$50,000 for a solar system, started using solar PPAs and leases to save money with clean electricity immediately. These financing products expanded the addressable market for companies selling solar. Yet, access to and supply of this valuable vendor financing artificially constrains the residential solar industry's growth now. A marketplace for residential solar finance products is the new catalyst for widespread consumer adoption of solar.



Nat Kreamer is CEO of Clean Power Finance. He is a founder of SunRun, and sold the first residential power purchase agreement in California.

Clean Power Finance | [www.cleanpowerfinance.com](http://www.cleanpowerfinance.com)

# New Money, Investors & Finance Models Needed To keep US renewable energy on track

WITH **ELECTRICITY DEMAND WEAK** and stimulus funds dwindling, the US renewable energy sector must attract new investors and make use of unique tax-based financing structures in the next 18 months or risk a sharp drop in new project builds, according to new research by specialist research firm Bloomberg New Energy Finance, commissioned by Reznick Group.

The clean energy industry in the US has been a major beneficiary of public support from the American Recovery and Reinvestment Act in the form of over \$65 billion in tax credits, grants, and soft loans. But, nearly all of those stimulus funds have now been deployed. Unless the private sector steps into the breach with substantial new investment, project development will slow.

With a cash-based incentive, which was part of the US stimulus program expiring at the end of 2011, tax credits are likely to again become the most important federal subsidies supporting renewable project development in the US. These incentives propelled the sector's growth for much of the past decade, particularly in the run-up to the financial crisis.

The report delivers two major findings about tax credits:

1. The economics of tax equity—the part of a renewable project's financing structure used to take advantage of tax credits—can provide attractive returns for parties involved in these transactions.
2. The US renewable sector will require new sources of tax equity if it is to meet market demand for project finance.

Along with several other findings, the report further concludes that alternative sources of tax equity may need to emerge to meet market demand for project finance. The total need for tax equity financing this year could be more than \$7 billion. That requirement exceeds the investment appetite of established tax equity providers, according to US Partnership for Renewable Energy Finance, a clean energy trade group.

Fortunately, expiry of the cash grant should not be expected to result in collapse of the US renewable sector. Tax equity is undoubtedly more complex than a cash-based incentive. Nevertheless, tax equity economics can deliver meaningful returns to developers and investors, and there remains political support for this policy. But, significant uncertainty will remain until Congress reaches a decision about whether or not to extend the production tax credit, currently set to expire at the end of 2012.

Read the full report at: [http://reznickgroup.com/sites/reznickgroup.com/files/papers/taxequity\\_reznickgroup\\_wp112011.pdf](http://reznickgroup.com/sites/reznickgroup.com/files/papers/taxequity_reznickgroup_wp112011.pdf)

**Bloomberg New Energy Finance**  
[www.bnef.com](http://www.bnef.com)

**Reznick Group**  
[www.reznickgroup.com](http://www.reznickgroup.com)

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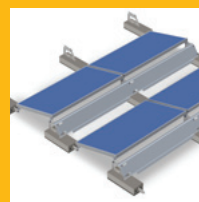
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Photo courtesy of Sky Power: Thunder Bay Airport (Canada) Project

# SOLAR BUYERS GUIDE



# 2012

# SOLAR BUYERS GUIDE DIRECTORY

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 BUSINESS & ENVIRONMENTAL CONSULTANTS  
 CAMERAS, SENSORS & THERMAL IMAGING  
 COMPONENTS | ELECTRICAL PROTECTION  
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 Cable Management  
 Ceramic Components  
 Custom Manufacturing Equipment  
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 DC Power Supplies  
 Electrical Protection  
 Hybrid Solar PV/Thermal Panels  
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 Material Dispensing & Coating Equipment  
 Measurement Systems  
 Motion Control | Actuators  
 Perimeter Security  
 Quality, Health & Safety, and Environmental (QHSE)  
 Renewable Energy Conservation  
 Rubber Components  
 Sequenced Inverter  
 Solar Cell Metallization & Screen Printing  
 Solar Simulation Equipment Manufacturer  
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### Solar Buyers Guide cover credit:

Image of a 10 MW system installed by Sky Power at the Thunder Bay airport (Thunder Bay, Ontario) with Canadian Solar modules.

Courtesy Sky Power: Thunder Bay Airport (Canada) Project

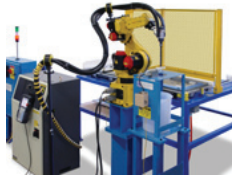
Canadian Solar | [www.canadiansolar.com](http://www.canadiansolar.com)

## ADHESIVES, SEALANTS & TAPES



### ADCO Products, Inc.

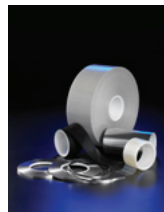
With focus on adhesives and sealants for module manufacturing and installation, ADCO's total systems approach to material, equipment, reliability, and installation brings all the pieces together. Innovative chemistries including polyisobutylene (PIB), acrylic, MS polymer, and polyurethane, as well as others, have proven track records of performance. "Best in Class" moisture barrier with PIB chemistry makes it the chosen solution for module sealing.  
[www.adcocorp.com](http://www.adcocorp.com)



### Sealant Equipment & Engineering, Inc.

Sealant Equipment & Engineering are manufacturers of dispensing systems for adhesives and sealants to dispense one- and two-part materials such as epoxy, urethane, silicone, acrylic, and hot melt. Systems are engineered for bonding, encapsulating, gasketing, and potting and sealing: panels; glass; junctions; batteries; inverters; electrical and electronic components; and surge protectors. Integrated robotic dispensing systems are available with fixtures, tooling, dress-out, and programming for six-axis and XYZ robots. ISO 9000:2008 certified.

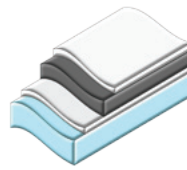
[www.sealantequipment.com/solar](http://www.sealantequipment.com/solar)



### Adhesives Research

Adhesives Research, a manufacturer of custom PSA tapes, offers electrically conductive foil tapes for bus bar applications, insulative tapes and positioning tapes for wire management and assembly, as well as encapsulation tapes for new, flexible PV modules. Their high-performance adhesive technologies can be developed into various product constructions to address the challenging bonding applications of the solar industry.

[www.adhesivesresearch.com](http://www.adhesivesresearch.com)



### AI Technology, Inc.

AIT SOLAR-IMB and SOLAR-TDB AIT melt-encapsulation backsheets reduce cycle times and increase efficiency. Both of these backsheets for solar panels provide thermally dissipative UV- and moisture-resistant properties, while providing mechanical strength and electrical insulation as good as that of T/P/T. Thermal dissipation improves overall solar panel efficiency and boosts power output by allowing faster passive cooling to ambient air. Specially formulated UV- and moisture-resistance in the encapsulating layer provide excellent protection. Furthermore, AIT backsheets allow for a fast melt-encapsulating process-step, reducing overall cycle time without the customary curing time. AIT SOLAR-IMB designates a backsheet with an insulated metal layer for mechanical strength and thermal dissipation. AIT SOLAR-TDB designates a thermal dissipative backsheet without metal layer for applications requiring higher flexibility.  
[www.aitechnology.com](http://www.aitechnology.com)

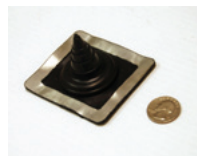


### Dow Corning Solar Solutions

Dow Corning is one of the only companies worldwide able to provide a full range of silicon-based solutions throughout the PV value chain. These solutions meet critical needs, such as improving the performance and durability of solar modules while reducing costs. They apply more than 65 years of experience to bring efficiencies to silicon-based materials that are an excellent fit for solar applications.  
[www.dowcorning.com/solar](http://www.dowcorning.com/solar)

### Ellsworth Adhesives

Ellsworth Adhesives is an authorized distributor of Dow Corning and Henkel Loctite adhesives and coatings for the solar energy industry. They help companies manufacturing solar cells and modules, integrating solar systems, and doing solar system installation with assembly products and manufacturing solutions.  
[www.ellsworth.com/solar\\_adhesives\\_tapes.html](http://www.ellsworth.com/solar_adhesives_tapes.html)



### Golden Rule Fasteners, Inc.

Golden Rule stocks neutral cure silicone sealant/adhesive for metal roofing, butyl tape, painted and unpainted metal roofing screws, and a huge assortment of pipe flashings including the mini flashing made for solar installation. Most orders ship the same day, and there are no minimum orders.  
[www.goldenrulefasteners.com](http://www.goldenrulefasteners.com)



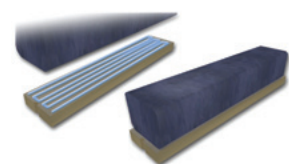
### Henkel Corporation

Henkel products for the solar industry include: structural adhesives; elastomers; thermally and electrically conductive materials; die attach adhesives; potting compounds; sealants; printable inks; molding compounds; masking's; solders; and cleaners. These products are specifically designed for applications that include: ingot bonding; wafer cleaning; solar cell bonding; housing assembly; glass/PMMA lens bonding/sealing; junction box potting/fixturing/bonding/sealing; module framing/mounting; electrically conductive bonding; frameless sealing/module mounting; laminating to plastic or metal panels; laminating to flexible roofing membranes; and weather/UV protection.  
[www.henkeln.com/solar](http://www.henkeln.com/solar)



### Straub Design Company

Straub Design Company designs and builds tape applicators and complete systems for most tapes including conductive, sealing, and insulating tapes with liners in place or liners removed. They also build web-converting machines and product handling systems; and they provide complete documentation and manuals. Start-up and service assistance is also available.  
[www.straubdesign.com](http://www.straubdesign.com)



### Valtech Corporation

Manufactured under the trade name VALTRON. Valtech's epoxy adhesives are used in the silicon wafering process, specifically for mounting ingots for squaring and wafer slicing. Valtech's molded polymer mounting beams are used for mounting silicon ingots for wire sawing, and are designed with a special grooved surface that ensures a consistent adhesive layer. The adhesive is easily and completely removed when heat is applied to the substrate. Post and final cleaning of sliced wafers are accomplished using either ultrasonic or in-line cleaning methods with VALTRON formulated detergents.  
[www.valtechcorp.com](http://www.valtechcorp.com)

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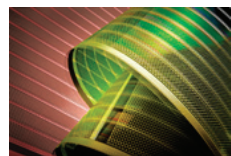
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Solar-Trac is flexible 316L stainless steel tubing for residential and commercial solar hot water systems. Solar-Trac comes in 3/8" up to 2" insulated or un-insulated supply and return lines. Coupled with Solar-Flare self-flaring fittings, Solar-Trac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



**Konarka Technologies**

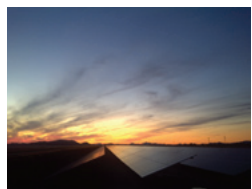
Manufactured at a low cost and with low energy consumption, the company's Konarka Power Plastic technology is lightweight, flexible, scalable, and adaptable for use in a variety of commercial, industrial, government, and consumer applications. It's ideal for various large- and small-scale applications including curtain walls, components within windows, and other building-integrated (BIPV) and building applied (BAPV) applications. It can be applied to glass, steel, fabrics, and other construction materials.  
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[www.gavazzionline.com/solar](http://www.gavazzionline.com/solar)



**Zachry Holdings, Inc.**

Zachry Holdings, Inc. is a privately held business engaged in the engineering, construction, and maintenance of industrial projects. Based in San Antonio, Zachry participates in a wide range of the energy sector including traditional and renewable power. Zachry is currently contracted on a turnkey basis to design, procure, and construct the largest utility-scale PV project to be built to-date in the industry.  
[www.zhi.com](http://www.zhi.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 line consists of 10 standard JIC enclosure sizes ranging from 6 x 6 x 4" D to 18 x 16 x 10" D.  
[www.fiboxusa.com](http://www.fiboxusa.com)



**Joyce Dayton Corp.**

Joyce/Dayton Corp. designs and manufactures jacks to move large arrays in utility and commercial installations, and supplies actuators to move smaller tracker designs for PV, CPV, and CSP applications. ComDRIVE jacks, which include gear reducers and motors, can move 50 tons or more; while Solar Actuators, powered by DC motors, can move up to two tons. Joyce has been building lifting and positioning equipment since 1873, with decades of experience providing reliable drive solutions for the solar industry.  
[www.joycedayton.com](http://www.joycedayton.com)



**Shoals Technologies Group**

Shoals Technologies Group is a global manufacturer of balance of systems solutions. Through innovation and diversification, Shoals has grown exponentially since founding in 1996 and maintains a diverse portfolio of PV balance of systems products, including: combiner/re-combiner boxes; master fuse boxes; custom harnessing solutions; junction boxes; PV wire; in-line fuses; racking; and PV monitoring solutions.  
[www.shoals.com](http://www.shoals.com)



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**SOLON** 



**Wieland Electric Inc.**

Wieland's PST 4011 DC solar connectors now include ETL certification for their panel-mount (bulkhead) connectors and field-assembled units. ETL certification assures users that Wieland PST 4011 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 one milli-ohm, minimizes power losses. NEC code requires a tool to disconnect the PV connection. Wieland PST 4011 connectors provide a low-cost solution using a safety clip, which can be removed with a screwdriver.

[www.wielandinc.com](http://www.wielandinc.com)



**Border States Electric**

When it comes to renewable energy projects like solar and wind, Border States Electric (BSE) offers an experienced team of professionals dedicated to its founding values: to deliver total customer satisfaction. Solar products include panels, inverters, batteries, racking, and others; and its professionals provide support for obtaining permits and tax benefits. With its unique employee-owned culture, BSE focuses on providing high-quality products and specializes in arranging customized services.

[www.borderstateselectric.com](http://www.borderstateselectric.com)



**eIQ Energy**

eIQ Energy's vBoost DC-to-DC converter module increases system energy harvest; and enables solar panels to be connected in parallel rather than in series. This reduces overall system cost and provides benefits for designers, installers, and operators. vBoost's advanced DC power management technology allows over 180 kW of solar to be installed with only a single pair of electrical terminations. This helps to greatly reduce the cost and time required for a solar installation. With distributed MPPT built in, vBoost-equipped systems can also harvest 5% to 30% more energy than conventional installations. Additionally, the Parallel Solar technology collects and reports detailed data on panel performance with no extra wiring, providing excellent operational visibility and reduced risk for system owners, as long-term performance of each system component can be monitored and assured.

[www.eiqenergy.com](http://www.eiqenergy.com)



**OPTI International Corp.**

OPTI-Solar features high-quality inverters such as the GT series On-Grid inverters, and SP series Hybrid and Off-Grid inverters. OPTI-Solar has always been devoted to mainly solar power systems and solar/LED Lighting. In 2006, they developed Hybrid inverter-SP300, a solar inverter, which can transfer solar power into electricity for home use. In 2007, they launched the On-Grid inverter, GT series, which can be coordinated with government Fix in Tax (FIT) programs all over the world.

[www.opti-solar.com](http://www.opti-solar.com)



**Solar Power Technologies**

Solar Power Technologies has developed the Clarity system, an intelligent suite of hardware and software solutions that provides an unprecedented level of insight and control to maximize performance of commercial and utility-scale solar sites. The Clarity system is scalable at panel level to the largest utility sites, and includes a suite of cloud-based software management tools—the Intelligent Array, which delivers actionable information to improve financial performance of solar assets.

[www.spowertech.com](http://www.spowertech.com)



**Ideal Power Converters**

Ideal Power Converter's 30 kW 480V AC 3-phase power inverter supports grounded PV arrays and weighs only 94 pounds, compared to 1200 pounds from conventional PV inverters with similar capabilities. The lower weight is achieved through Ideal Power Converter's patented, current-modulation topology, which utilizes an entirely different approach to controlling the power flow. This allows more than a 90% reduction in magnetic components such as transformer and inductors.

[www.idealpowerconverters.com](http://www.idealpowerconverters.com)



**Lufft USA, Inc.**

Lufft WS Family of Intelligent Weather Stations are designed to measure wind speed, wind direction, solar radiation, temperature, air pressure, and humidity, all with one compact sensor. The weather stations are designed as all-in-one components with a single cable connection and an easy-install bracket design. This makes Lufft the weather station of choice for solar systems integrators and installers. There are different stations available to meet specific needs.

[www.lufft.com](http://www.lufft.com)

**BATTERY | BATTERY TESTING & ENERGY STORAGE**



**Rolls Battery Engineering**

Rolls Battery product lines have earned a reputation based on reliability, durability, easy maintenance, and ongoing product support. Many of Rolls batteries include dual-container construction and high-density polyethylene material, maximizing durability and eliminating acid leaks even in the event of a ruptured outer container.

[www.rollsbattery.com](http://www.rollsbattery.com)

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**Sun Xtender® Batteries are the original AGM (Absorbent Glass Mat) battery adopted by the U.S. Military.**

- Deep cycle unique high density plate technology provides superior reliability, power & extended cycle life.
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**PVX-1530T**  
30H tall | 12Volt  
176 AH @100 HR

**PVX-4050HT**  
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443 AH @ 100 HR

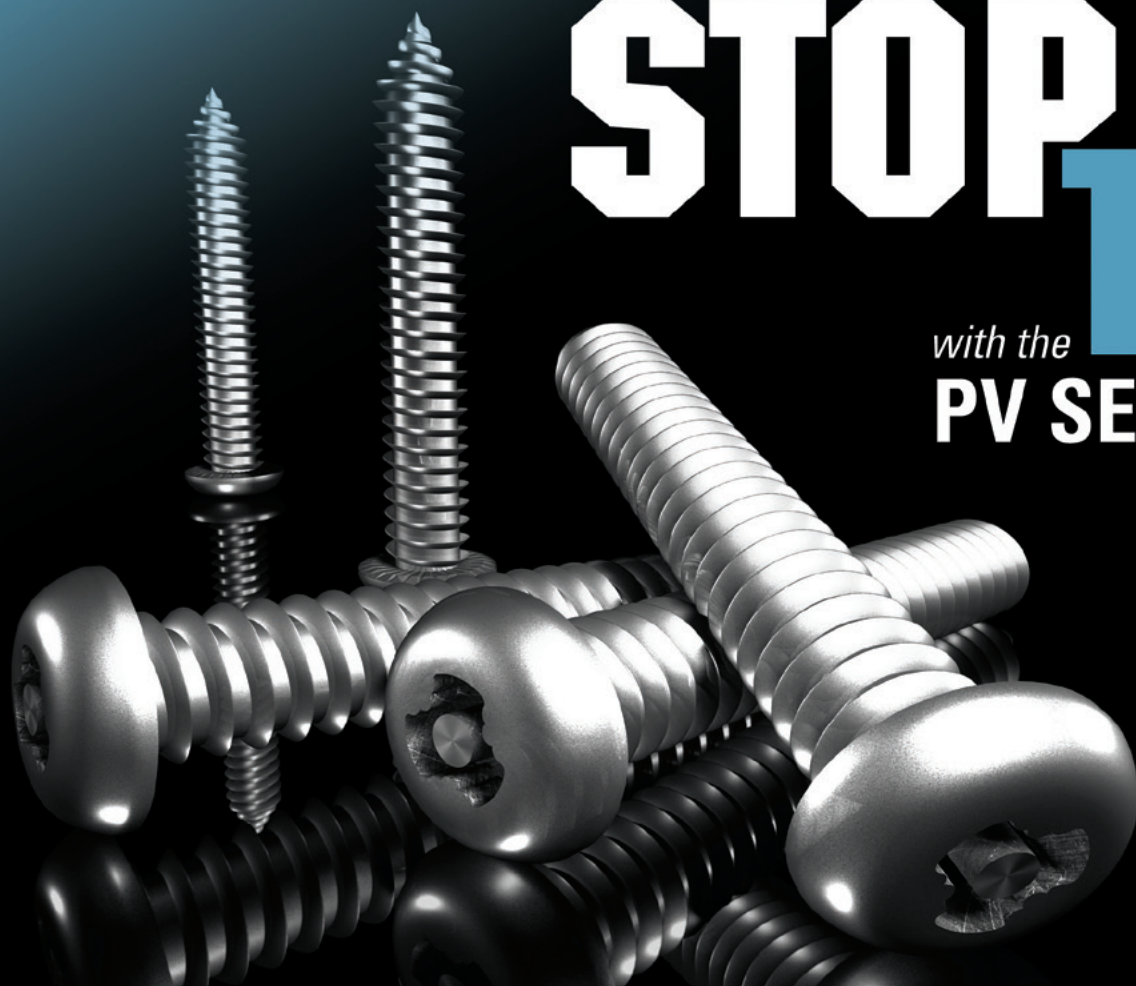
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with the PV SECURITY BOLT



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...AFFORDABLE  
...INCREDIBLY EFFECTIVE

Theft of PV modules is a big problem, costing millions of dollars in losses and project delays. Installers and contractors have tried hiring security services and/or installing cameras, fencing and alarm systems. ALL of these efforts have been costly...but NONE have been effective in deterring theft.

Now there's PV Security Bolt...the most effective solution for PV module theft prevention ever developed.

## A New Level of Security



Unlike key drivers for other security bolts, which are freely available via the Internet, the key driver for the PV Security Bolt is sold only to licensed PV installers. Each driver is numbered, registered and therefore traceable.

## Don't Let Thieves Delay or Ruin Your Project

Contact us and request a quote today.

## Thieves HATE PV Security Bolts

Why? Because they're designed with **Triple-Lock Protection**



### CAN'T UNSCREW THEM

No screwdriver or other tool can generate the torque necessary to turn the PV Security Bolt. Its unique clover design screw head can be operated only by a numbered, registered key driver, sold only to licensed PV installers.



### CAN'T CUT THEM OFF

The very low profile of the screw head and the serrations on its underside grip the PV module clamp, making it impossible to slip a tool of any kind between the head and the clamp.



### CAN'T DRILL THEM OUT

The PV Security Bolt is manufactured using 4140 heat-treated steel for maximum strength. Drilling out would ruin many drill bits and damage solar panels.



With Triple-Lock Protection™ **PV SECURITY BOLT™**



888.745.8166

1550 Industrial Parkway | Akron, Ohio 44310

www.pvSecurityBolt.com



### 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, from MK Battery, includes sealed lead acid GEL and AGM batteries in multiple configurations, as well as select flooded products.

[www.mkbattery.com](http://www.mkbattery.com)



### Analytic Systems

Analytic Systems' SolarMax Charge Controller 200 Voc Capacity uses an advanced Maximum Power Point Tracking (MPPT) algorithm, which is up to 30% more efficient than a non-MPPT charge controller standard battery charger, allowing users to maximize the energy harvested from their solar array. It also allows them to use a higher voltage PV array than their current batteries as it's capable of stepping down the voltage, which allows for greater flexibility in the choice of array for a system.

[www.analyticsystems.com](http://www.analyticsystems.com)



### SUNRRN OF VIRGINIA, Inc.

SUNRRN OF VIRGINIA's "Sun Runner" patented portable renewable energy generators are rugged with steel enclosure housing 8D 245Ah 2000+Whr AGM rechargeable battery, digital solar charge controller, 3500 W/7000 W surge 110, or 220 VAC inverter. They offer quick-connect 135 W solar panels, or other renewable energy sources such as wind or microhydro turbines. The power modules double storage/generation. Made in the US, hundreds of stand-alone applications are available, including supplemental, emergency, and off-grid power. They are an ideal replacement for gas generators.

[www.sunrrn.com](http://www.sunrrn.com)

## BUSINESS & ENVIRONMENTAL CONSULTANTS



### 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 solar sector, as well as the onshore and offshore wind, wave, and tidal sectors. Although the GL Garrad Hassan name is new, the company has a rich heritage. It's 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](http://www.gl-garradhassan.com)



### Trojan Battery Company

As a global manufacturer of deep-cycle batteries, Trojan Battery Company supplies energy storage solutions for renewable energy and back-up power applications. Having shaped the world of deep-cycle battery technology for over 85 years, Trojan Battery is now offering the broadest portfolio of high-quality, deep-cycle flooded, AGM, and gel products for a wide range of renewable energy and back-up power applications. Trojan also offers expertise and technical support.

[www.trojanbattery.com](http://www.trojanbattery.com)



### Concorde Battery Corp.

Sun Xtender Batteries provide VRLA-AGM Deep-cycle batteries for off-grid and grid-tied systems. Featuring sealed, no maintenance design with no spilling, these batteries offer the option to operate in any attitude. Copper alloy, corrosion-free connections provide for maximum conductivity and no lead exposure. This is the original AGM battery technology adopted by the US Military since 1986. Sun Xtender provides long service life, long float life, and reliable operation at temperature extremes. Batteries ship fully charged Hazmat Exempt via land, sea, or air.

[www.sunxtender.com](http://www.sunxtender.com)



### ZBB Energy Corporation

The ZBB EnerStore flow batteries are modular and scalable, self-contained, and front accessible, making them ideal for distributed energy projects whether operating on or off the grid. It has redundant features, is easy to maintain, and operates indoors or outdoors in the widest ambient temperature range of any flow battery. The ZBB EnerStore battery is the answer for capturing multiple value streams from time shifting, to firming of renewables or load management, to system back-up.

[www.zbbenergy.com](http://www.zbbenergy.com)

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Everyday at BURNDY® industry experts like Craig Lawson engineer our products specifically for the renewable field.

BURNDY® HYDENT™ compression terminals have evolved to meet the needs of the wind industry.

Today, HYDENT™ is designed to provide:

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There is no substitute for the BURNDY® Engineered System.



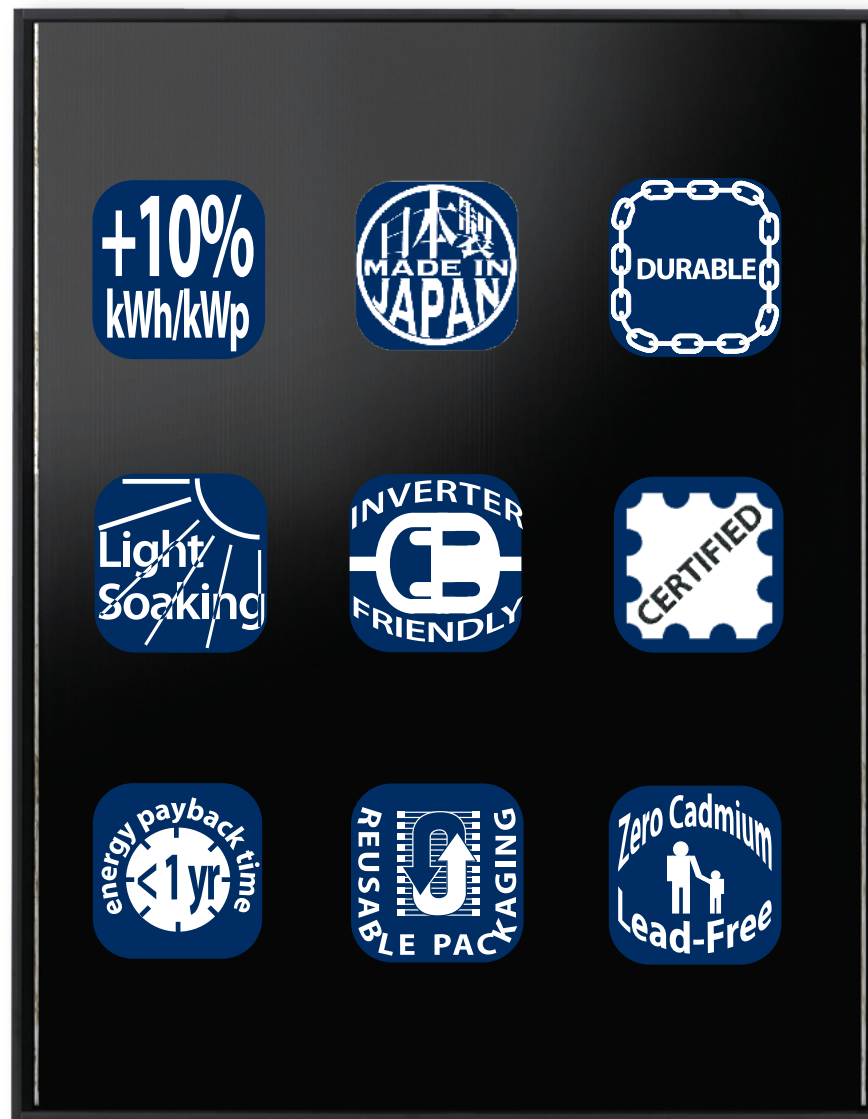
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**Middle East** Solar Frontier K.K. Technical & Scientific Office, Eastern Cement Tower, #306, King Fahd Road, Al Khobar, Kingdom of Saudi Arabia, Tel: +966 3882 0260  
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FLIR thermal cameras can be used for everything from quality control during the PV cell manufacturing process to PdM programs at solar installations. FLIR's lock-in thermography gives quantitative measurements of I-V characteristics from localized shunts, and lets users calculate the reduction in cell efficiency and map saturation current density over the entire cell. Better quality control results in less downtime and improved performance, in turn boosting the viability of solar power as a major energy source.

[www.flir.com/solar](http://www.flir.com/solar)



### JETprotect Corp.

JETprotect Interrogator is an all-in-one device to watch, detect, analyze, geo-track, video record, and alert of threats for remote, large areas of land that house valued assets. One unit covers 7.5 square miles, which results in great savings over multiple cameras and security guards. Minimal or no security guards are needed, resulting in increased reliability and lowered operational costs. Interrogator is all-weather and detects in day, night, snow, fog, rain, etc. This technology provides early warning of approaching threat, long before they reach the perimeter, and can illuminate and track a man at over one mile distance. Interrogator offers Customized Alert Zones for critical areas. iPhone/iPad wireless connection alert-and-control function provides situational awareness to view the site and see what Interrogator sees, in real time. The Interrogator, installed at the beginning of a solar project, protects against construction site losses. After completion it continues to protect the energy and revenue production.

[www.jet-protect.com](http://www.jet-protect.com)

### KEYENCE Corporation

KEYENCE has steadily grown in the development and manufacturing of automation and inspection equipment worldwide. Their products consist of the following: automation sensors; barcode readers; measuring instruments; vision systems; laser markers; and digital microscopes.

[www.digitalmicroscope.com](http://www.digitalmicroscope.com)



### LiteSentry Corporation

LiteSentry Corporation offers three valuable tools for the solar industry. The Osprey 5 Distortion Measurement System measures optical distortion, including roller wave, in heat-treated, as well as laminated glass, solar PV, and sheet plastic. The Falcon by LiteSentry measures the precise size of glass sheets, and the geometry of holes and drillings. One hundred percent measurement allows sorting of defective product, and guarantees that parts meet specification prior to shipment. The Raven by LiteSentry Thickness & Coating Sensor measures moving or stationary glass on-line to +/-0.08 mm thickness. This non-contact glass thickness sensor provides 100% inspection.

[www.litesentry.com](http://www.litesentry.com)

## COMPONENTS | ELECTRICAL PROTECTION



### BURNDY

BURNDY provides engineering and manufacturing of high-quality compression connectors, grounding products, and installation tooling. 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.

[www.burndy.com](http://www.burndy.com)



### Microsemi Corporation

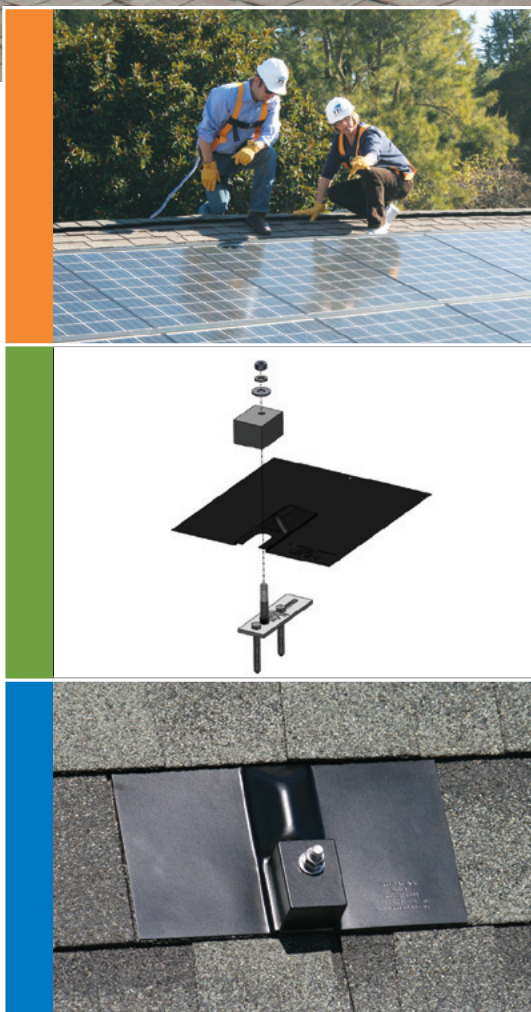
Microsemi offers an extensive range of solutions for the PV market, supporting a wide array of applications in power harvesting, power management, power switching, and power monitoring. With these products, the PV designer can develop highly efficient and reliable cost-sensitive applications to meet the ever-increasing demand of PV deployments worldwide. Microsemi carries an assortment of analog, mixed signal, and digital devices, such as: bypass devices; MOSFETs and IGBTs; DC-DC converters; mixed signal FPGAs; PWM modules; and more. Microsemi Corporation is a provider of semiconductor solutions differentiated by power, security, reliability, and performance. The company offers one of the industry's most comprehensive portfolio of semiconductor products for industrial and alternative energy markets. Additional products include high-performance and highly reliable analog and RF devices, mixed-signal and RF integrated circuits, customizable system-on-chip (cSoC) solutions, and complete subsystems.

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**Schweitzer Engineering Laboratories, Inc.**

Schweitzer Engineering Laboratories, Inc. (SEL) serves the electric power industry through the design, manufacture, and support of products/services for power systems worldwide. SEL's power interconnect, protection, communications, control, and metering products are ideal for renewable energy and distributed power sources. In addition to solutions to manage electrical generation systems at photovoltaic solar farms, wind farms, and biofuel and combustion-powered sources, SEL offers unmatched local support and a worldwide, 10-year product warranty. [www.selinc.com](http://www.selinc.com)



**Comdel Inc.**

Comdel designs and manufactures RF and DC power supplies, as well as 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 flexible power delivery solutions, the broadest frequency ranges, and product and safety certification, the ISO 9001:2000 company provides product solutions and support from its offices worldwide. [www.comdel.com](http://www.comdel.com)



**Diotec Electronics Corp.**

Diotec Electronics is a manufacturer of high-quality industry standard and custom power diodes and bridge rectifiers. They provide: bypass diodes; integrated junction box module with embedded heat sink; transient voltage suppressor (TVS) diodes and diode stacks; high-voltage/high-current button diodes (lead and/or tab-mounted); as well as high-voltage/high-current fast recovery full-wave bridge rectifiers and standard recovery bridge rectifiers (up to 50 Amp). Their vacuum soldering technologies enable them to create void-free die attachment, which makes their power diodes more reliable and perform better. [www.diotec-usa.com](http://www.diotec-usa.com)



**ElecDirect.com Inc.**

ElecDirect.com is an online professional source for PV connectors, PV wire, grounding lugs, multi-hole cable glands, and PV cable clips. ElecDirect.com stocks over 15,000 electrical connectors, wire management, and control products. [www.elecdirect.com](http://www.elecdirect.com)



**JST**

JST is a 54 year-old Japanese connector manufacturer, offering a variety of high-quality, reliable, and waterproof connectors for outdoor applications. Products include the MWP, WPK, WPJ, JWPF, and JWPS. [www.jst.com](http://www.jst.com)



**LEM U.S.A. Inc.**

CTSR current transducers are for use in a range of safety-critical applications including solar installations. They accurately measure AC or DC residual or leakage currents, from 300 to 600 mARMS as nominal values, which can arise in fault conditions in a number of industrial or power-generation scenarios. Examples include solar panels that are coupled to a grounded distribution network, or in failure modes such as a short circuits or ground faults. The connection of a solar panel to the grid raises safety concerns; if a fault occurs there's a potentially serious safety issue involving any human contact with the system. CTSR transducers measure the sum of all of the instantaneous currents flowing through their apertures, in single- or three-phase configurations, resulting in the residual-current monitored to ensure safety. [www.lem.com](http://www.lem.com)



**Schurter Inc.**

Schurter's quick-acting ASO fuse provides protection up to 1000 VDC, according to the latest gPV requirements. Offered with the FSO touch-safe fuseholder, the combination meets the needed robust circuit protection for the growing solar industry in a compact 10.3 mm x 38 mm size. Current ratings range from 1-30 A. [www.schurterinc.com](http://www.schurterinc.com)



**Semikron**

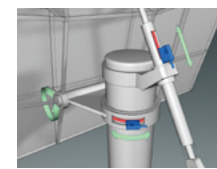
Semikron is a one-stop provider of silicon chips, discrete semiconductors, IGBT/SCR/Diode modules, IPMs, power assemblies, and systems for the solar market. Semikron's latest technology (SKiN) eliminated wire bonds internal to the power modules, resulting in a 10x improvement in product lifetime. [www.semikron.com](http://www.semikron.com)



**Stahlin Non-Metallic Enclosures**

Stahlin Non-Metallic Enclosures, manufacturer of frequently specified fiberglass enclosure products, has over 60 years of engineering and manufacturing experience in solving unique requirements. Stahlin builds non-metallic enclosures that meet individual companies needs, with quality that will exceed their expectations. Stahlin provides an extensive in-stock line of fiberglass enclosures and accessories. [www.stahlin.com](http://www.stahlin.com)

**CONCENTRATED SOLAR POWER (CSP)**



**SIKO Products; Inc.**

SIKO offers non-contact and wear-free measurement technology for position and angle detection of solar, heliostat, and PV modules. Whether incremental or absolute measurement solutions with integrated evaluation technology, the system is easy to install. Magnetic tape or a magnetic ring ready-made to customer specifications is fitted using adhesive or clamp mounting. Robust sensors scan the incremental or absolute measurements coded into the magnetic tape with no contact or wear. [www.sikoproducts.com](http://www.sikoproducts.com)



**Thermal Energy Products, Inc.**

Thermal Energy Products, Inc. is the original fabricator of "Solar-Wrap" Swivel Arm Ball Joint Insulation Blanket Assemblies. Their "Solar-Wrap" Assemblies and already proven materials, remain to be some of the most widely used and trusted choice, found in most CSP Plants and ISCC Solar Plants worldwide. Founded in 1986, Thermal Energy Products has provided Removable Insulation Blankets for many industries such as power plants, refineries, solar, and more. [www.tepinc.com](http://www.tepinc.com)



**Carling Technologies Inc.**

With an industry best rating of 100A, 600VDC in a compact two-pole configuration, the CX-Series circuit breaker features a unique patent-pending arc quenching configuration that allows the breaker to safely handle high-amperage and high-DC voltage applications in a compact package. The CX-Series is ideal for integration into PV renewable energy systems, which can be designed into the system's combiner box or main disconnect. [www.carlingtech.com](http://www.carlingtech.com)



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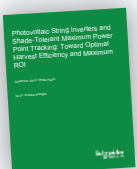
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**Aalborg CSP**

Aalborg CSP provides steam generators for large-scale concentrated solar power plants. They have delivered steam generator systems for parabolic trough plants with capacities of 50 MWe, as well as solar tower receivers for super-heated and saturated steam with capacities of 20 MWe. Currently, they are working on operational plants that, together, are producing 270 WMe. In addition to this, Aalborg CSP is developing systems for molten salt as heat transfer media and for heat storage.

[www.aalborgcsp.com](http://www.aalborgcsp.com)



**AREVA Solar**

AREVA deploys a diverse portfolio of sustainable low-carbon power generation solutions. Their global energy experience and emissions-free concentrated solar power solutions help customers thrive in a dynamic energy market. Low-cost, land-efficient, and water-wise, their solar steam generators reliably deliver super-heated steam for solar thermal power plants, power augmentation installations, and industrial process steam facilities. AREVA Solar customizes their Compact Linear Fresnel Reflector solar steam generators to meet client's exacting energy requirements. They also bring years of project delivery and commissioning services, and back their work with AREVA's performance guarantees.

[www.aveva.com](http://www.aveva.com)



**California Sunlight Corporation**

California Sunlight offers cost-effective, small-scale, portable solar energy systems including micro-CPV systems, as well as solar-powered ovens, stoves, BBQs, and active daylightings. The solar ovens, stoves, and BBQs use large Fresnel lenses to collect and concentrate sunlight with two-axis sun tracking. They can also be used as a rotisserie, water distiller, food dehydrator, clothes dryer, or a refrigerator. No electricity or fuel is needed. Components are expected to last 20 years.

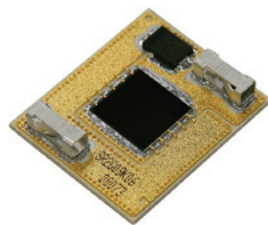
[www.california-sunlight.com](http://www.california-sunlight.com)



**ECHO Systeme**

ECHO designs; manufactures; integrates; and distributes solar thermal energy systems, specializing in commercial and industrial solar thermal. They are the designers of the Eco-Dome, an energy self-sufficient home concept.

[www.echosysteme.com](http://www.echosysteme.com)



**EMCORE Corporation**

EMCORE's a complete solar power technology provider, supplying component level products through complete concentrator photovoltaic (CPV) systems. Their high-efficiency concentrating triple-junction (CTJ) solar cells are the core of their solar offering. CTJ cells have an advantage over conventional silicon cells because fewer are required to achieve the same power output. CTJ solar cells are incorporated into their CTJ Terrestrial Receiver Assembly, which is easily integrated into virtually any system design and functions as the engine of concentrating PV systems. On the system level, EMCORE offers commercial rooftop and utility-scale concentrator PV systems. Using optical lenses and mirrors, they concentrate the sunlight onto solar cells to produce more electricity in a smaller area. EMCORE's Soliant 1000 commercial rooftop CPV system can deliver more than 500 watts peak per panel. EMCORE's Concentrator Photovoltaic GEN 3 System is designed for utility-scale solar installations and achieves 26% DC efficiency at 1090X concentration.

[www.emcore.com](http://www.emcore.com)



**Evonik Cyro LLC**

Evonik Cyro LLC offers superior acrylic for concentrating photovoltaics lens and mirror applications. ACRYLITE Solar products are characterized by excellent light transmission (92%), superb resistance to weathering and UV light, high mechanical strength, surface hardness, and scratch-resistance properties. Distinguished by their transmission characteristics across the spectral range, ACRYLITE products obtain the highest possible module efficiency when converting photons into electricity.

[www.acrylite.net](http://www.acrylite.net)

**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 3,565 MW of PV capacity, bringing together 41 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 113 countries in nearly every ecosystem on the planet.

[www.ene.com/service/energy/solar.aspx](http://www.ene.com/service/energy/solar.aspx)



**KEMA**

KEMA provides a full range of solar energy consulting services. They help clients develop technical solar opportunities through defining the best technologies to meet their needs, including PV and concentrated solar power. KEMA's project development services include; site development; energy yield calculations; owner's engineering; and final acceptance measurement. They also conduct technical due diligence and support governments in the development of national and international policy programs.

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**Kleinfelder**

Kleinfelder's solutions for the power market cover both generation and transmission for solar, wind, and more. With expertise and a broad range of services, they support client projects from early stage planning, allowing them to make significant contributions to major power infrastructure systems nationwide.

[www.kleinfelder.com](http://www.kleinfelder.com)

**TRC Companies, Inc.**

TRC's renewable energy experts work with developers, utilities, and government agencies to provide efficient, cost-effective support for large- and small-scale projects. They offer the expertise and resources necessary to plan, permit, engineer, and support the construction of these projects. Their solar energy services include: selection and evaluation; environmental impact assessment; power delivery and engineering; procurement and contract management; construction; as well as commissioning and testing.

[www.trcsolutions.com](http://www.trcsolutions.com)

**CONTRACTORS**



**Quanta Services**

Quanta Services brings scale, scope, and an industry safety record. A staff of PV, 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 130 MWdc of solar PV projects completed or under construction, Quanta applies best practices to smoothly transition projects from engineering consulting services to EPC contract structure to commercial operations. The 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](http://www.quantaservices.com)



**Electrical Contractors Association of Ontario**

The Electrical Contractors Association of Ontario and the International Brotherhood of Electrical Workers are qualified solar installation partners. With specialized training programs that meet the Canadian Standards Association requirements for Construction Electrician (NOC 7241) Solar Photovoltaic (PV) Systems Certified training, as well as 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](http://www.ecao.org)

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are  
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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.

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wieland

[www.wielandinc.com](http://www.wielandinc.com)

Wieland Electric offers 100 years of innovative technology.





### Fagen, Inc.

Fagen, Inc. is one of the largest and a respected merit shop green-energy design-builder in the United States. Utilizing a database of over 25,000 direct-hire employees, Fagen, Inc. has constructed a variety of projects including solar, wind farms, biomass plants, and power generation facilities. Fagen, Inc. owns the equipment necessary to meet industrial demand growth. Their standard for safety, quality, and service has led Fagen, Inc. to be listed in the top 400 in ENR's largest contractors in the US. [www.fageninc.com](http://www.fageninc.com)



### Mortenson Construction

Mortenson Construction is a renewable energy contractor, building safe, quality construction projects since 1954. With dedicated teams to help deliver renewable energy projects, Mortenson has been involved in the construction of over 100 solar power and utility-scale wind projects, totaling nearly 11,000 MW across the US and Canada. Mortenson is a US-based, family-owned construction company, providing a complete range of services, including: planning; program management; pre-construction; general contracting; construction management; design-build; and turnkey development. [www.mortenson.com](http://www.mortenson.com)



### Petrochem

Petrochem is a nationwide specialty contractor providing: insulation; siding; scaffolding; fireproofing; coatings and linings; removable insulation blankets; heat tracing; as well as lead and asbestos abatement services. Their regional offices have the experience and expertise to complete virtually any type and size of project. They are also a certified minority owned business to help fulfill any minority requirements on a project. [www.petrocheminc.com](http://www.petrocheminc.com)



### Rosendin Electric

Rosendin Electric has quickly established itself as an EPC builder of mid to large-scale solar photovoltaic (PV & CPV) systems throughout the United States and Canada. With over 50 MW of project installation experience to date, more than 150 MW in construction, and 500 plus MW in various stages of development, they bring the turnkey expertise and EPC capabilities to develop efficient and cost-effective solar solutions to customers. [www.rosendin.com](http://www.rosendin.com)



### Scalo Solar Solutions

Scalo Solar Solutions is a solar developer that services the east coast. The company is committed to helping businesses and institutions take ownership of their energy future. Scalo Solar utilizes solar technology and other sustainable building solutions to create opportunities that make sense for the environment and the bottom line. [www.scalosolar.com](http://www.scalosolar.com)

### ECONOMIC DEVELOPMENT

#### Nebraska Department of Economic Development

Nebraska offers an ideal location, quality workforce, and positive economic environment for a variety of industries and business endeavors, particularly for renewable energy and solar power. Nebraska's features include: low-cost, reliable power; a local workforce with strong technical skills; a central location and time zone; insulation from natural disasters; tax incentives; and job training. [www.nebraskaadvantage.biz](http://www.nebraskaadvantage.biz)

### EDUCATION | RESEARCH



### Royal Roads University

The challenge of sustainability is global, and with it comes new opportunities for collaboration across disciplines, between governments, scientists, and business leaders, and among those committed to innovative responses to complex ecological, social, and economic issues. Royal Roads University's Environment and Sustainability programs provide the leadership skills and interdisciplinary knowledge that lead to sustainable solutions. [www.royalroads.ca](http://www.royalroads.ca)



### Ulster BOCES Clean Energy Training Academy

Ulster BOCES in Port Ewen, New York offers an ISPO accredited PV training program. Courses include Introduction to PV Technology, PV Installer's Course, PV Technical Sales and Marketing, and numerous continuing education classes including BIPV and off-grid. It's an approved provider of the NABCEP PV Entry Level Exam, and offers prep courses for the NABCEP Certification Exam taught by an ISPO certified instructor. In addition, training is also available in solar hot water, small wind, and geothermal technologies. [www.ulsterboces.org/adult](http://www.ulsterboces.org/adult)

### ELECTRICAL WIRE, CABLE & CONNECTORS

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Stiebel Eltron has been at the forefront of water heating technology for almost 90 years. If we make it, it is the best. If we don't make it, we work with the company who does make the best. As a leader in the field, we never stand still.

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### Anderson Power Products

The Solar SPEC Pak, manufactured by Anderson Power Products, is a highly configurable interconnect with power capabilities up to 1000 volts. The rugged, IP68 shell is flame-resistant in accordance with UL 94 V-0 and has a F1 weatherability rating. The locking latch conforms to the NEC 2008 requirements, requiring a tool to release the locking latch. Its touch-safe shell is available for wire-to-wire or panel-to-wire applications that range in temperature from -40° C to 105° C (-40° F to 221° F). This highly configurable connector provides thousands of design options for the most demanding applications. [www.andersonpower.com/products/spec-solar.html](http://www.andersonpower.com/products/spec-solar.html)



### General Cable

Twenty-five years of experience, combined with a worldwide presence and extensive R&D program, enables General Cable to provide reliable and technologically advanced cable solutions to the global solar energy market. As a company committed to environmental stewardship and renewable energy, General Cable has specifically designed its SunGen suite of products to effectively and efficiently link solar PV panels to the grid—while being able to withstand the harsh operating environments of solar power applications. From low-voltage DC and AC connections, and medium-voltage distribution, to high-voltage overhead and underground transmission lines, General Cable has the offering to comprise a complete cable solution for solar power applications—from sun to the outlet.

[www.generalcable.com](http://www.generalcable.com)



### LAPP GROUP

#### The Lapp Group

The Lapp Group, a worldwide cable, connector, and accessory manufacturer, has developed cables for PV applications that comply with local standards. For North America, there are ÖLFLEX SOLAR XL multi and the new ÖLFLEX SOLAR XLR 4703. ÖLFLEX SOLAR XL multi is a dual-approved cable with UL USE-2 600V and CSA RWU90 1KV. ÖLFLEX SOLAR XLR 4703 complies with the latest UL 4703 600V Type PV wire approval. Both cables are halogen-free, flame-retardant, and have excellent resistance to weather, temperature, and UV sunlight. They're dual-layered and electron beam cross-linked. In addition, Lapp offers SKINTOP cable glands and other cable management accessories for PV installations.

[www.lappusa.com](http://www.lappusa.com)



### REMKEenergy

#### Remke Energy

Remke Energy offers an expanded family of Helio-Link solar products, including: MC/Type 4 field wireable and bulkhead solar connectors; 8- to 18-gauge PV/USE cable; assembly and installation tools and kits; thin-film junction boxes and combiner boxes; custom cable assemblies; as well as grid-tie products for grounding, bonding, and termination. With shipping in one to two days, they offer 15,000 electrical products in stock at 'The Remke Energy Online Warehouse.'

[www.remkeenergy.com](http://www.remkeenergy.com)



### SEALCON

#### Sealcon LLC

Sealcon, which offers cable management solutions for the renewables, has RoHS/Deca BDE liquid-tight strain relief fittings, cable glands, and cord grips for the solar and wind power, as well as hazardous duty industries. Materials consist of nylon/nickel-plated brass, PVDF, stainless steel, and hazardous-proof cable glands with ATEX/IECEX/Ex-e/Ex-d/Gost/ABS approvals. The NEMA 4x6 benefits include: UV/V0/ULf1 non-corrosive, circular connectors (M16/M23/M27/M40/RJ45/PoE); industrial enclosures (plastic/metallic); and conduit systems with sample applications available and no minimum orders.

[www.sealconusa.com](http://www.sealconusa.com)

# Introducing The First Three-Phase Commercial AC Solar Module



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The first in the Intelligrated™ Power module series, CommercialAC features three-phase sequenced inverter and module technology optimized for grid-ready commercial applications. It is an intelligent integration of state-of-the-art panel electronics and module, specially designed for maximum system performance.

#### New CommercialAC features:

- No inverter, module or string sizing
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- Rugged inverter components more reliable and durable than standard microinverters
- Installs cold with no high voltage DC and safeguards against arc faulting
- One industry-leading 25 year warranty covering module/inverter panel

#### Benefits:

- Easy "plug and play"
- Mix and match wattages
- On-the-spot system modifications
- Cost savings on design, labor (no more need for highly skilled labor), and BOS
- Safer, easier, better

#### Find out more at:

[www.canadiansolar.com/en/commercialac](http://www.canadiansolar.com/en/commercialac)

**All the benefits of microinverters at string inverter pricing.**



# CanadianSolar

**ILSCO**

Capturing the sun's energy for conversion to electricity is at the forefront of renewable energy projects around the globe. ILSCO manufactures and supplies connectivity and grounding product solutions to support solar project specifications. At ILSCO, they know how critical every component is to solar projects. That's why they deliver the highest quality connectors on time, with best-in-class customer service.

[www.ilsco.com](http://www.ilsco.com)

**Kris Tech Wire Company**

Kris Tech manufactures UL4703 PV and RHW-2/USE-2 for panel interconnection and home-run wire, along with grounding wire. Their wire is 100% USA manufactured for distributors and OEM's and shipped from their east and west coast distribution centers. Various options are available, such as flex-stranding, tinned copper, sunlight-resistance, etc.

[www.kristechwire.com](http://www.kristechwire.com)

**ENCLOSURES | COMBINER BOXES**



**Allied Moulded Products, Inc.**

Allied Moulded fiberglass enclosures are easily modified and have a high strength-to-weight-ratio. These enclosures offer maintenance-free protection, while being rainproof, dustproof, UV-resistant, flame-resistant, and corrosion-resistant. Fiberglass is also an electrical insulator, which helps to protect internal electrical and electronic equipment against electrical shock. Allied Moulded's enclosures are UL listed, CSA certified, and compliant to at least NEMA 4X outdoor protection.

[www.alliedmoulded.com](http://www.alliedmoulded.com)



**Crenlo | Emcors Enclosures**

In the dynamic and increasingly automated world of energy production, protection of vital components requires a number of new considerations. For that reason, it's important to select a manufacturer that's capable of supporting the market evolution with their manufacturing capacity and custom-design capabilities. Crenlo meets that description with their line of custom enclosures.

[www.crenlo.com/enclosures](http://www.crenlo.com/enclosures)



**Fibrebond**

Fibrebond precast concrete shelters have been leading the way in equipment protection since 1982. Fibrebond delivers consistent high quality from its manufacturing plant, and lean continuous improvement process. Their concrete shelters provide a controlled environment for inverters, step-up transformers, and miscellaneous electrical components. Quality and service have earned Fibrebond the reputation as a trusted partner in equipment protection.

[www.fibrebond.com](http://www.fibrebond.com)



**Sabre Building Systems by CellXion**

Sabre Building Systems by CellXion manufactures power conversion stations and control houses for the solar industry. Their in-house engineering team develops and supports customer-specific designs for physical plant requirements, medium- and low-voltage control and distribution systems, ventilation, climate control, and building management systems.

[www.sabreindustries.com](http://www.sabreindustries.com)

**ENGINEERING | OPERATIONS & MAINTENANCE**



**NAES Corporation**

NAES, an independent services provider for the energy and related infrastructure markets for over 30 years, offers facility operations and maintenance, maintenance and construction, turbine repair and overhaul, technical support, and staffing. Dedicated to adding value by optimizing facility performance, NAES delivers performance and results.

[www.naes.com](http://www.naes.com)



**Abbie Gregg, Inc.**

For over 25 years, Abbie Gregg, Inc. (AGI) has been providing engineering and consulting services to global technology industries. Their services have been successful on over 700 projects, spanning five continents, and include: feasibility and due diligence studies; technology and design review; PV manufacturing facility design; cost modeling; financial analysis; HPM and tool accommodation; process verification; and more.

[www.abbiegregg.com](http://www.abbiegregg.com)



**Alta-Pro Engineering Design, Inc.**

Alta Pro Engineering Design, Inc. is a design service company that assists clients nationwide with solutions related to solar engineering, design, permit-ready documentation services, and several custom services. Clients benefit many ways by outsourcing for Alta-Pro's services. They know how to listen and identify the scope of work to achieve what's being requested. Alta-Pro's experienced staff takes pride in providing quality customer service and a rapid turnaround time.

[www.alta-pro.com](http://www.alta-pro.com)



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**WHERE INNOVATION MEETS AUTOMATION**

AP Alternatives is a manufacturer of Modular Solar Racking Systems. Our innovative modular racking design allows installers to streamline the installation process by having the project pre-assembled before shipping.

By utilizing high tech automation, AP Alternatives can pre-panelize your entire ground mount project for you. Send your modules to us and consider them installed!

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- Off Site Pre-Panelization
- Integrated Module Grounding
- Interlocking System

**ROOF MOUNT**

- Modular Design
- Rapid Installation
- Grounding Provisions
- Interlocking System



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### GF Piping Systems

GF Piping Systems is a provider of high-quality piping systems products. GF offers a total plastic solution tailored to the PV industry, including products for DI water/specified water; measurement and control; chemical drain and waste; reclaim/recycle; plastic pipe and fittings; valves; actuators; rotameters; fabrications; fusion joining technology (machines); heat exchangers; secondary containment; flow monitoring; and process control instrumentation.

[www.gfpiping.com](http://www.gfpiping.com)



### Next Generation Energy

Next Generation Energy provides engineering of renewable energy products and services. Their team of dedicated professionals serves the needs of architects, engineers, contractors, and end-users by providing single-source accountability for full-service design consulting, engineering, procurement, manufacturing, and distribution of complete energy management systems.

[www.ngeus.com](http://www.ngeus.com)



### OneCAD Solutions Ltd.

OneCAD Solutions provides mechanical engineering contract design services, as well as 3D CAD and 2D drafting and engineering analysis. OneCAD is an on-call engineering department for customers needing an engineering staff. They can also supplement staff on a project basis to help with overflow work. In 2011, OneCAD completed a new rack design, performed wind, snow load, and flow analysis, and produced marketing images of PV layouts.

[www.onecad.com](http://www.onecad.com)

### The Magnum Group

The Magnum Group (TMG) offers solar PV designers and installers substantial savings on PV installation design and drafting costs, based on TMG's technology and experienced engineers. Project designs are done in volume, and paid for on a per design basis. <http://themagnumgroup.net>



### Westwood Professional Services

Westwood Professional Services Westwood provides quality engineering, surveying, planning, and environmental solutions that support utility and commercial-scale solar and wind projects, as well as the rebuild and construction of electric transmission lines and substations. Established in 1972, Westwood is selected by builders, developers, and contractors across the country.

[www.westwoodps.com](http://www.westwoodps.com)

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**PERMITTING**  
E & E can prepare all required federal environmental impact statements, state-equivalent impact assessments, and local use permits.

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**Wind**  
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[jhammond@ene.com](mailto:jhammond@ene.com)

**Geothermal**  
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## FINANCIAL SERVICES

**Clean Power Finance****Clean Power Finance**

Clean Power Finance is driving the mass-market adoption of residential solar by building an online marketplace to connect the solar industry with capital markets. Clean Power Finance markets and manages residential solar finance products offered by funds that are 100% owned by third-party investors, allowing investors and lenders to achieve superior returns and installers to access competitive, white label consumer financing options.

[www.cleanpowerfinance.com](http://www.cleanpowerfinance.com)



**TIOGA ENERGY**
**Tioga Energy**

Tioga Energy is an award-winning provider of Power Purchase Agreement (PPA) services to private and public organizations. Tioga offers customers a single-source solution for quickly deriving the economic and environmental benefits of clean solar energy, without providing any capital investment. Through its SurePath PPA, Tioga develops, finances, builds, owns, and operates onsite solar electric systems. Customers pay lowered electric bills and enjoy a hedge against energy price volatility—all without the hassles of ownership.

[www.tiogaenergy.com](http://www.tiogaenergy.com)

**Greenpower Capital, LLC**

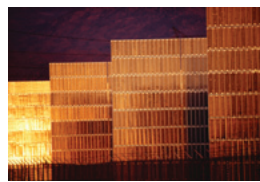
Offering project finance, leasing, and acquisition, Greenpower Capital has relationships with a multitude of institutional and private investors that represent over \$30 billion in funds for solar and wind projects. Greenpower offer their Early-stage Developer Buyout Program, Equity and Debt Finance Programs, as well as Full Project Acquisition Programs in which 100% of construction funds can be advanced in most cases. Greenpower's broad base of financial options provides options for almost any viable project.

[www.greenpowercap.com](http://www.greenpowercap.com)

**PNCEF Energy Capital LLC**

PNCEF Energy Capital LLC is a source of funding for the renewable energy industry. PNC has the financial capacity and industry expertise to provide strategic solutions for their 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, and operating or capital leases. With clients including developers, end-users, and panel manufacturers, PNC has a solid history of successful execution nationwide. PNC's focus to date has been on solar and energy efficiency deals, though they are committed to renewable energy in all sectors.

[www.pnc.com](http://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, and they have advised on over 240 power projects globally. TDJ offers project development, capital structuring, and project financing services, and have over 30 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](http://www.taylor-dejongh.com)

## HANDLING | MANUFACTURING



**KUKA Systems**

KUKA Systems is an international supplier of flexible manufacturing systems used in industries like solar panel manufacturing to optimize product quality and productivity. KUKA Systems' global workforce performs all aspects of assembly line design and construction, including prototyping, manufacturing, assembly, and commissioning. For solar energy, KUKA supplies engineering services, automated processing tools, production cells for performing every task associated with assembling and testing PV and thermal panels, as well as customized, turnkey production lines for all types of modules. For North American solar panel makers, KUKA Systems is a US-based integrator with proven expertise in adapting these technologies to local requirements, including all applicable standards and regulations.

[www.kuka.com](http://www.kuka.com)

**Elixir Industries**

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

[www.elixirind.com](http://www.elixirind.com)

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### Erdman Automation Corp.

Erdman Automation Corporation has developed a cost-effective sealant application station for applying to ambient, heated, or two-part sealants. The Erdman Solar Frame Sealant Applicator provides a precise and consistent quality application of sealant to solar frame parts.

[www.erdmanautomation.com](http://www.erdmanautomation.com)



### Geoking Solar

Geoking Solar manufactures and distributes solar products, including: solar panels (5-watt to 240-watt); solar street lights; attic fans; solar-power back-up and electric generators; portable solar power systems; solar hot water systems; and more.

[www.geokingsolar.com](http://www.geokingsolar.com)



### Nexus Plastics California, Inc.

Nexus Plastics California, Inc. is a manufacturer of PE, biodegradable, nylon, and multi-layer films for solar panels, including bags, sheeting, tubing, covers, etc. They also offer high-purity and additive-free products, as well as those with additives, including: anti-stat; anti-block; ultraviolet inhibitors; high heat resistance; moisture barrier; and more.

[www.nexuscalifornia.com](http://www.nexuscalifornia.com)



### Somont GmbH

Somont, a member of Meyer Burger Group, specializes in the development and production of soldering equipment for the connection and integrated testing of solar cells—so called stringers. The RAPID and CERTUS stringers stand out due to their proven Soft Touch Soldering Process and optimal temperature management. Through this process, the most sensitive cells are safely combined into strings with peak outputs and very low breakage rates.

[www.somont.com](http://www.somont.com)

## INSURANCE



### GCube Insurance Services, Inc.

GCube is a provider of insurance services for renewable energy projects in solar energy, as well as wind, biofuels, hydro, wave, and tidal power around the globe. GCube's SolarPro offers specialized property and liability coverage for commercial-scale solar construction and operational risks. 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](http://www.gcube-insurance.com)



“Now I get the same peace of mind on commercial PV installations that I’ve long enjoyed on our residential solar jobs.”

Tony Diaz, Century Roof & Solar

## Quick Mount PV Sets a New Standard for Low Slope Roof Attachments

Tony Diaz has been relying on Quick Mount PV's Classic Composition Mounts since 2006 to make his residential solar installations 100% code-compliant and watertight. So when Quick Mount PV introduced its all-new Low Slope Mount for commercial roofs in 2011, Tony was first in line to try them out.

“As I expected, Quick Mount put uncompromising quality and ease of use first and foremost in their new low-slope mounts,” said Tony. “It’s not only fast to install, but the superior strength of the base and post means I can make longer spans and use fewer mounts,” he continued. “Best of all, I know there won’t be any expensive call backs.”

Whether used to fully attach a solar array or to secure anchor points in a ballasted system, the Quick Mount PV Low Slope Mount follows all roofing best practices, and when installed properly will not void warranties for either membrane or built-up asphalt roofs.

Call or visit our website for more details, and see how you can mount PV on commercial roofs with ease and confidence.

### LOW SLOPE MOUNT FEATURES

- ▶ Code compliant for TPO, PVC, EPDM, & built-up asphalt
- ▶ Strongest off-the-shelf mechanical mount
- ▶ All exposed hardware is stainless steel
- ▶ 3 post heights offer 7", 9" or 12" clearance off the deck
- ▶ All fasteners and related hardware included
- ▶ 100% IBC compliant
- ▶ Meets or exceeds roofing industry best practices
- ▶ 10-year warranty; 50-year expected life
- ▶ Works with all leading single-ply membranes
- ▶ Available through all major distributors



Low Slope Mount installed on substrate

...on built-up asphalt roof with aluminum cone

...on membrane roof with boot specified by roofing manufacturer



925-687-6686

[products@quickmountpv.com](mailto:products@quickmountpv.com)  
[www.quickmountpv.com](http://www.quickmountpv.com)





### Solar Insurance & Finance

Solar Insurance & Finance (Solarif) is an internationally operating independent insurance broker and authorized agent that specializes in insuring solar PV installations—also known as PV insurance. Solarif insures PV installations on the roofs of private clients and businesses, as well as solar energy parks. [www.solarif.com](http://www.solarif.com)

### LIGHTING SYSTEMS & SURGE PROTECTION



#### CITEL Inc.

CITEL's VG Surge Protectors are designed with patented VG Technology, a hybrid Metal Oxide Varistor (MOV) + Gas-filled Spark Gap (GSG) surge protection circuit that dramatically increases the life expectancy of the surge protector and totally eliminates working current and leakage current. Rated for DC Power Applications up to 1200Vdc and UL 1449 3rd Edition. [www.citel.us](http://www.citel.us)



#### 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 DEHNgard 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. Having celebrated their 100th-year anniversary in 2010, DEHN continues to serve the electrical industry in the research, design, and manufacture of products, offering technical expertise to minimize the effects transients caused by lightning and other sources. [www.dehn-usa.com](http://www.dehn-usa.com)



### Raycap

#### Raycap Inc.

Protect an investment in solar generated power with products specifically developed for protection of solar power systems. Raycap's PV products, featuring Strikesorb and ACData surge protection, continuously defend solar power inverters and solar panels from damage caused by direct lightning strikes. Suitable for AC & DC protection, Raycap provides electrical protection at the PV inverter and string/combiner boxes, which make up the key elements of any PV system. [www.raycapsurgeprotection.com](http://www.raycapsurgeprotection.com)



#### EverLast Lighting

EverLast Lighting is a subsidiary of Full Spectrum Solutions, Inc., and has quickly grown into a quality manufacturer of energy efficient induction lighting solutions for roadway, parking structures, facility, and area lighting applications. [www.everlastlight.com](http://www.everlastlight.com)

### R3&A Limited

R3&A Limited offers DEHN products to protect photovoltaic systems. The exposed arrangement and extended surface of PV systems creates a high risk of direct and indirect lightning strokes. PV systems inevitably represent a connection to the electrical installation of a building. Possible lightning effects on PV generators can, therefore, affect an entire building. Solar power plants are very susceptible to damage due to their enormous space requirements and their complex design. In all cases, downtime has to be prevented by means of a technically and economically coordinated lightning and surge protection concept. For more than 15 years, DEHN has been engaged in developing lightning and surge protection concepts for PV systems. [www.r3alimited.com](http://www.r3alimited.com)



### Sol Inc. (Solar Outdoor Lighting)

Sol is a manufacturer of commercial solar LED lighting solutions with 50,000 systems installed worldwide. Sol's commitment over the past 20 years is built on innovative products, quality systems, and the strongest support and design team. Sol develops solutions that are economical, well-engineered, and easy to install for: roadways; parking lots; pathways; perimeter security; shelters; and more. Sol is ISO 9001:2008 compliant. [www.solarlighting.com](http://www.solarlighting.com)

### 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, ground-mount solar arrays, which greatly reduces installation time, labor, and costs. By using factory production automation, they can produce processed/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 module-to-module wiring and cable management complete, ready for simple home-run wiring in integrated wire management trays. AP Alternatives also offers a modular roof mount racking systems, the Solar Ray for crystalline modules and the Flat Rack for thin-film modules. [www.apalternatives.com](http://www.apalternatives.com)



## Solar Mounting Solutions.

We Make it Ourselves.  
And We Make it Well.

Many solar hardware makers have been in business only a few years. But DPW Solar has delivered quality hardware mounting solutions for almost 20 years.

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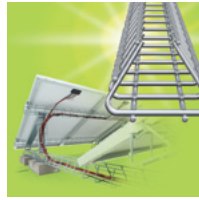
### Array Technologies

Array Technologies' DuraTrack Solar Tracker optimally balances performance with high durability, long-term reliability, and minimal operating costs and maintenance, to maximize the ROI for utility-scale and commercial projects. The robust, uncomplicated gear drive system doesn't transmit wind forces through the driveline. Tracker rows efficiently adapt to variable terrain and closely follow irregular site boundaries. Intelligent design reduces labor and time required to install and maintain. [www.arraytechinc.com](http://www.arraytechinc.com)



### DPW Solar

New Mexico-based DPW Solar is a wholly owned subsidiary of Preformed Line Products Company. Founded in 1993, DPW Solar designs and manufactures PV solar rack mounting systems under its POWER-FAB name for commercial, residential, and industrial applications. The POWER-FAB product line includes: the CRS system; Power Rail; POWER GRID; Top-of-Pole; Multi-Pole; Side-of-Pole; roof/ground-mounts; and enclosures. [www.dpsolar.com](http://www.dpsolar.com)



### Legrand Cablofil

FAS Rack ground-mounted photovoltaic supports speed-up, utility-grade PV installation times reducing overall project costs up to 75%. FAS Rack is pre-engineered for each specific project, eliminating onsite engineering adjustments, and can be installed with two-man crews using simple tools. FAS Rack features a number of patent-pending innovations including pier caps designed with built-in stops to make grid table positioning easier. All grid tables are pre-assembled to eliminate labor-intensive "stick built" construction methods. Plus, all hardware is RoHS compliant, so the entire system contributes to LEED points. To date, FAS Rack has been used on a number of solar arrays throughout North America, totaling more than 60 MW. Legrand also offers a number of related electrical products for the solar market including Delta Strut rooftop PV supports, CB Series combiner boxes, and pre-terminated cabling. [www.legrand.us/cablofil/fas-rack](http://www.legrand.us/cablofil/fas-rack)

# Why I switched to SunWize



**Ian Huddleston, Owner/Installer**  
Greene Tech Renewable Energy in TN  
[www.greentechenergy.com](http://www.greentechenergy.com)

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*2400W Zomeworks tracker array,  
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M16 Signal

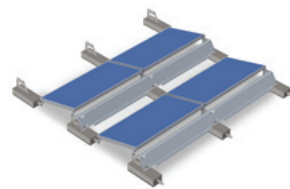
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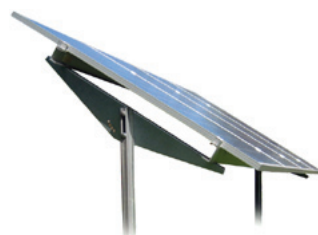
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**panelclaw**  
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### PanelClaw

PanelClaw is a supplier of ballasted PV mounting systems, offering simple, flexible solutions for flat-roof and ground-mount applications. PanelClaw's systems, which are UL 2703 listed for electric bonding and grounding, feature just three major components and significant factory pre-assembly. These designs speed and simplify installation—and together with PanelClaw's extensive technical service, advanced testing and certification program, and cutting-edge engineering—lower lifecycle costs on every project. PanelClaw mounting solutions are available in the US, Canada, and the European Union. [www.panelclaw.com](http://www.panelclaw.com)



**PatriotSolarGroup**

### Patriot Solar Group

Patriot Solar Group is the source for commercial, industrial, and consumer needs. They maintain a diverse line of quality and innovative products, which consists of fixed pole mounts, ground mounts, and single or dual-axis trackers with controllers and inverters. Patriot Solar has on- and off-grid systems, as well as a new line of mobile solar trailers and portable lighting systems. [www.patriotsolargroup.com](http://www.patriotsolargroup.com)



**ProtekPark SOLAR**

### ProtekPark Solar

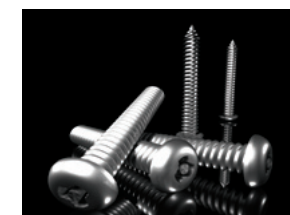
Combining the structurally efficient, yet aesthetically pleasing truss design with a high-performance marine-grade coating, ProtekPark Solar continues to create a long lasting and cost-effective solar canopy system. ProtekPark Solar has the experience and commitment to design and manufacture value engineered and customized structural solutions for each installation. [www.protekparksolar.com](http://www.protekparksolar.com)



**PVHardware**  
SOLAR MOUNTING AND TRACKING SYSTEMS

### PV Hardware, LLC

PV Hardware is a provider of fixed-tilt and single-axis tracking systems engineered by highly experienced industry professionals. Their highly efficient designs minimize the total cost of install through reduced foundation requirements, fewer components, rapid constructability, and lower material costs. In addition, their team is comprised of experts in solar technology and construction, enabling them to provide unparalleled customer service and support. [www.pvhardware.com](http://www.pvhardware.com)



With Triple-Lock Protection  
**PV SECURITY BOLT**

### PV Security Bolt

The PV Security Bolt is one of the most effective deterrents to PV module theft. Thanks to its "Triple-Lock Protection," thieves can't unscrew the bolts—the PV Security Bolt can be unscrewed only by a unique key driver sold exclusively to licensed PV installers. Each driver is numbered, registered, and traceable. Thieves also can't cut the bolts off because of its low-profile design and serrations on the underside of the screw head, it's virtually impossible to slip a tool of any kind between the head and the clamp. And, thieves can't drill the bolts out. The PV Security Bolt's 4140 heat-treated steel gives it amazing strength and durability. After drilling out just three or four PV Security Bolts, a drill would lose power (and ruin many drill bits). [www.pvsecuritybolt.com](http://www.pvsecuritybolt.com)



**Quick Mount PV**  
RESPECT THE ROOF

### Quick Mount PV

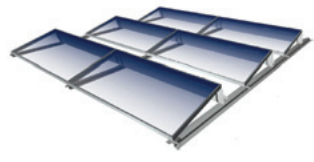
Quick Mount PV mounts are the recognized industry standard for 100% code-compliant, watertight solar roof mounts. The Classic Comp & Shake Mounts are ICC-certified, and the newly released New Roof Comp, Universal Tile & Low Slope Mounts offer one of the strongest mechanical roof attachments on the market. They work with all standard racking systems. All products are made in the USA. [www.quickmountpv.com](http://www.quickmountpv.com)



### Roll Forming Corporation

Roll Forming Corporation (RFC) has over 60 years of experience as a high-quality, competitively priced roll form manufacturer that delivers to their customer's needs. RFC has over 35 roll lines designed for a variety of sophisticated metal types, widths, and gages. While capable of addressing simple shapes, RFC's niche is tackling unique shapes with challenging features and tolerances. RFC is in the business of roll forming solutions and puts a large knowledge base of roll forming to work for their clients.

[www.rfcorp.com](http://www.rfcorp.com)



### Schletter Inc.

Schletter provides innovative solar mounting systems for a broad range of clients in utility, commercial, and residential solar applications. Each system can be individually designed for a cost-effective photovoltaic mounting solution in utility-scale ground mounted systems, commercial or residential pitched-roof, and flat-roof systems. In addition Schletter manufactures the Park@Sol PV carport system for any sized carport structure.

[www.schletter.us](http://www.schletter.us)



## sapa:

### Sapa Extrusions North America

Sapa Extrusions is a global manufacturer of aluminum profiles and a key supplier to the solar industry, providing solutions to all solar market segments, including: PV racking and mounting systems (open field, flat roof, and residential); solar thermal (H<sub>2</sub>O) applications; module frames and components; concentrated solar power collectors; inverter housings and components; and thermal management solutions. Sapa's North American Technical Center works with customers to establish finished designs for innovative custom features and improved end-use applications. Sapa's manufacturing capabilities include standard and custom extrusion, as well as finishing and fabricating. Sapa supplies critical components for solar applications that help customers optimize the value of their products.

[www.sapagroup.com/solar](http://www.sapagroup.com/solar)

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**SolarDock**

SolarDock is the flat-roof mounting system that offers a high-performance, lightweight, non-penetrating roof installation method. SolarDock is available in tilt angles up to 35° for greater energy output per dollar of investment, and requires virtually zero ongoing maintenance as a result of full protection of the panels, wires, and roof membrane. UL Listed and TUV certified, SolarDock is precision-engineered for fast installation and maximum power generation.

[www.solardock.com](http://www.solardock.com)



**TTi**

The patented TTI Flat Jack Comp Shingle Mount is a durable, watertight residential solar roof-mount, requiring no trimming or sealants. With three primary components, the Flat Jack is quick and easy to install, reducing labor hours and offering peace of mind that the highest quality product is supporting a roof installation. This fully flashed mount, with a base of 10" in width and 11" in length, provides a 100% waterproof foundation, and is built to withstand heavy vertical loads and high winds. The Flat Jack, made from the most durable materials, will withstand the elements and confidently protect one's roof and one's investment.

[www.ttisolar.com](http://www.ttisolar.com)



**Zilla Corporation**

Zilla Corporation, manufacturer of Zilla racking and mounting solutions, has developed one of the simplest, most adaptive, and comprehensive system in the marketplace today. Providing a variety of mounting options for solar products, Zilla's many proprietary and patented products provide all-inclusive solutions. From individual products to complete system design, Zilla Corporation delivers environmentally friendly, practical, and affordable innovations to installation professionals worldwide.

[www.zillarac.com](http://www.zillarac.com)



**80/20 Inc.**

80/20 offers the T-slotted aluminum construction system. Made from corrosion-resistant recyclable aluminum, this modular system of T-slotted profiles, mounting components, and accessories is versatile, lightweight, and strong—making it an ideal fit for custom framing and mounting of solar panels and components. No-obligation, free design assistance, and design software available.

[www.8020.net](http://www.8020.net)



**Advanced Technology & Research Corp.**

ATR Solartech's Dual Panel Tracker (DPT) is a versatile, ground-mount, two-panel tracking mount built for easy installation on a pole or simple wooden post. A GPS-enabled mechanism lets the 235-watt panels track the sun and produce up to 30% more power per day than fixed panels. The unit is suited for business or home-use in any place with good southern sun, with multiple units a ready option. The DPT provides a simple way to install a high-performance, durable, easy-to-maintain solar system.

[www.atrsolartech.com](http://www.atrsolartech.com)

**BAND-IT IDEX, Inc.**

BAND-IT IDEX Inc., a global manufacturer of stainless steel clamping systems used in a variety of engineered applications, assist customers to reduce fastening and joining lifecycle costs. BAND-IT's application engineers can redesign existing project, offering customers ideal solutions.

[www.band-it-idex.com](http://www.band-it-idex.com)



**Conergy**

By easing each step of the quoting, planning, and installation processes, the Conergy SunTop IV system comprehensively delivers value across business operations. Flexibility and simplicity are brought to design, permitting, job planning, and construction. This, combined with high-quality components, German engineering, and local production is why SunTop IV is the total residential PV mounting solution.

[www.conergy.us](http://www.conergy.us)

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In addition to our popular and innovative **Eos-Array String Monitoring System** and new transformerless and fanless **ISGA PV Inverters**, CARLO GAVAZZI also offers **Energy Meters**, **PV Surge Arresters**, as well as **Irradiation**, **Temperature** and **Wind Sensors**.

**Eos-Array** is the innovative and expandable solution for turning an underachieving combiner box into an overachieving PV string monitoring, management and control solution.

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### Cooper B-Line

Cooper B-Line is a global provider of innovative solar solutions, including ground and rooftop mounting systems, wire management, and complete balance of systems. Included is its ARISTA Monolithic racking system, designed with limited components and pre-assembled fittings to help yield significant installation time and labor savings for commercial rooftop applications. The ARISTA Monolithic racking system is compatible with standard strut, fittings, and other accessories, making electrical solutions endless. It offers building code compliance in the US and Canada, and has optimized roof loading through certified third-party wind tunnel testing. The system is raised off the roof to promote wind and water flow, as well as flexibility during installation. For easy grounding of PV modules, it also offers a module clamp with integrated grounding for portrait orientation applications.

[www.cooperblinesolar.com](http://www.cooperblinesolar.com)



### Daetwyler Clean Energy

Daetwyler Clean Energy (DCE) is a global provider of solar mounting solutions. DCE provides its clients with the greatest value by implementing the highest degree of competency. They use the latest in materials and manufacturing processes to minimize costs and maintain reliability for ground-mount, rooftop-mount, and pole-mount solar power, as well as parking solar canopies.

[www.daetwylerce.com](http://www.daetwylerce.com)



### DynoRaxx

DynoRaxx Evolution FR is the only fiberglass professional ballasted racking system available today. The system requires no tools to assemble and only consists of three parts. The system was in development for three years and installed into 10 MW of projects before being offered to the solar industry. DynoRaxx studied the ergonomics of solar installations creating a system that promotes the quickest, easiest installation of any system currently on the market. DynoRaxx Evolution FR was wind tunnel tested at NASA. It's lightweight and stacks like cups for reduced shipping costs. It greatly reduces the time of hoisting equipment to the roof.

[www.dynoraxx.com](http://www.dynoraxx.com)



### EJOT Solar Fastening Systems

EJOT offers high-quality, secure, and easy-to-install fastening systems for solar installations. They are a specialist for fastening mounting systems on exposed fastener metal panel roofs and flat roofs. Their common goal is that each installation is long-lasting, securely fastened, and stays watertight on a roof.

[www.ejot-usa.com](http://www.ejot-usa.com)

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[www.upsolar.com](http://www.upsolar.com)



**PRAXIA ENERGY**

PRAXIA ENERGY designs, engineers, and produces solar mounting systems for open field and roof-tops. With a global presence, they provide proper structural calculations according to each country's specification, and offer direct control over the value chain.

[www.praxiaenergy.com](http://www.praxiaenergy.com)



**PV Racking LLC**

PV Racking designs, manufactures, and distributes solar racking components that are used in roof and ground-mounted solar systems. PV Racking uses a new solar racking system that eliminates the need for clamps, making it much easier to install, more secure, and superior in appearance.

[www.pvracking.us](http://www.pvracking.us)



**RBI Solar, Inc.**

RBI Solar, Inc. designs, engineers, manufactures, and installs solar mounting systems for large commercial and utility-scale projects. As a specialist in ground-mount, roof-mount, and custom-designed specialty solar structures, they focus on providing best-in-class racking systems and project management capabilities to serve owners and integrators.

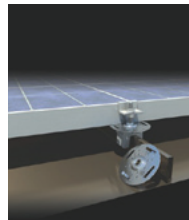
[www.rbisolar.com](http://www.rbisolar.com)



**Renusol America**

Renusol America offers PV racking systems for mounting solar panels on flat and pitched roofs. The Renusol CS60 flat-roof mounting system made from high-molecular weight polyethylene is a one-piece mounting system per panel. The Renusol VS pitched roof mounting systems has pre-assembled and adjustable parts for simple inventory management and easy installations for all size panels. Both systems are simplified to minimize project design and labor installation. Renusol America, is a subsidiary of Renusol GmbH out of Germany, which has over 400 MW of product installed since 2004. Renusol America operates a full-scale warehouse and distribution facilities throughout the US.

[www.renusolamerica.com](http://www.renusolamerica.com)



**S-5!**

S-5! recently enhanced its S-5-PV Kit to ensure electrical continuity between modules. With this stainless steel solar mounting solution, the module is anchored with the kit, and is automatically bonded. Lugs and copper wire won't be required except to connect one string of modules to another, and to ground the system. The updated S-5-PV Kit is listed to the new UL subject 2703, a standard that covers both bonding and mounting, and has gained an ETL Listing to UL 1703. The S-5-PV Kit is attached to standing seam metal roofs utilizing S-5! zero-penetration technology to avoid piercing the roof paneling. The S-5-PV Kit can also be attached to exposed-fastened and corrugated profiles when used with VersaBracket and CorruBracket.

[www.s-5.com](http://www.s-5.com)



**Sedona Energy Labs**

Sedona Energy Labs releases IntelliTrack 2000A. A new approach to dual-axis tracking, their new line of seasonally adjustable dual-axis solar tracking frames enables maximum possible power production at a competitive price. Based on patent-pending technology, these new systems enable solar arrays to generate a 40%, or greater, increase in power production, compared to fixed solar frames.

[www.sedonaenergylabs.com](http://www.sedonaenergylabs.com)



**Sollega, Inc.**

The InstaRack ballasted solar racking system, manufactured by Sollega, is designed to reduce labor and shipping costs for low-slope, flat-roof solar installations. It's manufactured from high-density polyethylene, utilizing 35% recycled content with a built in UV inhibitor. The InstaRack is available in tilt angles of 10° and 15°, and is compatible with solar modules 30 inches to 44 inches in width. The InstaRack is easy and intuitive to install, and uses readily available strut.

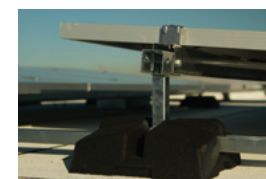
[www.sollega.com](http://www.sollega.com)



**SPG Solar**

The All-Weather SPG Solar SunSeeker Tracker is a single-axis tracker with a robust design, optimized for long-term reliability in all weather conditions—from high winds, hurricane zones, to snow regions. This is SPG Solar's latest generation of the SunSeeker Tracker, further maximizing solar returns. By developing a more streamlined design, up to 40% less material is required, reducing the overall installation time and costs. With over 40 MW installed nationwide, the SPG Solar SunSeeker is easily scalable through a modular power block design, creating efficiencies for the large and utility-scale solar system projects. Built and tested to endure all weather conditions, the high-performing SPG Solar SunSeeker is installed faster, generates more power, requires minimal maintenance, and ensures the greatest returns

[www.spgsolar.com](http://www.spgsolar.com)



**SunLink Corporation**

SunLink's mounting, wire management, and combiner box products are designed as an integrated package for optimal convenience, installation efficiency and value. On the roof, SunLink RMS provides Tilt-Access and integrated wire management, and Core RMS features a linked grid assembly to accommodate high loads. On the ground, Large-scale GMS is both sturdy and flexible with features that facilitate rapid installation, while Ballasted GMS is ideal for brownfields and landfills.

[www.sunlink.com](http://www.sunlink.com)

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\*Germanischer Lloyd certification pending; patent pending    The trade-mark and registered trade-mark are owned by Con-Tech Systems Ltd.





**TRA-MAGE, INC.**

When it comes right down to it, a solar system is only as good as its mounting structure. Turn to TRA-MAGE for quality roof mounting accessories and fastening systems. Built to last, every component in their solar mounting line creates an ideal foundation for solar systems.

<http://sun.tra-mage.com>

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**Northwind Solutions**

Established in 2004 in Canada, Northwind Solutions is a progressive energy services organization dedicated to serving the renewable and clean energy sector. Northwind delivers a complete suite of the high-quality essential services to project developers, asset owners, as well as OEMs throughout North America. With over 60 renewable energy projects (in solar PV and wind) in seven provinces and 15 US states, Northwind's turnkey solutions for the solar markets include: construction management and installation services; project service, operations, and maintenance; and consulting services.

[www.northwindsolutions.com](http://www.northwindsolutions.com)

**PERFORMANCE MONITORING | TRACKING SYSTEMS**



**Campbell Scientific**

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

[www.campbellsci.com/solar-energy](http://www.campbellsci.com/solar-energy)



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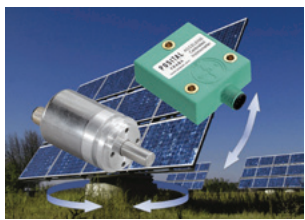
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TYPE	CAPACITY Amp-Hours (AH)			VOLTAGE
	5-Hr Rate	20-Hr Rate	100-Hr Rate	
IND9-6V	355	445	545	6 VOLT
IND13-6V	533	673	820	6 VOLT
IND17-6V	711	897	1090	6 VOLT
IND23-4V	977	1233	1500	4 VOLT
IND29-4V	1245	1570	1910	4 VOLT

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FRABA

**FRABA POSITAL Inc.**

FRABA POSITAL is an international supplier of position sensors with applications in the solar power industry. MAGNETOCODE absolute rotary encoders and ACCELENS inclinometers are ideal for use in single and dual-axis solar trackers for all kinds of PV, CSP, or CPV systems. Reliability under harsh conditions is assured by highly effective environmental sealing (IP69K), and robust, damage-resistant packaging. Electronic interfaces are available for most control system hardware.  
[www.posital.com](http://www.posital.com)



**SPX**

**SPX ArgusON**

SPX Solar Power Management is more than monitoring. If one's current platform only monitors solar power performance, then it's just part of the solution. Solar Power Management combines performance monitoring, system alarming, and trouble ticket management with the support of a staffed 24/7 National Operations Center. Customers can trust their solar PV system performance and ROI to a Fortune 500 company that has been providing monitoring and management to over 30,000 multi-industry sites for 12 years.  
[www.arguson.com](http://www.arguson.com)



**YOKOGAWA** ◆

**Yokogawa Corporation**

Yokogawa Corporation of America provides complete control, communication, and instrumentation systems for utility-scale solar applications. Yokogawa's HXS10 controller is specifically designed for controlling solar trackers with embedded NREL Solar Positioning Algorithm, robust operating temperature (-20° C to +70° C), and extensive field communications support. Since the HXS10 was specifically designed for solar tracking applications, it has a variety of specialty inputs for inclinometers and position feedback sensors, including RS232, RS485, and high-speed pulse encoders, as well as full trigonometric functions for calculating positions. A single HXS10 is capable of controlling up to 20 axes for cost-effective tracker deployments. Yokogawa's turnkey control systems include tracker control panels (LOCs), Supervisory Control Systems (SCS), Distributed Control Systems (DCS), communication networks, and field instrumentation. Their field instrumentation is designed to accommodate measurement of high-temperature, concentrated solar thermal heat transfer fluid, with several proven installations worldwide.  
[www.yokogawa.com](http://www.yokogawa.com)



**DECK Monitoring**

DECK Monitoring pairs advanced software and revenue-grade hardware with a commitment to customer service, providing added value to all parties. For installers, DECK has streamlined the customer experience to provide easy system planning and installation. For end users, the customizable dashboard is full of features to generate "green" PR. For O&M, responsive support helps with every aspect of system management. And, for investors, DECK tools and support help to ensure long-term ROI on a PV investment.  
[www.deckmonitoring.com](http://www.deckmonitoring.com)

**DH Solar**

DH Solar, a division of DH Satellite, has been a commercial manufacturer of premium horizon-to-horizon satellite antennas and mounting systems for the past 30 years. The DH Solar division manufactures the following systems: the Dual Axis System; the Horizon-to-Horizon Tracker; the Fixed Pole System; and the Modular Single Axis Tracker. The Horizon-to-Horizon Tracker always points precisely at the sun, even when it's cloudy. The Fixed Pole System is ideal for smaller areas as it's pole-mounted with or without a seasonal adjustment. The Modular Single Axis Tracker has a pre-set elevation set for the longer days, tracking from east to west throughout the day. This system also provides the ability to add panels over time.  
[www.dhsolar.net](http://www.dhsolar.net)

**Solar Monitoring Systems**

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[www.campbellsci.com/renewables](http://www.campbellsci.com/renewables)



**Cone Drive Gearing Solutions**

Cone Drive offers double-enveloping gear technology. With Cone Drive's double-enveloping design, the worm "wraps around" the gear, putting up to 10 times more teeth in contact than conventional worm gearing. That means the total torque load is distributed among more teeth, increasing durability, precision, and efficiency. There's more output, less downtime, and more precision—and all of these elements are crucial when tracking the sun effectively and economically.  
[www.conedrive.com](http://www.conedrive.com)

**meteocontrol North America**

meteocontrol is a global provider of solar performance monitoring software and hardware, SCADA solutions for PV plant control, independent engineering, and O&M services for PV installations. meteocontrol currently monitors 4GW worldwide in more than 23,500 PV systems, and has provided energy yield reports and technical consulting services for PV projects with an investment value over \$10B. meteocontrol currently offers asset management and O&M services for more than 150 MW of PV projects.  
[www.meteocontrol.com](http://www.meteocontrol.com)



### Moxa Americas, Inc.

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



### P4Q Solar Tracking Controllers

P4Q Suntrack controllers generate 800 MW of energy daily. Features include connection via Ethernet or Zigbee, backtracking, tower auto-configuration, and SCADA compliance. Their controllers are used in CSP, CPV, and PV applications. [www.suntrackpro.com](http://www.suntrackpro.com)



### The Energy Detective (Energy, Inc.)

The Energy Detective (TED) is an electricity monitor that installs in the breaker panel and provides real-time data for production and consumption, as well as a net meter reading. [www.theenergydetective.com](http://www.theenergydetective.com)



### US Digital

US Digital provides the CSP, CPV, and PV industries with high-accuracy, cost-effective inclinometers and encoders, supporting solar tracking systems and other applications. The T7 inclinometer features 0.1° accuracy with 0.01° resolution. The T7 inclinometer is IP67-rated and is available with RS232, RS485, and Modbus communication protocols. US Digital's vertically integrated design and manufacturing capabilities allow products to be delivered with little to no lead time. [www.usdigital.com](http://www.usdigital.com)



### WeatherHawk

WeatherHawk weather stations offer air and panel temperature, RH, wind speed and direction, rainfall, and irradiance measurements in an easy-to-install, easy-to-use package. These industrial-grade weather stations are available with a MODBUS protocol or in a Fat Spaniel compatible configuration. [www.weatherhawk.com](http://www.weatherhawk.com)

What's your power system challenge?

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**"Advanced Energy PV inverter systems are utilizing SEL synchrophasors for intelligent, safety-critical control."** —Michael Mills-Price, Advanced Energy

Schweitzer Engineering Laboratories is teaming with Advanced Energy to use wide-area synchrophasor measurements to provide innovative, highly effective, autonomous control of PV sites, resulting in safe, reliable, and cost-effective distributed generation.

Reliably interconnecting PV generation is challenging. SEL works with utilities, system integrators, distributed generation owners, and inverter manufacturers to apply advanced synchrophasor technology to address these challenges. Let SEL help you integrate renewable generation sources. Our solutions include protection, communications, and the experience to efficiently integrate your distributed generation.

SEL synchrophasor measurement and control technology provides innovative solutions to solve power system challenges.



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[www.ontility.com](http://www.ontility.com)



**SunWize**  
Solar Electric Solutions

**SunWize Technologies**

SunWize is a distributor of solar electric systems, solar modules, and components to installers serving the residential and commercial markets in North America. They provide customer training workshops and conferences, webinar technical programs, solar resources, and product information on their website. SunWize's dealer program includes new product information and updates, as well as dedicated technical specialists. They maintain an extensive inventory in 200,000 square-feet in two major warehouses.

[www.sunwize.com](http://www.sunwize.com)



**Inovateus Solar**

As a solar integrator, Inovateus Solar has partnered with top solar module and inverter manufacturers to offer the highest quality, cutting-edge products available. Specializing in large-scale solar installations for businesses and universities worldwide, allows them to offer competitive pricing with flexible financing options. Owning a system allows customers to take advantage of incentives, rebates, and feed-in tariffs to increase their ROI. To gain the benefits of a renewable energy system without tying up resources, Inovateus Solar can offer a power purchase agreement (PPA) financing model, allowing the long-term benefits of reduced electricity prices and a green image without the up front costs of ownership.

[www.inovateussolar.com](http://www.inovateussolar.com)



**LUMOS Solar**

LUMOS Solar designs PV products for solar integrators at the highest value. Their new LSX frameless module system provides the most aesthetic solar solution on the market. Its integrated racking system, low-profile appeal, and through-bolted connection provides a new option for integrators while minimizing labor during installation. Modules come in black, white, and clear backsheets to be used in multiple applications. LUMOS Solar also provides traditional framed modules, racking solutions, and system components.

[www.lumossolar.com](http://www.lumossolar.com)

**Renewable Future Energy Resources Inc.**

Renewable Future Energy Resources are a source for Day4 Modules, solar racking, inverters, and balance of systems. Renewable Future Energy's staff are all certified, and they have the largest installation team in western Canada, who travel globally for installations and training.

[www.solarpowernerg.com](http://www.solarpowernerg.com)



**SES21 USA – Wholesale Solar Panels**

SES21 USA specializes in wholesale solar energy component sales, and are a US distributor of solar panels, complete solar PV systems, inverters, and solar mounting systems to the entire country. From home solar systems to commercial solar planning and solar carports, SES 21 USA has the right solution for solar energy projects.

[www.ses21usa.com](http://www.ses21usa.com)

**Solar Solutions & Distribution, LLC**

Solar Solutions & Distribution is a master distributor of solar equipment. With megawatts in stock, they ship worldwide, and are a wholesale distributor of PV modules, mounting systems, as well as BOS and kits. They cater to electrical distributors, solar integrators, resellers, roofers, and developers.

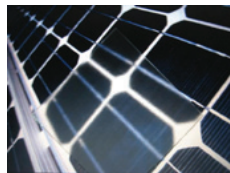
[www.soldist.com](http://www.soldist.com)



**SolarTown, LLC**

SolarTown provides educational resources, design guidance, and the right solar energy products for the job so that customers are successful with solar power. SolarTown offers solar home panels, water heaters, water pumps, and solar power lights, as well as solar fridges and ovens.

[www.solartown.com](http://www.solartown.com)



**Targray Technology International Inc.**

Founded in 1989, Targray Technology is a worldwide supplier of solar silicon, advanced materials, and consumables to the solar industry. Targray offers a full-line of PV materials and focused solutions, which enable solar cell and module manufacturers to maximize their cell and module quality and reliability, while significantly lowering their manufacturing cost per watt. The company works with several global partners to bring to market materials, including: polysilicon; encapsulant; solar wafers and cells; silver paste; aluminum paste; sealants; adhesives; and more. Targray is a global company with operations in over 50 countries.

[www.targray.com](http://www.targray.com)



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[www.joycedayton.com](http://www.joycedayton.com)

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### United Electric Supply

United Electric is a full line stocking solar and electrical distributor. They offer design services for commercial and residential solar systems. Stocked products include: solar modules; fused combiner boxes; inverters; racking structures; flashings; grounding clips and lugs; PV wire; Tyco and MC4 connectors; kWh meters; cord grips; cable tray; Soladecks; electrical and solar meters; tools; preprinted labels; and thousands of additional items.

[www.unitedelectricsolar.com](http://www.unitedelectricsolar.com)



### Wiosun USA

Wiosun USA, a subsidiary of Wiosun GmbH, is bringing solar-related products from around the world to the US market. They represent the exclusive B2B distribution and production segment of Solarzentrum Allgaeu. Wiosun USA offers the German designed, engineered, and produced combination PV-thermal solar panel, which addresses most shortcomings of current solar power technology. Such shortcomings include high thermal water demand or decreasing yields with an increase in temperature, which limits the application spectrum and return on investment. Wiosun's product portfolio also includes PV modules, high-efficiency inverters, and mounting systems, as well as the PVT combination panel.

[www.wiosun.com](http://www.wiosun.com)

### PV INSTALLERS



### CanadianSolar

#### Canadian Solar (USA) Inc.

CommercialAC, the first three-phase commercial AC module, integrates sequenced inverter technology and optimized module for maximum performance. Built with technology that eliminates diodes, the rugged inverter is more reliable and durable than standard micro inverters. CommercialAC is inherently safe with no high-voltage DC. It dramatically simplifies design and installation, reducing the necessity for highly skilled labor. CommercialAC is covered by Canadian Solar's 25-year warranty. [www.canadiansolar.com/en/commercialac](http://www.canadiansolar.com/en/commercialac)



### Pfister Energy

Pfister Energy specializes in the complete turnkey design, procurement, and construction of multiple renewable energy systems designed for commercial, industrial, and institutional facilities. As a total solutions provider, Pfister Energy offers building-integrated alternative energy systems that maximize efficiencies and ROI, including: solar energy (photovoltaics); daylighting; energy efficiency; solar lighting; solar thermal systems; green roofs; rainwater harvesting; fuel cells; wind turbines; and geothermal systems. Pfister Energy delivers these onsite energy solutions that will save energy and control costs with a payback in as little as three years.

[www.pfisterenergy.com](http://www.pfisterenergy.com)

# The smartest PV Supports under the sun



### Delta Strut™ for Rooftop Arrays

integrates solar panel framing and cable management into ONE welded wire support. Delta Strut is lightweight, yet strong enough to withstand 150 mph winds and extreme snow load conditions.



### FAS Rack™ for Ground-Mounted Arrays

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[www.visitsunworks.com](http://www.visitsunworks.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 organizations. Established in 1995, Dovetail is one of the Midwest region's oldest, largest, and experienced design and installation firms with multiple offices. 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've installed over 3.1 MW and 210 systems, all built to be clean, safe, low maintenance, and durable.  
[www.dovetailsolar.com](http://www.dovetailsolar.com)



### Ontario Solar Provider Inc.

Ontario Solar Provider Inc. (OSP) is a Toronto-based solar development and installation company, specializing in Feed-In Tariff (FIT) rooftop solar installations and ground-mounted solar farms. The company's management has developed and financed more than 45,000 kW of ground-mounted installations and constructed over 400 grid-connected rooftop installations, comprising in excess of 11,000 kW. OSP's management team has global experience, and personally owns more than 1,000 kW of rooftop PV systems. OSP's directors and management have worked at various well-known investment, development, and installation firms.  
[www.ontariosp.com](http://www.ontariosp.com)



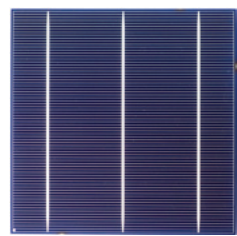
### TOPPER SUN Energy Technology Co., Ltd.

TOPPER SUN Energy Technology Inc. is a certified solar module and PV system supplier in Taiwan, supplying high-quality, competitively priced solar PV systems. They offer durable solar modules and PV inverters developed with professional technology and strict quality control. TOPPER SUN solar modules have been applied to PV systems and solar power plants all over the world. They also offer PV system customization solutions to satisfy individual customer requirements. Since TOPPER SUN is a customer-oriented corporation, prompt delivery, high quality, and customer satisfaction are their main principles.  
[www.toppersun-energy.com](http://www.toppersun-energy.com)



### Ambassador Energy, Inc.

Ambassador Energy, Inc. is a uniquely diverse renewable energy company, offering solar PV training by NABCEP certified trainers, NABCEP EL testing, as well as design and installation of systems throughout California.  
[www.ambassadorenergy.com](http://www.ambassadorenergy.com)



### Gintech Energy Corporation

Gintech has obtained manufacturing technology to produce high-quality solar cells, along with its full process transfer from European and Japanese PV manufacturers. Gintech plans to continue expanding its production capacity to achieve greater economies of scale; by 2011, total annual production capacity will have reached 1.5 GW.  
[www.gintechenergy.com](http://www.gintechenergy.com)



### Power Partners MasTec, LLC

Power Partners MasTec delivers turnkey solar facilities solutions. Their internal design engineers focus on creating a system that's installer friendly and meets expected return to investors. Through their relationships with leading PV panel suppliers, Power Partners MasTec cost-effectively procure PV panels, support systems, cabling, and inverters that are used to build the solar infrastructure. They're a part of the MasTec family of companies that deliver reliable solar power and construction services.  
[www.powerpartnersllc.com](http://www.powerpartnersllc.com)

### PV MANUFACTURERS & EQUIPMENT



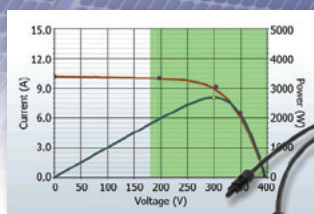
Powering Business Worldwide

### Eaton

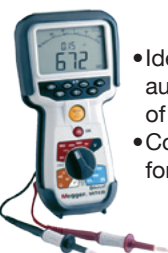
A global power management company, Eaton helps manage the power of the sun by connecting solar power to the grid. Eaton solutions are engineered to improve reliability and enhance safety for utility, commercial, and residential customers. Backed by a century of experience with electrical power systems, Eaton's complete balance of system solutions includes DC and AC switching and protection, solar inverters, and energy storage, as well as design, build, and installation support.  
[www.eaton.com/solar](http://www.eaton.com/solar)

# What Risk?

Volt- and Clamp- meters don't give you the whole picture. The **PV Analyzer** from **Solmetric** measures the string's full I-V curve and compares it to the expected curve. Verify that your PV system is functional and delivering optimal results.



## Solmetric PV Analyzer



- Ideal for commissioning, auditing and troubleshooting of PV systems
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### Solar Liberty

Solar Liberty is the largest solar electric installer in New York State. Founded in 2003, the company installs grid-tied photovoltaic solar energy systems for government, nonprofit, education, commercial, and residential customers. Solar Liberty is committed to creating turnkey renewable energy solutions with high-quality components.  
[www.solarliberty.com](http://www.solarliberty.com)



**First Solar, Inc.**

First Solar is one of the world's largest manufacturer of thin-film PV solar modules, and a premier provider of comprehensive PV solar systems. First Solar is a world-class company with a proven track record for delivering the industry's most competitive prices. Designed and produced in the USA, First Solar has set the benchmark for environmentally responsible product lifecycle management with the industry's first pre-funded collection and recycling program for solar modules.

[www.firstsolar.com](http://www.firstsolar.com)



SHIFTING THE LIMITS

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Fronius has been researching new technologies for converting electrical energy since 1945. Along with their Solar Electronics division, Fronius is also well known for its battery charging systems and welding technology. High-quality products and services, such as the Fronius IG Plus and CL inverter series, as well as the unique Fronius Service Program, make the Fronius Solar Electronics division a model of sustainability.

[www.fronius-usa.com](http://www.fronius-usa.com)



**Hukseflux USA**

The new DR02 Pyrheliometer and SR03 Pyranometer sensor models from Hukseflux (for DNI, GHI, POA, and Diffuse solar irradiance measurement) represent the next evolutionary step in thermopile solar sensing technology. Unlike competing ISO-9060 solar sensor models, which are slow and limited by comparison in response time, the latest DR02/SR03 sensor models feature a blistering one-second (95%) response time, enabling PV and CPV performance monitoring that's synchronous and well correlated to the real-time solar resource. Also well suited for solar thermal and routine meteorological measurement applications, additional DR02/SR03 performance benefits include no tilt dependency effect, <1% temperature dependence, full solar spectral response, low-power 1.6 watt heater for optics anti-soiling, and excellent long-term stability

[www.huksefluxusa.com](http://www.huksefluxusa.com)



**Ingeteam Inc.**

Ingeteam has extensive experience in the design and supply of inverters, offering customers solutions for the equipment of large-scale PV plants. With a 500 MW production capacity in the US, Ingeteam offers: inverters with output powers ranging from 2 kW and 5 kW to 630 kW for grid-connected systems and integrated solutions for utility scale projects; 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.

[www.ingeteam.com](http://www.ingeteam.com)

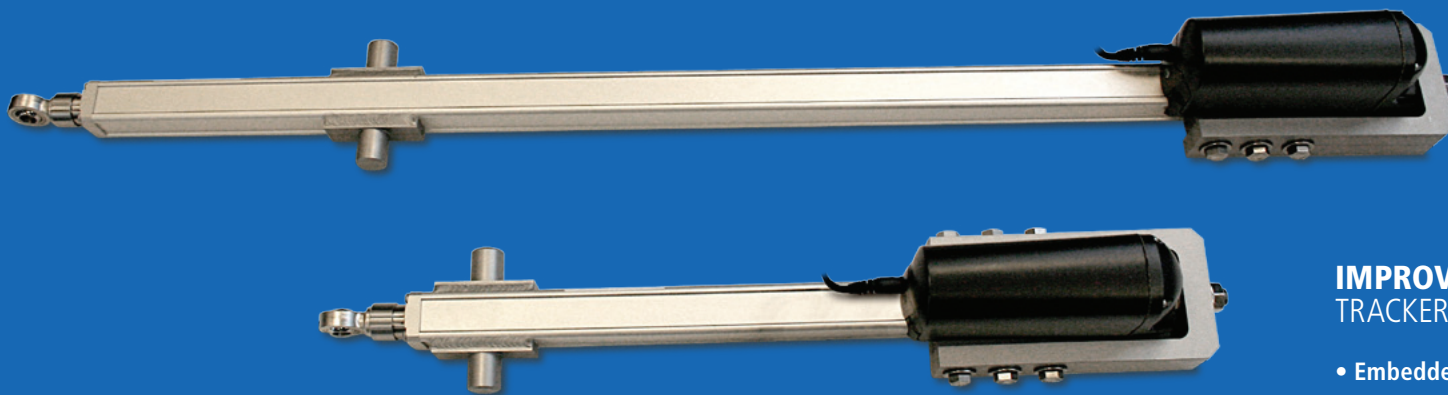
[www.solar-tracking.com](http://www.solar-tracking.com)



# Catch More of the Sun

with **Intelligent Actuator Solutions**

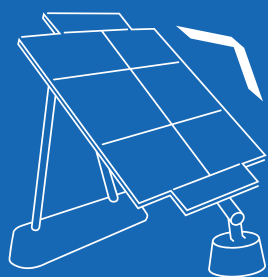
LINAK helps to automate tracking solutions, so you can catch more of the sun. Our linear actuator systems are maintenance free and can help provide instantaneous increases in yield.



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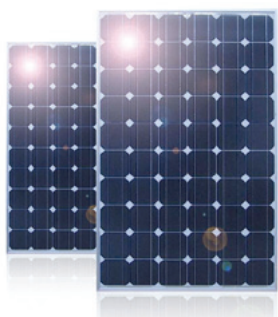
**IMPROVE THE ROI OF YOUR TRACKER SOLUTION:**

- Embedded MODBUS communication
- Longer lifetime
- Lower investment
- Lower maintenance costs
- Service data logging



For additional information contact Chris Gibbs  
[cgibbs@linak-us.com](mailto:cgibbs@linak-us.com) • 502.318.2199





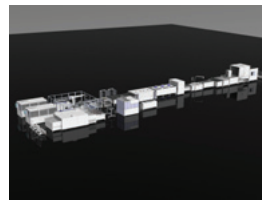
**Lumin Solar**

Lumin Solar is a Canadian-owned premier manufacturer of high-quality, high-efficiency PV modules that meet the Ontario FIT Domestic Content requirements. Located in Ontario, the facility manufactures Lumin Solar modules, and is now also a certified manufacturer of LDK Solar Modules, which provide solar solutions for use in on-grid and off-grid applications. Having amassed over 30 years of experience in manufacturing, Lumin Solar's focus is on being the best in its class, emphasizing quality and customer service, while helping bring a greener vision to Ontario.  
[www.luminsolar.com](http://www.luminsolar.com)



**Solar Frontier**

Solar Frontier's mission is to create the most economical, ecological solar energy solutions on earth of the largest scale. Their proprietary CIS technology (for key ingredients copper, indium, and selenium) combines compelling economics and energy conversion efficiency today, with greater potential for tomorrow. Their new 900 MW production plant in Japan offers the world's largest CIS factory, enabling the company to meet demand for a new standard in affordable solar panel performance.  
[www.solar-frontier.com](http://www.solar-frontier.com)



**2BG S.r.l.**

With 15 years of experience, 2BG offers equipment for crystalline module production—following customers from initial consultancy for a project, to assistance in module production and certification. They offer a well-established engineering team for customized solutions, including a mechanical division for producing components and an R&D laboratory. 2BG provides installations worldwide.  
[www.2bg.it](http://www.2bg.it)

**Air Liquide Electronics U.S. LP**

Present in more than 70 countries, Air Liquide provides industrial and medical gases and related services. The Group offers innovative solutions based on constantly enhanced technologies. Air Liquide Electronics supplies the global high-tech industries, such as semiconductor and photovoltaic, by offering ultra pure and specialty gases, chemicals, and advanced precursors, as well as providing specialized gas and chemical management services. Through its division, Balazs Analytical Services, Air Liquide Electronics also provides analytical and laboratory services.  
[www.us.airliquide.com](http://www.us.airliquide.com)



**Applied Energy Systems, Inc.**

Applied Energy Systems, Inc. is a 43 year-old corporation that specializes in the design, manufacture, testing, and installation of ultra-high purity gas source and distribution systems for the solar and PV industries. Equipment start-up and system validation services, as well as high-purity process piping are available.  
[www.appliedenergysystems.com](http://www.appliedenergysystems.com)



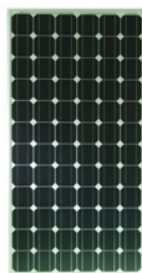
**AU Optronics**

AUO's pioneering technology and comprehensive product line positions AUO as a frontrunner in the global TFT-LCD industry. AUO AC Unison is a new breakthrough in solar photovoltaic technology. AUO combines its premium PV module with reliable microinverter technology to maximize PV benefits for installers and end users. The integrated microinverter converts module DC to grid compliant AC at each module. This increases system performance by up to 25%, reduces shading losses, and makes PV safer to install and own. AUO AC Unison is installed, monitored, and maintained with ease. AUO AC Unison is manufactured under AUO's strict quality control standards and designed for 25 years of efficient production.  
[www.auosolar.com](http://www.auosolar.com)



**Morningstar Corporation**

Morningstar Corporation is a supplier of photovoltaic controllers and inverters using advanced technology. Their controllers have set new standards in the industry for quality, high reliability, and extended battery life. Selling over two million controllers worldwide, Morningstar Corporation's advanced SunSaver and TriStar Maximum Power Point Tracking (MPPT) controllers, with TrakStar technology, maximize the energy harvest from the solar into the batteries, while lowering overall system costs.  
[www.morningstarcorp.com](http://www.morningstarcorp.com)



**Upsolar**

Upsolar produces high-quality PV modules through its "Excellence at Each Step" approach to manufacturing. The company's R&D capabilities and meticulous production processes enable Upsolar to provide the best available price/quality ratio. Through flexible manufacturing platforms, Upsolar integrates new technologies and multiple levels of innovation as they come to market. Backed by warranties and insurance programs, Upsolar guarantees its customers are making reliable PV investments.  
[www.upsolar.com](http://www.upsolar.com)



**Annealsys**

Annealsys manufactures Rapid Thermal Processing (RTP) and Chemical Vapor Deposition equipment for R&D and production. RTP systems are available from two to eight inches. Cold wall chamber, high-temperature, and high-vacuum capability are the main features, with special configurations for selenization and sulfurization processes. MOCVD and spray pyrolysis systems dedicated to oxide and metal deposition are available from two inches up to 200 mm. LPCVD furnaces for R&D. Annealsys provides worldwide sales and service.  
[www.annealsys.com](http://www.annealsys.com)



**Auxin Solar**

Auxin Solar is a California-based module manufacturer. Their PV modules offer a power range from 150 W to 285 W, and are UL and CEC Listed.  
[www.auxinsolar.com](http://www.auxinsolar.com)

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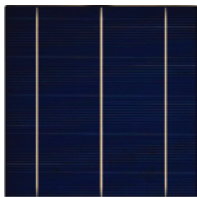
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### **BIG SUN Energy Technology Inc.**

BIG SUN Technology Inc. is a certified solar cell manufacturer in Taiwan, supplying high-efficiency solar cells, including mono-crystalline and multi-crystalline solar cells with a competitive price. They provide professional technology and strict quality control, so their quality is guaranteed. In addition, they offer solar cell customization solution to satisfy customer requirements. BIG SUN Solar Cell has been applied to solar modules, PV system, and even solar power plants globally. Since BIG SUN is a customer-oriented corporate, prompt delivery, high quality, and customer satisfaction are their main principles.

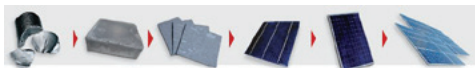
[www.bigsun-energy.com](http://www.bigsun-energy.com)



### **Dark Field Technologies**

Dark Field's unique, ground-breaking technology sets it apart. Their systems utilize specially built lasers and cameras for unequalled detection performance. In addition, Dark Field systems are the easiest to install, requiring no maintenance. Only Dark Field systems are self-aligning and 100% solid state, all this while consuming 10 times less power than competitive systems. Systems inspect solar PV panels at a resolution of four times smaller than a human hair. System speeds of 1.6 billion pictures (pixels) per second are captured and analyzed in 128 levels of gray. Systems measure critical solar panel features including scribe lines and detect defects at line speeds to 30 m/min.

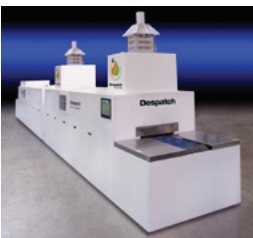
[www.darkfield.com](http://www.darkfield.com)



### **centrotherm photovoltaics AG**

centrotherm photovoltaics AG is a global technology and equipment provider to the PV industry. Across the entire value chain, they provide equipment for polysilicon, ingot, and wafer production to turnkey production lines for crystalline solar cell and module, as well as CIGS thin-film module manufacturing and the planning of complete photovoltaic systems.

[www.centrotherm.de](http://www.centrotherm.de)



### **Despatch Industries**

Despatch Industries is a provider of thermal and processing equipment for advanced photovoltaic production, including their best-selling metallization firing furnace. Combining Despatch expertise with that of solar manufacturers inspires flexible, next-generation technology that integrates seamlessly into production lines. Industry leaders rely on Despatch equipment for maximum cell efficiency, increased uptime, and reduced operating costs.

[www.despatch.com](http://www.despatch.com)



### **Commonwealth Laminating & Coating, Inc.**

Commonwealth Laminating & Coating, Inc. (CLC) PV barrier films provide robust dielectric performance and weatherability, as well as strong interlayer and encapsulant adhesion. Offering innovative solutions that reduce cost and improve performance, such as fluoropolymer, all-PET, and other proprietary, and custom constructions that adapt to the industry's rapidly changing needs.

[www.commonwealthlaminating.com](http://www.commonwealthlaminating.com)



### **ecoSolargy**

ecoSolargy is a provider of solar energy solutions. As a vertically integrated manufacturer, ecoSolargy provides a full line of PV products and solutions. ecoSolargy's focus is on developing relationships with integrators, developers, and system component manufacturers. They've found their success is due to assisting customers throughout their solar project, helping to bring solar projects to life. With new product innovations, ecoSolargy has scheduled a January 2012 launch of their new high-efficiency black-on-black modules using nano technology, which are leading the way to improving the mesh between aesthetics and performance.

[www.ecosolargy.com](http://www.ecosolargy.com)



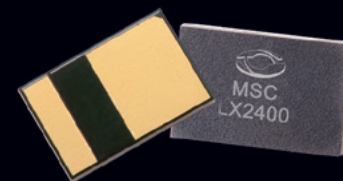
### **COTEK Electronic Ind., Co. Ltd.**

COTEK is now introducing Pure Sine-Wave inverter-chargers, a 5 kW PV inverter, a 3 kW wind controller and more. Their ISO factories have been supplying OEM/ODM customers for 25 years, and COTEK is recognized globally as a manufacturer of Pure Sine Wave Inverters. The COTEK brand is currently being expanded throughout North America and Europe.

[www.cotek.ca](http://www.cotek.ca)

# Harvesting Solutions

## Solar Bypass



### IDEAL™ Solar Bypass Solution



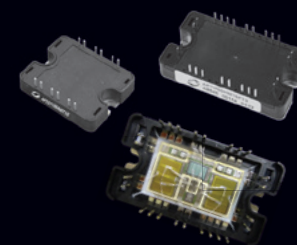
### World's Thinnest Solar Bypass Diodes

## Power Management



### Low Power FPGAs & cSoCs

## Power Switching



### IGBTs/MOSFETs & DC-DC Converters



[www.microsemi.com/solar](http://www.microsemi.com/solar)

+1 (949) 380-6197



### ET Solar Energy Ltd.

ET Solar is a solar power one-stop solution provider. As a vertically integrated solar equipment provider, with a local presence throughout Europe, North America and, Asia, ET Solar integrated manufacturing capacity includes: silicon ingot; wafer; cell; module; and a variety of BoS component products. In addition to the broad product suite, they also offer high-quality and cost-efficient turnkey system solutions and services to specialized PV investors. Over the past years, their products were used in a large number of residential, commercial, and utility-scale PV projects around the world, demonstrating strong performance in these projects. ET Solar's fast growth trajectory demonstrates their commitment to be a significant contributor to the industry's future growth.

[www.etsolar.com](http://www.etsolar.com)

### FLEXcon

FLEXcon offers a comprehensive line of backsheet products, namely, FLEXcon multiGUARD. The backsheet line of products comprises of a variety of fluoropolymer (Tedlar and Kynar), EVA, and PET-based laminated constructions. Designed to meet the 25-year life expectancy of solar modules, they have the industry recognized standards and regulations required. Custom backsheet solutions are also available.

[www.flexcon.com/pv](http://www.flexcon.com/pv)



### FlexLink Systems, Inc.

For over 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. Based on a deep knowledge of material and information flow management solutions in the solar industry, FlexLink knows how to leverage efficiency in production and provide gentle and clean handling of cells, modules, and inverters.

[www.flexlink.com](http://www.flexlink.com)



### Gemu Valves

CleanStar SmartLine Gem offers a high-quality, metal-free valve that reliably ensures the quality of a process at low cost. Applications include: wet process equipment; dosing/mixing systems; media supply and disposal systems; water treatment; and water supply/disposal systems. CleanStar SmartLine Advantages include: flexible mounting system with slotted holes; flare connection compatibility; PTFE diaphragm; improved flow characteristics; optional flow direction; and minimal deadlegs.

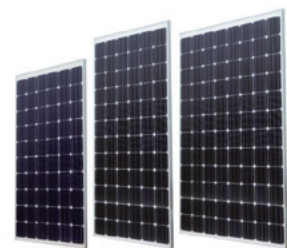
[www.gemu.com](http://www.gemu.com)



### GreenTow

With their electrical and mechanical engineers, GreenTow continues to produce some of the most efficient, functional, mobile solar trailers, providing clean and quiet "green" power. Because GreenTow designs and builds their trailers from the ground-up, they offer custom configurations and designs that are easy to operate, making GreenTow trailers as friendly and diverse as the applications for which they are used. Whatever the mobile, clean-power needs are, GreenTow has the solution.

[www.greentow.com](http://www.greentow.com)



### Helios Solar Works

Helios Solar Works manufactures high-performance mono-crystalline solar modules for use in solar electric systems. Headquartered in Wisconsin, they source from American suppliers whenever possible to ensure high performance, high quality, and on-time delivery. Their modules are tested to CEC, IEC, FSEC, TUV, and UL standards, and their advanced manufacturing facility is also ISO:9001 compliant.

[www.heliossolarworks.com](http://www.heliossolarworks.com)



### HUBER+SUHNER

HUBER+SUHNER RADOX Solar Junction Boxes for module manufacturers are certified globally. HUBER+SUHNER offers a wide range of standard and custom-made connectivity systems for solar module manufacturers. They are a global manufacturer with a strong legacy of performance amongst other manufacturers of high-performance modules, especially with their models HA3 and RH3 junction boxes. Both systems stand out due to low forward voltage drop-through, excellent contacting (welding or soldering) of all components, connectors with lamella spring contacts, and the overall balance of the system. These boxes are characterized by minimal handling and assembly time, and are suitable for automation, as well as for manual installation. An increased service life is ensured due to complete sealing and improved heat dissipation.

[www.hubersuhner.com](http://www.hubersuhner.com)



### Jetion Solar (US) Corporation

Jetion Solar offers mono (170 W to 305 W) and poly (200 W to 280 W) PV solar modules to meet all kinds of requirements and applications while optimized to deliver the highest possible yield. This is a product line that not only meets current industry standards, but also continues to offer the market new innovations. The product line's energy efficiency is much higher than the industry average. Jetion Solar offers ongoing new methods, patents, and multiple-tested and proven PV solutions.

[www.jetionsolarus.com](http://www.jetionsolarus.com)

### k-Space Associates, Inc.

k-Space announces their kSA BandiT PV, in-line PV process monitoring system. This new system directly measures key parameters, such as surface roughness, layer thickness, optical band gap, temperature, and other thin-film properties critical to PV device performance. Modular designs and flexible geometries allow for rapid measurement at multiple locations across either glass panel or flexible substrate processing lines to maximize yield and throughput.

[www.k-space.com](http://www.k-space.com)



### LayTec in-line GmbH

LayTec is a German company that develops and manufactures in-line metrology systems. The advanced in-line metrology is especially designed and optimized for large-area deposition techniques, such as amorphous, polycrystalline, and organic thin-films. The properties and thickness of all thin-film PV layers TCO, absorber, and buffer layers can be detected. LayTec's optical in-line metrology finds its applications in a wide range of thin-film processes depositing nano-scaled anorganic or organic layers on smooth or textured substrates.

[www.laytec.de](http://www.laytec.de)



### LDK Solar Tech USA

LDK Solar is a vertically integrated producer of crystalline solar PV products. LDK Solar produces a full line of mono and polycrystalline modules for residential, commercial, industrial, utility, and off-grid markets. LDK Solar's depth and strength in photovoltaics is the result of its ownership at each stage of the manufacturing process. This control enables continuous innovation to reduce costs, improve efficiency, and sustain high quality year over year.

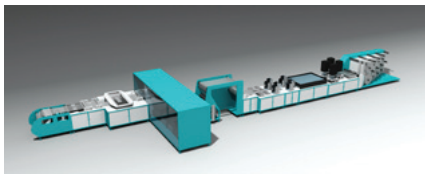
[www.ldksolar.com](http://www.ldksolar.com)



### MAGE SOLAR Projects, Inc.

MAGE SOLAR USA specializes in complete solar solutions, providing high-quality modules, intelligent mounting systems, top-performing brand-name inverters, as well as technical design and marketing assistance. MAGE SOLAR features exceptional guarantees and warranties with the 5, 10, 12, 30 benefit package: +5 watt tolerances, 10-year product warranty, 12-year 90% power guarantee, and 30-year 80% power guarantee. MAGE SOLAR is a complete system solution provider.

[www.magesolar.com](http://www.magesolar.com)



### Muhlbauer, Inc.

Muhlbauer offers reel-to-reel equipment for the production of flexible solar cells and panels. The lightweight and rollable design of flexible solar panels allows a far better integration into buildings and enables quick and easy installation. Further application areas include portable and mobile goods in transportation, consumer electronics, as well as outdoor products.

[www.muhlbauer.com](http://www.muhlbauer.com)



### Mustang Solar Inc.

Mustang Solar designs and manufactures semi-custom thin-film deposition solutions for flexible and ridged substrates deposited by physical vapor deposition (PV, PVD, PE-PVD), or sputtering (by either DC, RF, AC, or pulsed DC power and evaporation). They offer front contact TCO (eg. ZnO Window Layer CdS Absorber), as well as CIGS back contact. In terms of molybdenum experience, they bring 25 years of thin-film deposition experience—both lab and production—to the solar industry. Mustang builds true production tools that have been designed specifically for high-speed volume manufacturing of thin-film coatings optimized for the deposition of PV materials.

[www.mustangsolar.com](http://www.mustangsolar.com)



### POWERCOM CO., LTD

POWERCOM is one of the few companies globally that can produce both PV inverters and solar panels. They're also the only company that owns a complete vertical integration manufacturing, and can provide an extra 20% profit for customers every year. With professional quality control on solar panel, they provide some of the most efficient power generation, allowing a power plant or house roof to earn a 380%+ profit in just 20 years. POWERCOM's power plant in Thailand (5 MW) and Taiwan (0.49 MW) are the best examples.

[www.pcmups.com.tw](http://www.pcmups.com.tw)



### Pyromaitre

Pyromaitre provides the solar industry with patented lamination systems for flexible amorphous silicon PV laminates. The PYRO - DOUCET compact layout with unique features greatly increases quality, minimizes work in process and human effort, while saving floor space. The proposed solution features multiple, dual-function (heating/cooling), independent treatment chambers. Each treatment chamber delivers consistent, repeatable heat transfer rates in a minimum of time under constant vacuum conditions (without vacuum interruption through the whole process). A semi-automatic laminate preparation, dispenser, layup table, IC cell pick and place, plus load/unload system assist a minimum of operators produce laminates up to nine meters long.

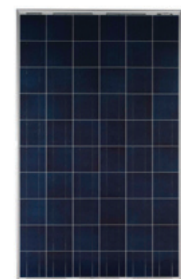
[www.pyromaitre.com](http://www.pyromaitre.com)



### Quick Cable Canada Ltd.

Quick Cable are experts at getting companies to the grid or to a battery storage system. They carry everything from PV connectors and lugs to PV, battery, and welding cables to storage boxes, trays, heat shrink, and tools. OEM's, larger service contractors, or anyone requiring fabricated cables in the field, or purchasing pre-manufactured cables, can benefit from Quick Cables manufacturing capabilities.

[www.quickcable.com](http://www.quickcable.com)



### Sainty Solar, Sainty International Group

Sainty Solar guarantees 0~+5W power tolerance for each module. Their modules can withstand wind up to 220km/h or snow up to 550kg/m<sup>2</sup>. In-line Electro-luminescence (EL) testing of each panel ensures no micro-cracks or mismatch on cell. Ammonia endurance test was carried out under 70° C, 70% relative humidity, and 750 ppm NH<sub>3</sub> density for 1500 hours. Aging test under 85° and 80% relative humidity for at least 1500 hours guarantees a low-power degradation for 25 years.

[www.saintysolar.com](http://www.saintysolar.com)



### SALES OFFICE

#### Kipp & Zonen USA Inc.

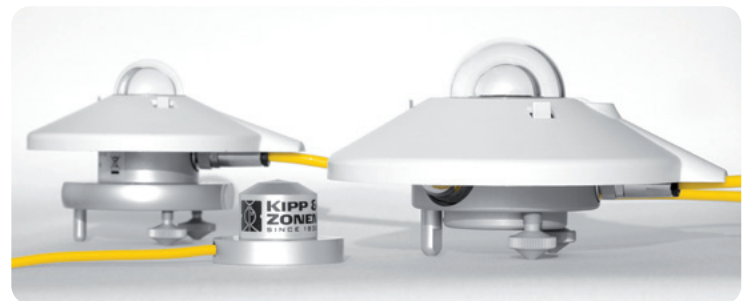
125 Wilbur Place  
Bohemia NY 11716  
USA

#### Rodney Esposito

T: +1 (0) 631 589 2065 ext. 338  
F: +1 (0) 631 589 2068  
M: +1 (0) 631 786 1558  
[rodney.esposito@kippzonen.com](mailto:rodney.esposito@kippzonen.com)  
[www.kippzonen.com](http://www.kippzonen.com)

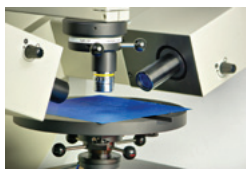
Passion for Precision

### Accurately Monitoring the Performance of your Solar Energy System



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

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



**SENTECH Instruments GmbH**

SENTECH has 20 years of experience equipping production lines for photovoltaics with metrology tools. The analysis of thin layers and layer stacks is essential for obtaining maximum efficiency and a homogeneous appearance of solar cells. SENTECH laser and spectroscopic ellipsometers are especially designed to meet the requirements of R&D and quality control in the PV industry. Their anti-reflective coatings, passivation layers, TCO, and absorber films can be characterized.

[www.sentech.de](http://www.sentech.de)



**Spire Corporation**

Spire Corp. is a global solar company providing turnkey solar factories, PV manufacturing equipment, installed PV systems, and critical related services. Embedded in their equipment and turnkey lines are process recipes that allow customers to achieve the highest levels of factory efficiency, yield, and output. Spire's equipment is used by over 300 companies in 50 countries worldwide.

[www.spirecorp.com](http://www.spirecorp.com)



**Unirac**

Unirac is a North American provider of solar infrastructure solutions. Unirac serves customers in the utility, commercial, and residential markets with a full line of products. Unirac's module-agnostic SolarMount-(E)volution, has redefined what residential mounting systems offer distributors and installers, with its installer-inspired design, more intuitive attachments, and a future-proof approach to engineering excellence that makes it easy to support future codes and standards.

[www.unirac.com](http://www.unirac.com)

**RESEARCH & DEVELOPMENT, TESTING**



**Alpha-Omega Power Technologies, LLC**

Alpha-Omega Power Technologies (AOPT) has developed a line of pulsed concentrator photovoltaic (CPV) solar simulators, based on its experience with pulsed, high-voltage flash lamp systems, as well as its patented high-speed, high-power load. If a 1 sun, large area pulsed solar simulator (LAPSS) system or a high-intensity pulsed solar simulator (HIPSS) system is required, AOPT has it. They also offer CPV testers. AOPT has a broad spectrum of engineering disciplines, ranging from high-voltage pulsed power to industrial controls and electronics.

[www.alphaomegapt.com](http://www.alphaomegapt.com)



**Solarland USA Corporation**

Solarland offers a wide array of solar products and solutions, including: mono and poly crystalline panels; portable solar kits; solar Powerpack LED lighting kits; controllers; mounts; as well as various cables and connectors. Solarland specializes with off-grid solar, and their latest range of Solar Powerbanks offer complete off-grid solutions for remote locations.

[www.solarlandusa.com](http://www.solarlandusa.com)



**Suniva, Inc.**

Suniva manufactures high-efficiency crystalline silicon solar cells and high-power solar modules using patented, low-cost techniques. Led by an internationally regarded team of business executives and PV scientists, Suniva leverages exclusive licenses to critical patents and patent-pending intellectual property developed at the Georgia Institute of Technology's University Center of Excellence for Photovoltaic Research, which is funded by the Department of Energy. Suniva sells its advanced solar cells and modules worldwide, and is dedicated to making solar generated electricity cost competitive with fossil fuels.

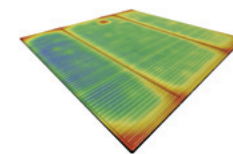
[www.suniva.com](http://www.suniva.com)



**Vikram Solar Pvt Limited**

Vikram Solar is a global provider of PV solar modules and EPC solutions. Headquartered in India, with offices across the globe, they have a high level of expertise in manufacturing, designing, and delivery of solar modules and power generating facilities. Their PV solar modules are certified: TUV (IEC 61215 and IEC 61730); UL 1703; MCS; CEC; and MNRE (Government of India).

[www.vikramsolar.com](http://www.vikramsolar.com)



**cyberTECHNOLOGIES**

cyberTECHNOLOGIES is a provider of high-resolution 3D Optical Metrology Systems for non-destructive process control of film thickness, surface topography, and quality inspection of solar cells and many other devices. Their systems reliably measure on the surface of anti-reflective, absorbent, highly reflective, and soft or transparent materials with high-resolution—even over large areas of interest.

[www.cybertechnologies.com](http://www.cybertechnologies.com)

**Solar Solutions International, Inc.**

Solar Solutions International Offers Level One—a full line of solar racking products manufactured exclusively in the United States. LevelOne Solar Racking Systems provide flexible, cost-effective solutions for roof-mount, commercial ground-mount, and parking structure applications. LevelOne racking is durable and easy to install, and has been engineered to provide each installer with a solution that fits their specific application. With specialized profiles and components, even the most challenging solar installations are made easier. Plus, LevelOne is committed to its customers' projects with fast product delivery and professional service.

[www.levelonesolar.com](http://www.levelonesolar.com)

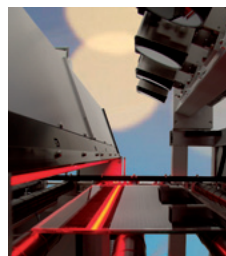


**TecHarmonic, Inc.**

California-based TecHarmonic provides exhaust gas abatement solutions for treatment of toxic, pyrophoric, and corrosive gases. Products include the high-flow capacity Hercules thermal/wet systems used for crystalline and thin-film solar processes, water scrubber systems, and high-capacity dry media scrubber systems suitable for CIGS and ion implant applications.

[www.techarmonic.com](http://www.techarmonic.com)

**PV MODULE INSPECTION**



**Schenk Vision**

The Schenk SolarInspect series fulfills the special requirements throughout the production of thin-film solar modules. These turnkey vision systems offer reliable quality control for the entire running production process, including: incoming bare glass coated glass; TCO, molybden layer deposition; structuring/laser scribing chemical steps; and edge-deletion back glass finished modules. In addition, continuous monitoring of the production process allows timely corrective action to be taken when process deviations appear. With the technology series SolarMeasure, Schenk has complemented its product range with precise and reliable measurement solutions that focus on the physical characteristics of solar modules. These innovative developments are available as stand-alone systems, such as the Electrical Insulation Tester, or as options integrated into SolarInspect systems (e.g. Layer Thickness Monitoring or the Microscope Review Station).

[www.drscchenk.com](http://www.drscchenk.com)



**Desert Silicon LLC**

Desert Silicon, LLC is a supplier of materials and services used by the solar and semiconductor industry in the manufacturing of integrated circuits and discrete components. They provide: silicon wafers; silicon wafer processing services; spin-on dopants; spin-on glass; P-640 phosphorous doped glass; and B-1200 boron doped glass.

[www.desertsilicon.com](http://www.desertsilicon.com)



**Energy Exemplar LLC**

Energy Exemplar is the developer of power-market simulation software called PLEXOS for Power Systems. PLEXOS is a successful, fundamental power-market simulation product used for power-market modeling and simulation and analysis. Features of PLEXOS include: price forecasting; power-market simulation and analysis; detailed operational planning and optimization; trading decision support; and strategic modeling.

[www.energyexemplar.com](http://www.energyexemplar.com)



**Sonali Solar**

Sonali Solar produces competitively priced PV modules without compromising on quality. They've added a brand new, 25 MW manufacturing line to their plant that includes a first-of-its-kind electroluminescence tester in India. This allows them to find the types of micro-cracks that most manufacturers are incapable of detecting, leading to improved product quality and reliability.

[www.sonalisolar.com](http://www.sonalisolar.com)

## RESIDENTIAL OR SMALL OFFICE SOLAR PV



### Green Sun Rising Inc.

Green Sun Rising Inc. is an Ontario-based solar company offering complete turnkey solar solutions. They design and implement solar PV and solar thermal systems for residential, commercial, and industrial size projects. Established in 2008, Green Sun Rising installed and commissioned some of the first solar photovoltaic systems under the OPAs microFIT program. Their solar mounting (Mounts4solar) and solar tracking systems (Tracker4solar) are manufactured locally, and all of their PV products comply with the Ontario domestic content rule. Their newest product, the solar pergola, can serve as a solid cover to provide shade for a patio or as a carport, while producing clean electricity and generating revenue. For electric vehicle owners, they also offer an integrated electric charging station.

[www.greensunrising.com](http://www.greensunrising.com)



### Powell Energy and Solar

Powell Energy and Solar is a respected solar EPC (Engineering, Procurement & Construction) company operating in New Jersey. They sell, design, and install solar systems for residential and commercial buildings. They're also a PPA provider and operate a number of systems on various properties throughout the state. In addition, they are energy consultants, BPI certified and NJ State certified energy auditors, capable of a full line of energy testing and efficiency retro-fit work.

[www.powellenergyandsolar.com](http://www.powellenergyandsolar.com)



### Sun City Solar Energy, LLC

Solar specialists since 1983, with offices throughout the US, Sun City Solar Energy provides commercial and residential solar power, solar hot water heating systems, solar pool heaters, as well as solar heating.

[www.suncityenergy.com](http://www.suncityenergy.com)



### Sunelco Solar

Sunelco's experienced technicians have been designing and selling renewable energy systems since 1985. Whether connected to the grid or for a remote property, Sunelco can design a solar energy system specific to a customer's needs. The Sunelco Planning Guide and Products Catalog is full of helpful design and planning information.

[www.sunelco.com](http://www.sunelco.com)

## ROBOTICS



### Reis Robotics

With over 1000 module lines installed worldwide, Reis Robotics provides turnkey integration of PV module manufacturing lines. Reis offers some of the most advanced design and project services and support available. From line layout in a customer's factory space, to handing off a fully operating line to trained staff, Reis Robotics can maximize an investment while minimizing risks.

[www.reisroboticsusa.com](http://www.reisroboticsusa.com)



### Staubli Corporation

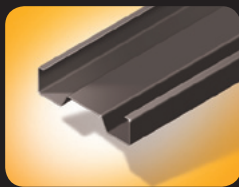
The TX200PV robots, consisting of TX200PV and TX200PVL models, are suited for a range of applications within c-Si and thin film production, including: loading/unloading; cutting; measuring; as well as sorting and packing of ingots, bricks, wafers, cells, and modules. They offer particular advantages in wafer handling, both before and after the wet bench, as they're specifically designed for use in clean environments.

[www.staubli.com](http://www.staubli.com)

## Every Vision Should be Supported



## With Exceptional Frame Work



*Roll forming is used to make a variety of parts for the mounting and racking industry including purlins, complex hat sections and mounting posts for industrial ground applications.*

### STRONG. DURABLE. COST-EFFECTIVE.

These are the characteristics you need in solar panel mounting systems — and Roll Forming Corporation can deliver like no one else in the industry. As part of the world's largest custom roll forming group, with 11 affiliate companies in 10 countries, we leverage the very latest technologies and innovations from around the world to transform your unique vision into reality.

**Roll Forming Corporation has all the capabilities to deliver above and beyond your expectations.**

[sales@RFCorp.com](mailto:sales@RFCorp.com) | [www.RFCorp.com](http://www.RFCorp.com) | (502) 633-4435.



A voestalpine company

C O N T I N U O U S L Y   S H A P I N G   I N N O V A T I O N   |   R F C O R P . C O M

**SAFETY**



**Garlock Safety Systems**

Since designing the original “no holes” fall protection guardrail, Garlock Safety Systems has led the industry in manufacturing easy-to-use and affordable safety devices. Their product line continues to grow, along with their line of accessories, options, and available finishes. Their products are OSHA-accepted and manufactured to strict quality standards. Products include: rooftop perimeter guard rails; sky-light and roof hatch protection; and twin-man and multi-man fall arrest/restraint systems.

[www.railguard.net](http://www.railguard.net)

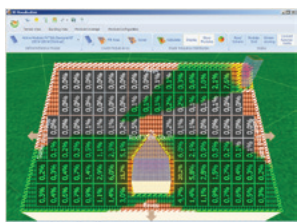
**SOFTWARE**

**Clean Power Finance**

**Clean Power Finance**

Clean Power Finance’s online solar sales solution, CPF Tools, provides installers, manufacturers, and distributors with financing options and comprehensive tools for designing systems, developing proposals, and closing residential solar sales. CPF Tools supports the business processes of more than a third of all national solar companies, and represents the industry’s most comprehensive and precise software connecting installation, design, sales, and financing.

[www.cleanpowerfinance.com](http://www.cleanpowerfinance.com)



**Valentin Software, Inc.**

Since 1988, Valentin Software has been the developer of solar PV and thermal design software—and now heat pump simulation and sales software. Valentin Software’s PV\*SOL and T\*SOL programs are known worldwide for their power, accuracy, and ease-of-use. Valentin Software also just added GeoT\*SOL (basic) to their product line. The software is used by customers in over 70 countries to design and sell residential, commercial, and utility systems.

[www.valentin-software.com](http://www.valentin-software.com)

**SOLAR ASSESSMENT & FORECASTING**



**Turquoise Inc.**

Turquoise provides profitability assessments by combining the three key ingredients of a successful solar investment: accurate insolation estimates, optimized PV design, and a sound financial analysis. Their products are designed to help installers prepare winning quotes and increase sales. They help developers maximize project revenues, while controlling the risk. No matter where a project site is, Turquoise’s products help convert watts to dollars.

[www.turquoisesolar.com](http://www.turquoisesolar.com)

**SOLAR COATING**

**AlmeCo-TiNOX GmbH**

ALMECO-TiNOX GmbH, part of the ALMECO Group, is committed to the manufacture of highly selective absorber surfaces for heat generation and high-reflectance surfaces for the production of solar energy concentration systems.

[www.alme-co-tinox.com](http://www.alme-co-tinox.com)

**Process Materials, Inc.**

Process Materials manufactures materials used in thin-film coatings in planar and cylindrical target form, including backing plates and bonding services.

[www.processmaterials.com](http://www.processmaterials.com)



**Sono-Tek Corporation**

Sono-Tek Corporation provides precision ultrasonic spray coating systems for depositing buffer, AR, TCO active layer, CIGs, CdTe, dopants, and other layers onto flexible thin-film cells, organic cells, solar glass, and silicon PV modules. Full coating systems for R&D, pilot line, and high-volume manufacturing are available. Repeatable, proven, highly uniform coatings, with 95% effective material usage is offered at a fraction of the cost of vapor deposition processes.

[www.sono-tek.com](http://www.sono-tek.com)

**SOLAR COLLECTORS | INVERTERS**



PI Powered solaron siteguard

**Advanced Energy**

Advanced Energy offers inverters and energy management solutions. The company’s Solaron and PV Powered inverters enable utility-scale, commercial, and residential solar project stakeholders to maximize the lifetime value of their power plants by providing innovative, reliable, and easy-to-install PV inverter solutions.

[www.advanced-energy.com/solarenergy](http://www.advanced-energy.com/solarenergy)



**Crown Technical Systems**

Crown expands its pre-fabricated enclosure line with the Solar Connection inverter Dock, or SCiD. Designed to match the unique specifications of any inverter on the market, the SCiD boasts an innovative modular design, which is offered in three models: SCiD Platform optimized for outdoor use; SCiD Enclosure fully enclosed NEMA3R enclosure; and SCiD Hybrid with provisions for exterior mounted step-up transformer. Each SCiD is designed to meet industry standards.

[www.crowntechnicalsystems.com](http://www.crowntechnicalsystems.com)



**Eltek**

Eltek provides reliable, high-efficiency power-conversion products, offering renewable technology perfected over 10 years in mission-critical environments for the highest field reliability. Eltek offers Theia HE-t isolated PV inverters, made in North America with a built-in web server, best-in-class warranty, and over 97% efficiency.

[www.eltek.com/theia](http://www.eltek.com/theia)



**Growatt North America**

Growatt manufactures some of the most efficient and cost-effective inverters in the solar PV industry, with conversion efficiencies above 98% and a CEC rating of 97. Their UL-1741 ETL-certified products feature: transformerless circuitry; dual-input string controllers; whisper-quiet operation; free monitoring software with multiple interface options; and they exceed industry standards for temperature, humidity, and high-altitude tolerance. Their lightweight, compact line has a comprehensive warranty and is USA-made in 2012.

[www.growattusa.com](http://www.growattusa.com)



**LTi REEnergy**

The LTi REEnergy 600/1200kW PVmaster station is plug ‘n play ready for large-scale PV plants. All PVmaster Stations feature an integrated monitoring system and come standard with a five-year warranty, extendable up to 20 years. Even with an ultra-compact design, a maximum efficiency of more than 97% (including MV transformer) can be guaranteed, meaning smaller overall balance of system costs. The use of over one million German-made LTi inverters in the past 40 years testifies to the high quality of the components.

[www.lt-i.com](http://www.lt-i.com)



**Solectria Renewables**

Solectria Renewables is a US-based PV inverter, string combiner, and web-based monitoring manufacturer for residential, commercial, and utility-scale solar projects. Their wide range of products includes 1.8 kW to 500 kW grid-tied inverters for systems 1 kW to multi-MWs. Solectria Renewables is backed by over 20 years of power electronics and inverter experience and world-class warranties.

[www.solren.com](http://www.solren.com)



### The Switch

The Switch photovoltaic inverters are designed for utility-grade solar applications that optimize solar power harvesting and LCOE in central inverter megawatt-scale PV power plants. Each system component is chosen to maximize system performance, efficiency, and uptime for optimum overall power generation and plant revenue throughout the plant's lifetime. The Switch's inverters comply with the latest standards set for grid-tied operation, safety, and electromagnetic compatibility.

[www.theswitch.com](http://www.theswitch.com)

### SOLAR FASTENERS



#### DURA-CON Advanced Fastening Systems

DURA-CON Advanced Fastening Systems' feature fasteners specifically tested for solar applications that: save up to 40% versus industry-standard stainless steel; resist environmental corrosion; are tested at 1500 salt spray hours in aluminum with no corrosion (ASTMB117); avoid galvanic corrosion of aluminum caused by stainless steel; eliminate galling; create reliable clamp force; have a greater tensile strength than stainless steel; and that can be compatible with the American Recovery and Reinvestment Act

[www.duracon.info](http://www.duracon.info)



#### EcoFasten Solar

EcoFasten Solar designs and manufactures patented, watertight, roof-mount bracketing systems for solar panels, conduit, and other roof-mounted products. Their clients include many of the leading solar panel developers, brand-name racking system providers, and commercial installation companies serving the solar industry today. EcoFasten Solar offers solutions for flat-roof, low-slope, and steep-slope applications. Products include: Eco-44; Eco-65; GreenFasten; Quik Foot; Simple Seal; and BETP for membrane roofs. EcoFasten Solar serves the commercial, industrial, municipal, government, and residential sectors. Products are made in the USA from recycled materials, which comply with ARRA standards.

[www.ecofastensolar.com](http://www.ecofastensolar.com)

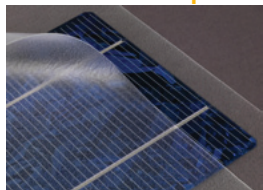


#### Mudge Fasteners

An expert in solar fasteners since 1975, Mudge offers fasteners, tools, mounting hardware, fall protection, and adhesives to the solar industry both nationally and internationally. The company's growth has been fueled by a commitment to customer service, on-time delivery, competitive pricing, and guaranteed high-quality products. Mudge carries over 60,000 products in stock, many of which can be purchased online.

[www.solarfastenerexpert.com](http://www.solarfastenerexpert.com)

### SOLAR GLASS | ENCAPSULATION



#### Solutia, Inc.

Solutia Solar GmbH, a subsidiary of Solutia Inc., is a global provider of advanced solar encapsulants, providing long-term durability and high-performance to solar modules. They are a supplier of films for use in photovoltaic applications. Solutia acquired Etimex Solar GmbH of Germany (renamed as Solutia Solar GmbH) to become the only producer of all major PV encapsulation technologies branded as Vistasolar EVA/TPU and Saflex PVB. In 2011, they began manufacturing Vistasolar EVA in China. They leverage a unique EVA-TPU-PVB portfolio, manufacturing scale, and technical expertise to deliver high-end solutions to help lower total production costs for leading solar module manufacturers.

[www.solutia.com/PV](http://www.solutia.com/PV)



#### XYG Glass

XYG Glass is one of the largest solar glass manufacturers globally, with total solar glass capacity of 2,300 ton/day. They are capable of supporting over 10GW of PV panel production annually, and have been supplying solar glass products to major PV panel manufacturers worldwide. XYG Glass produces a full range of solar glass products, including low-iron pattern/flat solar glass, TCO glass, AR coated solar glass, and fully tempered back glass.

[www.xyglass.com](http://www.xyglass.com)

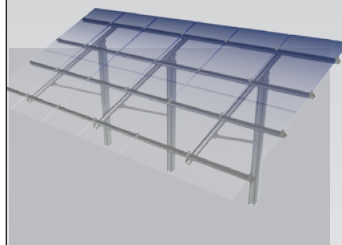
# Schletter — Over 6 GW of Installed PV Systems Worldwide.



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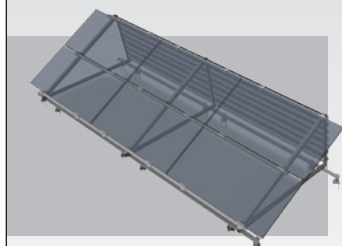
#### Ground Mount Systems

NOW offering the **FS System™** with ETL Certification! Combined with the module grounding clamps, the FS System is an unbeatable ground mount package for mid-to-large solar installations—saving time and money.



#### Roof Mount Systems

Regardless of the system size or roof type, Schletter manufactures roof mount systems for nearly all applications. Don't miss the **NEW AluGrid™**, specifically designed for flat roofs.



#### Module Clamps and Roof Attachments

Variety of components available including the Rapid<sup>2+</sup> Grounding Middle Clamp, **ETL Listed**



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**SOLAR HOT WATER DISTRIBUTOR****Premium Solar**

Premium Solar offers affordable Ezinc solar thermal products. The variety ranges from portable solar water heaters to high-quality flat plate collectors. Their products carry FSEC, SRCC OG-100, and OG-300, as well as solar key mark certifications.

[www.presolarnet.com](http://www.presolarnet.com)

**Solar Services, Inc.**

Solar Services has been in business since 1986, providing installation services to the solar industry. They install solar pool heat, solar hot water, and solar electric systems.

[www.solarservices.com](http://www.solarservices.com)

**Solcan**

Solcan manufactures flat-plate solar collectors and incorporates them into commercial solar water heating projects. They also offer the Solcan drainback solar water heater, used for residential hot water applications. Solcan further designs, installs, and provides maintenance services for solar water heating systems and PV systems for residential and commercial application using solar energy.

[www.solcan.ca](http://www.solcan.ca)

**SOLAR INTEGRATOR****S&C Electric Company**

S&C Electric Company is applying its 100 years of innovation to address challenges facing the world's power grids, and is shaping the future of reliable electricity delivery. The mission of its employee owners is to continually develop new solutions for electricity delivery, fostering the improved efficiency and reliability required for the intelligent grid. S&C provides grid connections and turnkey installations, and is experienced working with electric utilities, independent system operators, and transmission service providers. S&C has knowledge of design, system protection, coordination, and reactive power compensation requirements. They can integrate solar, wind, and other renewable-energy sources into the grid, provide energy storage, and maximize power assets and efficiencies. S&C maintains operations around the globe.

[www.sandc.com](http://www.sandc.com)

**Cascade Renewable Energy**

Cascade Renewable Energy provides distributed renewable energy solutions tailored for residential, community, and commercial needs. They develop behind-the-meter solar and wind energy projects throughout the US. Cascade's distribution division carries the top PV brands. As a division of Cascade Engineering, Inc., a Certified B-Corp, they are part of a family-owned company that has been in business for over 35 years.

[www.cascaderenewableenergy.com](http://www.cascaderenewableenergy.com)

**ECO DEPOT, Inc.**

Since 1999, ECO DEPOT has provided residential and commercial integration, design and turnkey installation of solar PV.

[www.ecodepotinc.com](http://www.ecodepotinc.com)

**ESA Renewables, LLC**

ESA Renewables, LLC is a total turnkey solar solutions provider, with service that include: engineering, procurement, and construction (EPC); research and development (R&D); and operation and maintenance (O&M). They have developed their own proprietary monitoring system. ESA totals over 475 installations and over multi-megawatts of power currently installed. Their expertise lies in designing, fabricating, and maintaining solar PV electric systems.

[www.esarenewables.com](http://www.esarenewables.com)

**Gridwerks PV, Inc.**

GridWerksPV is a seasoned developer of clean energy power generation, storage, and energy efficiency in big buildings. GridWerksPV consults with US companies entering the renewable space and international manufacturers seeking to enter the US market. GridWerksPV works with building/landowners, electricians, roofers, financiers, integrators, building scientists, A&E firms, and community groups to deploy ground-mount, commercial rooftop, and utility-scale PV power plants, as well as BIPV systems.

[www.gridwerkspv.com](http://www.gridwerkspv.com)

**Independent Energy Solutions, Inc.**

Independent Energy Solutions, Inc. (IES) is a full-service renewable energy development, engineering, and construction firm with over 100 years of combined senior-level experience in solar electric generation (photovoltaics), conventional electric generation, and support infrastructure. Founded in 1998, and licensed in California and Arizona, IES has projects that span the globe, from small commercial to utility-scale applications. Clients include the US military, utilities, municipalities, and commercial firms. The company uses high-quality equipment and standardized installation techniques that ensure constructability, reliability, performance, safety, longevity, and serviceability. Whether it's a complete PV system, complex hybrid generation plant, or a simple retrofit, IES delivers reliable and competitively priced solutions on time and on budget.

[www.indenergysolutions.com](http://www.indenergysolutions.com)

**Lumberg, Inc.**

Lumberg is a global, high-quality connectivity company with millions of connections in the field. Their product range starts with jBoxSets for module producers, covers receptacles in components such as inverters, and offers harnesses, branch connectors, inline fuses, and other parts for installers and system integrators.

[www.lumberg.com](http://www.lumberg.com)

**Melink Corporation**

Melink Corporation is a provider of energy efficiency and solar PV solutions for commercial and institutional building industries. They provide solar PV project development, installation, financing, maintenance, and monitoring, as well as a pre-engineered ground-mounted system called Ingrid. Melink's corporate headquarters is LEED Platinum EB and are net-zero energy.

[www.melinkcorp.com](http://www.melinkcorp.com)

**Sunside Solar Inc.**

Sunside Solar specializes in the design, manufacturing, and delivery of affordable, high-performance solar electric systems for residential and commercial consumers worldwide. Through their strong brand-equity and affiliation with reputable solar companies and government agencies, they're able to deliver high-value solar PV systems to customers. Sunside Solar understands the adverse effects that energy production may have on the health of our planet. In an effort to preserve the earth, Sunside Solar strives to provide sustainable and cost-effective solar solutions that help reduce the effects of global warming and environmental degradation.

[www.sunside.com](http://www.sunside.com)

**SOLAR SCRIBING & MOTION CONTROL****JP Sercel Associates, Inc.**

JP Sercel Associates, Inc., (JPSA) provides advanced laser micromachining systems and services to companies worldwide in the solar, LED, and semiconductor industries. Their PV-5000 system is a fully automatic laser-scribing tool for high-speed scribing of the absorber, metal film, or TCO film on glass solar panels. The system is readily configured for a variety of laser types and wavelengths to meet specific client processing requirements. The system can be configured for either through-the-glass or filmside patterning, depending on processing needs. Their Excimer, DPSS, and Ultrafast systems operate at wavelengths from 157 nm to 1064 nm. JPSA operates four main business divisions: systems group; laser applications services; contract manufacturing (job shop); and laser service and support.

[www.jpsalaser.com](http://www.jpsalaser.com)



## 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](http://www.aetenergy.com)



### Baja Construction, Inc.

Baja is a highly specialized solar construction company—designing and engineering steel structures, with a proven track record of execution. They are experts in designing, engineering, supplying, and installing some of the most cost-effective structures to not only meet design details and budgetary needs, but to maximize kilowatt-per-hour (kWh) production. Baja is the backbone of a solar energy facility, offering: solar carports; solar/EV charging stations; solar truck bays; solar RV/boat storage; and solar shade structures.

[www.bajacarports.com](http://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](http://www.contechsystems.com)



### MacLean Dixie

MacLean Dixie Helical Foundations feature a complete line of cost-effective steel earth foundation products for commercial, residential, marine, and solar 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 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](http://www.macleandixie.com)

### Domcast Metals Inc.

Domcast Metals offers multiple materials and assemblies for solar support structures, including: steel tubular products; plastic; iron; sub assembly; metal weldments; fabrication; powder coating; and hot dip galvanizing.

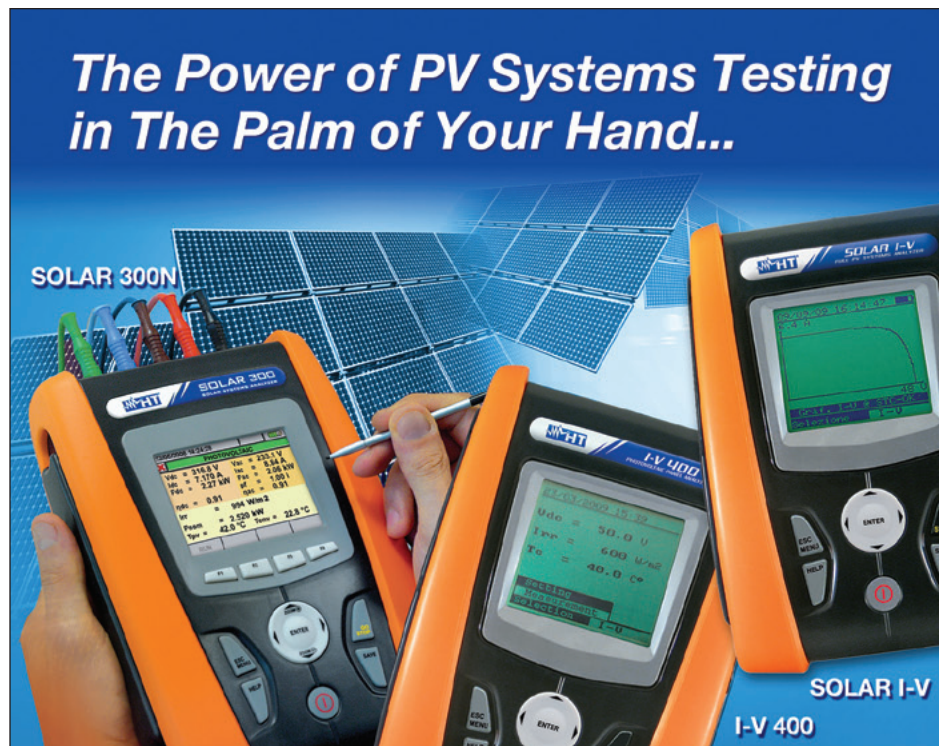
[www.domcastmetals.com](http://www.domcastmetals.com)



### FABRACK Solar Inc.

FABRACK Solar Inc. manufactures racking solutions in Ontario. Their products include a four-season variable position ground-mount racking system, a variable or fixed flat-roof racking systems, as well as a sloped roof system. They've also been involved in providing custom racking solutions to many clients. A new zero-ballast mounting system was also developed that doesn't require roof penetration or ballasting. It's engineered allowing a weight factor of two pounds per square foot—all inclusive.

[www.fabracksolar.com](http://www.fabracksolar.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.

- I-V Curve Trace Meters
- 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.



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**HatiCon Solar**

HatiCon Solar provides all aluminum PV racking solutions for ground-mount, residential, and commercial rooftop applications. Their proven system, with over 1 GW installed globally, features pre-assembled components, low part count, and minimal onsite fabrication. With North American manufacturing facilities in both the USA and Canada, HatiCon Solar can meet ARRA and Ontario FIT requirements, and help customers meet project deadlines and minimize transportation costs.  
[www.haticonsolar.com](http://www.haticonsolar.com)

**SOLAR THERMAL MANUFACTURING & EQUIPMENT**



**Beijing Sunda Solar Energy Technology Co., Ltd.**

Beijing Sunda Solar Energy Technology Co. Ltd. was established in 1995 as a manufacturer that produces metal absorber evacuated tubes. They're actively engaged in developing, manufacturing, and marketing of evacuated tubes and collectors, which are extensively applied to hot water, space heating, air-conditioning, and Concentrated Solar Power (CSP) fields. They own over 10 international certificates, and their products have been exported to over 80 countries and regions.  
[www.sundasolar.com](http://www.sundasolar.com)



**IECsolar**

Solar thermal is hot, but IEC Solar keeps customers cool with their TempmatiX line of tempering valves designed for solar control. The TS valve passively regulates the maximum solar collector fluid temperature. The weatherproof valve in 1" and 1/2" NPT is rated for 400° F and 350 PSI. There are additional models to control tank outlet temperatures for radiant floors. TempmatiX is available worldwide from IECsolar, a specialty hydronic and electrical distributor  
[www.iecsolar.com](http://www.iecsolar.com)



**STIEBEL ELTRON**  
**Simply the Best**

**Stiebel Eltron, Inc.**

Stiebel Eltron is a German manufacturer of Tempra tankless electric water heaters, solar thermal systems, and Accelera 300 heat pump water heaters. Founded in 1924, Stiebel Eltron is now the largest manufacturer of tankless, electric water heaters. The solar thermal systems and Accelera 300 have been developed over the last 30 years. The primary focus in product development has been on products that use less energy, are much safer, and give the consumer higher levels of comfort. Stiebel Eltron Tempra tankless electric water heaters can provide an ideal back-up to the solar systems when the sun needs a little assistance.  
[www.stiebel-eltron-usa.com](http://www.stiebel-eltron-usa.com)



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

With more than 30 years of experience in the solar industry, Viessmann is a manufacturer of innovative renewable energy and fossil fuel heating systems. A complete line of Viessmann 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 coils; mounting systems; and system accessories. Constructed from only the highest quality materials, all solar system components are carefully design-matched to ensure superior performance and reliability throughout the system lifespan. Viessmann solar collectors and residential system packages are SRCC and CSA certified.  
[www.viessmann.us](http://www.viessmann.us) | [www.viessmann.ca](http://www.viessmann.ca)



**Advantech Corporation**

Advantech Corporation is a pioneer in eAutomation technology, combining connectivity, flexibility, and ruggedness with today's most reliable PC-based automation technologies. Product offerings include: open HMI platforms; industrial Ethernet; automation controllers automation software; embedded automation computers; distributed I/O modules; plug-in I/O; and industrial communication solutions for a wide array of industries.  
[www.advantech.com](http://www.advantech.com)

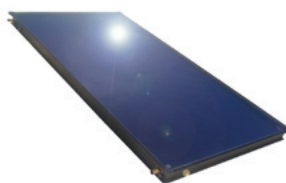


**A. O. Smith**

Cirrex, from A. O. Smith, is a leap forward in solar thermal water heating and one of the "greenest" solutions available to homeowners today. Up to 70% of its energy comes from the sun, significantly reducing homeowners' utility bills, in addition to helping protect the planet. Cirrex is available in 16 packaged systems, 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 gallons to 120 gallons. With Solar Energy Factors up to 10.1, the Cirrex system is ENERGY STAR-qualified and eligible for a federal tax credit of 30% of the entire installation cost.  
[www.hotwater.com](http://www.hotwater.com)

**Hasse Tank USA**

The Haase Energy Tank is a German-engineered and manufactured pressure-free fiberglass tank, which comes with or without internal heat exchangers made from stainless steel. These fiberglass tanks are assembled on site, and are available in sizes from 300 gallons to 25,000 gallons for commercial and residential use.  
[www.haasetank.com](http://www.haasetank.com)



**KIOTO Clear Energy S.A. de C.V.**

KIOTO Clear Energy is the parent company of the solar thermal collector manufacturer GREENoneTEC. They provide rapid and pragmatic solutions for customer-specific requirements and, as an OEM partner, a dependable long-term approach based on co-operation. As such, they offer customers adequate production capacity, standards, and the widest range of absorbers, collectors, and systems adapted to the needs of regional markets.  
[www.kioto.com.mx](http://www.kioto.com.mx)



**MC2 Energy, Inc.**

MC2 Energy is a high-efficiency air heating solar systems manufacturer and designer. The ESOLAIR Air Heating Solar collectors, manufacturer by MC2 Energy, have some of the best efficiency factor on the North American market (certified by SRCC and CSA International).  
[www.mc2energy.net](http://www.mc2energy.net) | [www.mc2energy.com](http://www.mc2energy.com)



**PAW NA, LP**

PAW is a manufacturer of solar thermal pump and heat transfer stations. Their product portfolio also includes pump stations and distribution manifolds for hydronic heating systems.  
[www.paw.eu](http://www.paw.eu)



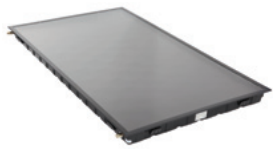
**Power Partners Solar**

Power Partners Solar's US-made, virtually unbreakable water-heating collectors are certified to SRCC OG 100/300 and Energy Star standards. Lightweight is a design goal for safer lifting during installation. Panels are available in 26 trim colors.  
[www.powerpartnerssolar.com](http://www.powerpartnerssolar.com)



**Rayspower New Energy Co., Ltd.**

Rayspower New Energy manufactures solar thermal mirrors, including parabolic reflectors and heliostats.  
[www.rayspower.com](http://www.rayspower.com)



### Roth Industries

Roth Solar Flat Panel HelioStar 252 "stressable," unbreakable polycarbonate case is lightweight and corrosion-resistant with no leakage due to construction. In one seamless piece, it can withstand high-impact temperatures, wind, and offers long-term, absolute UV-resistance. A selectively coated full area absorber guarantees the highest performance and connection of the pipes to the absorber plate. Other features include: a thick-walled polycarbonate case; back wall insulation of 60 mm low iron; double-sealed solar safety glass; a rounded case form without edges; optimal stability; low weight; as well as a dark color for appearance and easy installation with few tools. The attachment system is not visible. On roof or free-standing installation is available, as is installation on facades. The collector yields 166,467 BTU/ft<sup>2</sup> annually. There's also a 10-year Roth system guarantee.

[www.roth-america.com](http://www.roth-america.com)



### Steca Elektronik GmbH

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

[www.stecasolar.com](http://www.stecasolar.com)

### SOLAR THERMAL SYSTEMS



### ART TEC Solar LLC

ART TEC Solar offers solar-powered differential temperature controllers for PV powered circulation pumps in residential solar thermal systems. Controllers operate from 12 or 24VDC and switch up to 6 Amps.

[www.arttec.net](http://www.arttec.net)



### Caleffi North America, Inc

Caleffi's pre-packaged, OG-300 certified, specially engineered solar water heating system includes all of the components needed for a standard installation—from the solar collectors, to the pump station and controller, to pre-insulated piping, to the storage tank, and all of the necessary hardware and plumbing components. The complete package is ready to be professionally installed on newly constructed or existing homes, and comes with the added assurance of a detailed warranty plan.

[www.caleffi.us](http://www.caleffi.us)



### Chromagen – Solar Water Solutions

Chromagen has been a pioneer in the production of solar water solutions since 1962. Chromagen's systems, which are available in more than 35 countries worldwide, bring innovation, quality, and cost savings to homeowners, institutions, and commercial projects. Globally, the company has developed a solid install base, increasing supply and demand annually, with a commitment to delivering high-quality water-heating solar solutions and promoting environmental awareness.

[www.chromagen.com](http://www.chromagen.com)



### Gorman-Rupp Industries

GRI releases version two of the Integrity Series recirculation pump, the INTG2. The magnetic drive pump's brushless DC motor can operate on nine to 27 volts, and OEMs can change the pump's flow and pressure with a built-in speed control. Designed with no motor bearings, the impeller assembly is the only moving part. Fewer parts promote longer life, quieter operation, and lower power consumption. GRI specializes in the design and manufacturing of custom-designed fluid pumps for OEMs worldwide.

[www.gripumps.com](http://www.gripumps.com)



### Heliodyne

Established in 1976, California-based Heliodyne has acquired a reputation of engineering and manufacturing quality solar water heating equipment for residential and commercial applications. The company manufactures and assembles a variety of solar water heating products such as flat plate collectors, web enabled solar thermal control units, and residential and commercial scale pre-assembled heat transfer appliances.

[www.heliodyne.com](http://www.heliodyne.com)



### Matrix Energy Inc.

Since 1985, Matrix Energy has been providing practical, cost-effective, renewable power products and systems. Their Renewable Power Group provides full-service, wholesale product distribution and turn-key solutions for dependable and affordable power generation. Under the MatrixAir brand, their Solar Thermal Group offers a number of patent-pending, solar air heating solutions for industrial, commercial, agricultural, and institutional applications.

[www.matrixenergy.ca](http://www.matrixenergy.ca)



### Performance Metals Products

The easiest way to decrease one's solar thermal payback is to make a solar tank last longer and avoid the landfill. One of the best ways to do that is to use Performance Metals Products' patented Intelligent Anode. Made from the same materials as OEM anodes, the Intelligent Anode can communicate with users through the box, controller, or a web-based interface. Optional products include leak detection and emergency shut-off valves.

[www.performancemetals.com](http://www.performancemetals.com)

### SOLAR TRACKING SYSTEMS



### GoshLab Pty Ltd.

GoshLab develop integrated tracking control solutions for solar power applications. Their core technology is the Heliostat Local Controller, a flexible and robust high-precision, autonomous, two-axis tracking solution for demanding applications. The Heliostat Local Controller is suitable for reflecting heliostats, as well as direct sun-tracking applications such as dishes, CPV, or PV. GoshLab also offers custom solar software development and simulation services.

[www.goshlab.com.au](http://www.goshlab.com.au)

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**TESTING & CERTIFICATION**



**Solmetric Corporation**

Solmetric is a provider of precision design software and hardware to the solar industry. The SunEye 210 creates professional-grade shade analysis that ensures precise solar production forecasts. The PV Analyzer measures I-V curves on installed arrays for commissioning and troubleshooting. PV Designer software enables shade adjusted performance estimates and layout.  
[www.solmetric.com](http://www.solmetric.com)



**tec5USA, Inc.**

tec5USA, Inc. offers reliable, low-maintenance, and fast measuring spectrometer systems (detector-array technology), which can be used for various applications. Thin-film analysis of AR coatings on solar cells can be achieved based on in-line measurement of reflectance and color. Features include: spectral sunlight distribution; accuracy over long times; measured and logged; and system components in protective housings. The sunlight simulators are time-resolved monitoring on flashes. For quality control of the solar glass, there are simultaneous, in-line transmittance and reflectance measurements.  
[www.tec5usa.com](http://www.tec5usa.com)



**Q-Lab**

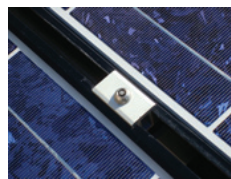
Q-Lab provides quality, affordable, weathering test equipment and contract testing services. Conducting accelerated weathering tests allows users to make informed decisions about product durability in a reasonable timeframe. Q-Lab's line of weathering test chambers includes the QUV accelerated weathering tester, one of the world's most widely used weathering tester. It 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](http://www.q-lab.com)



**TUV Rheinland PTL**

TUV Rheinland PTL is a partnership between Arizona State University and TUV Rheinland, the \$1.5 billion global provider of independent testing, assessment, and certification services. Approximately 80% of all solar module manufacturers have products tested at TUV Rheinland to obtain national and international market licenses. TUV Rheinland operates test laboratories for solar modules and systems in six locations worldwide. The company provides its clients with technology, global expertise, and advanced testing solutions required to ensure safety, reliability, and performance of solar power technologies. It's an ISO 17025 accredited facility by the American Association for Laboratory Accreditation, and performs tests of many critical standards required to bring products to international markets, including: IEC 61215; IEC 61646; IEC 61730; IEC 62108; ANSI/UL 1703; EN 12975; EN 12976; ENV 12977; ISO 9806; ISO 9459; SRCC Standard 100-08; SABS 1210; PowerMark; California Energy commission; and others.  
[www.tuvptl.com](http://www.tuvptl.com)

**THEFT PROTECTION**



**Bryce Fastener, Inc.**

As solar panel theft is a growing problem, Bryce Fastener, Inc. has developed a keyed locking fastener that replaces standard fasteners of any size. The Key-Rex Fastener is keyed and licensed to each new customer, ensuring only the licensed owner of the key code can gain access to the drivers. The Key-Rex Fastener is made from 302 stainless, and will last the lifetime of a panel. These keyed fasteners offer the lowest cost, and are the most effective theft solution available for securing solar panels. The largest national insurance underwriter offers a full 10% discount to its customers that specify and use Key-Rex.  
[www.brycefastener.com](http://www.brycefastener.com)

**TRANSPORTATION**



**Union Pacific**

Union Pacific (UP) operates 32,000 miles of track covering 23 states in the western two-thirds of the country. If they can't transport products on their own tracks, they have relationships with nearly 200 shortline and other Class I railroads, as well as trucking companies, to make sure customers are covered from coast-to-coast. They also serve every major gateway to Mexico and interchange traffic with Canada. Factor in ocean carriers, and UP ships to virtually any destination, worldwide.  
[www.unionpacific.com](http://www.unionpacific.com)

**TOOLS**



**Rennsteig Tools, Inc.**

For 30 years, Rennsteig has been manufacturing tools to the highest standards. Their precision cutting, stripping, and crimping tools are specifically engineered for the wires and terminals specific to the solar industry. They also have the knowledge to meet any customer specifications. Rennsteig's Professional Solar Crimp Kits saves customers' money by fabricating their own customized PV-cable. Rennsteig offer tools for all major manufacturers.  
[www.rennsteig.us](http://www.rennsteig.us)

**UTILITY-SCALE SOLAR | PV**



**AEG Power Solutions**

Engineered for maximum yield and reliability, the new Protect PV.500 inverter from AEG Power Solutions delivers efficiency greater than 98%. This 500 kW inverter supports DC input voltages up to 1000 volts, and flexible grid management features including reactive power, fault ride-through, and power control. For over 60 years, AEG Power Solutions has been providing reliable power systems for rugged industrial applications.  
[www.aegps.com/solarinverters](http://www.aegps.com/solarinverters)



**Transcat**

Transcat is a supplier of hand tools, test and measurement products, and safety equipment. In addition, they offer customized site and technician tool kits with the advantage of having the appropriate kit items calibrated and ready for in-field use, straight from the box. Couple their extensive product offerings with their accredited calibration and repair services, and customers are better equipped to make fact-based tool decisions to reduce costs and improve overall safety.  
[www.transcat.com](http://www.transcat.com)



**Patriot Solar Group**

Patriot Solar Group (PSG) has become one of the most recognized manufacturers of heavy-duty solar trackers and ground-mount systems in the solar industry. Their product line has evolved into a broad range of solar trailers, dual-axis trackers, single-axis trackers, an economical ground-mount system, and fixed-pole mount systems. All of their systems are modular and expandable up to utility-scale (multi-MW). Each system is designed to fit most PV modules.  
[www.patriotsolargroup.com](http://www.patriotsolargroup.com)



### Schneider Electric

The Schneider Electric Conext Core XC Series is a new line of central inverters designed for high efficiency and flexibility for any PV panel type and installation. The Conext Core XC Series has peak efficiencies of 98.7%, and its flexibility allows the inverter to be configured with voltage and power outputs up to 680 kVA. In addition, the Conext Core XC Series is designed to allow for DC inputs up to 1000 Vdc for longer string lengths. It contains the latest grid management features to meet global utility requirement, including the new BDEW requirements for Germany.

[www.schneider-electric.com/renewable-energies](http://www.schneider-electric.com/renewable-energies)



### 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 ground-mounted 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](http://www.whiteconstruction.com)



### Bonfiglioli USA

With utility-scale installations currently in place around the world, Bonfiglioli is a global supplier in the renewable energy market. Bonfiglioli produces electronic control systems for PV fields, which support intelligent utility grid integration and management features. Recently announced is the release of a complete utility-scale solar PV power conversion system for North America. Since 2008, more than 1 GW has been installed worldwide with Bonfiglioli's technologies.

[www.bonfiglioliusa.com](http://www.bonfiglioliusa.com)



### Q-Cells North America

Q-Cells North America combines best-of-world technology, processes, and partnerships to deliver utility-grade solar PV solutions. Q-Cells NA offers a full spectrum of PV solutions—from cells and modules to power plant development, design, construction, operations, and maintenance. With proven capabilities across the solar value chain, Q-Cells North America minimizes uncertainty and risk, to help customers achieve a predictable return on their investment in solar energy.

[www.qcells.com](http://www.qcells.com)



### SOLON Corporation

SOLON SOLquick offers an innovative solution for flat roofs by integrating the solar module and mount into one unit for a fast, easy, and tool-free installation. Designed with a simple plug-and-play concept, the lightweight system allows for flexible installation on various roof surfaces—self-ballasted, ballasted, and roof penetrating.

[www.solon.com](http://www.solon.com)



### American Solar Specialists, LLC

American Solar Specialists' provide utility-grade facilities around the world. They bring together all aspects of the industry to provide a quality product, at an affordable price. They work in all areas of renewable energy, including: solar PV; solar thermal; regenerative systems; kinetic energy systems; and energy storage design. They have a design for all projects—from the smallest to the largest—and can design, maintain, build, and consult on each project.

[www.americansolarspecialists.org](http://www.americansolarspecialists.org)



### AMSC

Having a solution that minimizes installation and O&M costs while maximizing the energy yield of utility-scale solar power plants is key for lowering the LCOE. AMSC's SolarTie system is a fully optimized solution for utility-scale solar PV power plant owners and developers. It boosts power generation and yields a lowered LCOE in the ever-changing solar utility-scale environment.

[www.amsc.com](http://www.amsc.com)



### CleanPower Energy Systems

CleanPower Energy Systems develops, builds, and maintains large-scale renewable solar and alternative energy projects throughout the US, Canada, the Caribbean, and Latin America. Combining three decades of experience in development, construction, solar, finance, and management, CleanPower's team is uniquely positioned for continued success in developing large-scale renewable energy projects.

[www.cleanpoweres.com](http://www.cleanpoweres.com)

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[www.kukanao.com](http://www.kukanao.com)

## KUKA



**Siemens Industry, Inc.**

Siemens Industry's PVS 500 solar inverter is a cornerstone for the company's wide portfolio of horizontally and vertically integrated solar products and solutions, which covers the entire value chain—from machine automation to field operations inverters, tracking control, wireless communication, and other automation components. The Sinvert PVS 500 inverter provides PV plants with a reliable, grid-compatible, and economical solution for LCOE. With three-phase output for grid parallel operation supply, and up to two megawatts in a master-slave combination, the PVS 500 is optimally suited for use in large, megawatt PV plants. Whether as a container solution/system solution or as a stand-alone solution, with or without a monitoring system, the PVS 500 provide 98% efficiency for smart lifecycle management of grid-connected PV systems. [www.usa.siemens.com/solar](http://www.usa.siemens.com/solar)

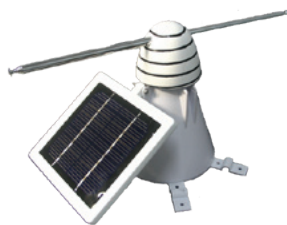
**OTHER**  
**Battery-based Inverters**



**Magnum Energy Inc.**

Magnum Energy Inc. manufactures battery-based inverter/chargers for off-grid and back-up power installations. Magnum offers systems from 600 W to 17.2 kW, as well as a complete line of system integration equipment, automatic generator start, battery monitoring, and web-based monitoring. New products to be introduced in 2012 include the MPPT charge controller and AC load diversion controller. [www.magnumenergy.com](http://www.magnumenergy.com)

**Bird Control**



**Bird-B-Gone, Inc.**

Bird-B-Gone, Inc. is one of the world's largest manufacturer of professional-grade bird deterrents. Founded in 1992, their products have helped solve pest bird problems in commercial, industrial, and residential settings. They offer effective and humane solutions to prevent birds from landing and roosting in unwanted areas. Products include bird netting and hardware, bird spikes, electric track systems, and more. Bird-B-Gone has a devoted team of bird control engineers with over 80 years of combined experience to help in all aspects of bird control, including design and installation. [www.birdbgone.com](http://www.birdbgone.com)

**Cable Management**



**Snake Tray**

Solar Snake Tray is one of the world's only hand-bendable cable tray's available for solar installations, specifically designed to secure cables in outdoor applications. Solar Mega Snake is a pre-configured cable tray system for utility-grade installations. Both products have built-in mounting systems that quickly connect together and nest together for easy handling and low-cost shipping. Snake Tray is made in the USA, utilizing solar power generated from their own rooftop solar array. [www.snaketray.com](http://www.snaketray.com)

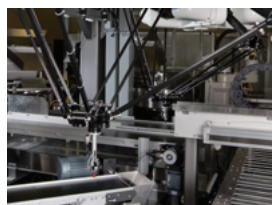
**Ceramic Components**



**International Ceramic Engineering**

International Ceramic Engineering is solving the advanced ceramics needs of today's evolving industries. They are specialists in the manufacture and fabrication of advanced ceramics and performance plastics. ICE provides engineering support, which includes material selection, along with the most cost-effective design for ceramic and plastic applications. Whether the requirement is high temperature, wear, electrical, corrosion resistance or thermal insulation, they can furnish customers with the advanced material to fit their needs. [www.intlceramics.com](http://www.intlceramics.com)

**Custom Manufacturing Equipment**



**Isthmus Engineering & Manufacturing**

Isthmus Engineering & Manufacturing delivers custom automation solutions for solar industries, including thin-film and crystalline PV, CPV, and solar thermal. Isthmus provides custom automation equipment not otherwise available in the marketplace, resulting in higher efficiency, improved quality control, and lower manufacturing costs. Isthmus' automation equipment encompasses a range of manufacturing technologies, including: robotic integration; machine vision; custom material handling; system integration; custom packaging; web handling; and other custom processes. Isthmus completes the concept, design, and manufacturing for each project at their Wisconsin facility, and the company is a worker-owned cooperative. [www.isthmuseng.com](http://www.isthmuseng.com)

**Data-networking & Distribution**



**Graybar**

Graybar provides distribution of high-quality electrical, communications, and data networking products, and specializes in related supply chain management and logistics services. Graybar PowerSmart is partnering to provide a full range of training and services for solar applications. [www.graybar.com](http://www.graybar.com)

**DC Power Supplies**



**Kepeco Inc.**

Kepeco BOP series bipolar amplifiers provide a one-step solution for test and characterization of solar cells and panels. A free LabView subvi allows rapid characterization of the solar device using only the BOP 1 kW, eliminating the need for separate DMMs to measure voltage and current. The subvi is designed for both I-V Trace and Dark I-V testing, and easily adapted to existing test applications. This solution offers lower cost, greater throughput, and increased ROI when testing solar devices. [www.kepecopower.com](http://www.kepecopower.com)

**Electrical Protection**



**Mersen**

Mersen makes it easier to increase system longevity with a full range of electrical protection solutions for PV systems. From the combiner box and inverter to the panelboard and utility distribution network, Mersen has it covered. Mersen offers fuses, fuse holders, disconnect switches, surge protection, cooling, and wire management—all designed to make customers an expert at generating safe, reliable solar energy. <http://ep-us.mersen.com/solutions/solar-power.cfm>

**Hybrid Solar PV/Thermal Panels**



**CADMUS ENERGY**

CADMUS ENERGY manufactures the only factory integrated panel with amorphous thin-film, plus optional solar thermal system and adjustable racking systems. It arrives at the job site already fully assembled, reducing onsite labor cost. One Panel-One Footprint, two alternative energy systems, this patent-pending, lightweight system outperforms conventional crystalline panels electric production, while adding solar thermal savings. Approximately 1.5 lbs/sq.ft. with faster and easier installation, the system ships flat and pops-up with an adjustable tilt for optimum output. It also plug-n-play quick-connects and has durable laminate panels. It offers the highest throughput at the lowest installed cost. [www.cadmusenergy.com](http://www.cadmusenergy.com)

**Laboratory Equipment**



**Shimadzu Scientific Instruments**

Shimadzu offers testing solutions for photovoltaic manufacturing processes and R&D that contribute to higher conversion efficiencies, reliability, and yields from solar cells. Shimadzu's comprehensive line of analytical instruments can evaluate materials, as well as provide quality control for PV cells and modules during the manufacturing process. Instruments include UV-VIS-NIR and FTIR spectrophotometers, and a wide range of materials testers. [www.ssi.shimadzu.com](http://www.ssi.shimadzu.com)

**Material Dispensing & Coating Equipment**



**PVA**

PVA's dispensing and coating solutions are used in solar assembly applications to provide: structural stiffening; dispense solder paste; pot and attach junction boxes; encapsulate solar cells; thin-film backside coating; and deposit electrical connection sealant/grease and seal edges/frames. Accurate, repeatable solutions reduce material waste and handling, improving product quality. [www.pva.net](http://www.pva.net)

## Measurement Systems



### EagleView Technologies

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

[www.eagleview.com](http://www.eagleview.com)

## Motion Control | Actuators



### LINAK U.S. Inc.

LINAK is a manufacturer of electric linear actuators for solar trackers, including horizontal trackers. They have over 35,000 actuators installed in solar parks across the globe. They offer embedded Modbus control for utility-scale solutions, allowing customers to link more trackers to one controller and get real-time diagnostic information about the moving parts. LINAK's actuators are designed for harsh outdoor environments and are compatible with a number of commercially available controllers.

[www.solar-tracking.com](http://www.solar-tracking.com)

## Perimeter Security



### Southwest Microwave, Inc.

With over 40 years of experience and 53,000 installations in 80+ countries, Southwest Microwave is a producer of high-performance outdoor perimeter security systems, which offer precise intrusion detection for security-sensitive applications and harsh environments. Southwest Microwave's INTREPID sensor technologies deliver some of the industry's broadest feature set and highest detection performance, effectively protecting solar energy facilities worldwide.

[www.southwestmicrowave.com/ssd](http://www.southwestmicrowave.com/ssd)

## Quality, Health & Safety, and Environmental (QHSE)



Move Forward with Confidence

### Bureau Veritas North America, Inc.

Founded in 1828, Bureau Veritas has developed a worldwide network to help businesses and organizations assess, attain, and demonstrate compliance with standards and regulations in the fields of Quality, Health & Safety, and Environmental (QHSE). The company's focus is on protecting its clients' brands, assets, and business.

[www.us.bureauveritas.com](http://www.us.bureauveritas.com)

## Renewable Energy Conservation



### BCx Energy

BCx Energy provides comprehensive, cost-effective, clean energy solutions for a business, facility, school, or home. They are committed to assisting with the implementation of renewable energy projects by testing the environmental air quality, engineering passive energy savings into building designs and renovations, and lighting a site with efficient, cost-saving lighting. Their experts will assist in reducing energy costs, while creating for a return on investment.

[www.bcxenergy.com](http://www.bcxenergy.com)

## Rubber Components



### Lauren Manufacturing

Lauren Manufacturing is a global manufacturer of custom engineered seals and gaskets. Lauren is a full-service extruder and molder of organic, silicone rubber, as well as a full range of thermoplastics and other specialty polymers. Their experienced engineering staff focuses on delivering custom and innovative design solutions for roof- and ground-mount applications. Lauren's rubber components are currently in the marketplace through established racking companies, solar manufacturers, and solar installers. Such products are Isolator Seals (roof- or ground-mount) and Soft Mount Pads (roof-mount). These high-performance products exceed industry standards for weatherability, and are a part of systems designed to last 25 years or more. Lauren's engineering staff works directly with customers to ensure proper performance for any project.

[www.lauren.com/so](http://www.lauren.com/so)

## Sequenced Inverter



### ArrayPower

ArrayPower provides innovative power electronic technologies and delivers a fully integrated, three-phase Sequenced Inverter for commercial solar applications. ArrayPower's Sequenced Inverters are fully integrated with the solar module to create AC power that is grid-ready and commercial-grade. The result is a durable, safe, and integrated system that delivers more power at optimal costs.

[www.arraypower.com](http://www.arraypower.com)

## Solar Cell Metallization & Screen Printing

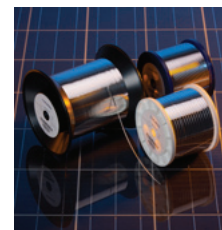


### DEK Solar

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 photovoltaic 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](http://www.deksolar.com)

## Solar Ribbon



### Luvata

Luvata, an early pioneer in the photovoltaic industry, manufactures solar ribbon branded Sunwire. Sunwire is compatible with thin-film technology and crystalline silicon, and is used as both an interconnecting ribbon and a cross-connecting ribbon. Luvata's Sunwire proprietary manufacturing technology is extremely energy-efficient, chemical-free, and compact in design. Sunwire is available in cut-to-length or on new bi-conical spools, which ensures gentle unwinding.

[www.luvata.com/sunwire](http://www.luvata.com/sunwire)

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- Solar Lighting
- Daylighting
- Geothermal
- Rainwater Harvesting
- Fuel Cell
- Green Roofs
- Energy Efficiency

### Solar Simulation Equipment Manufacturer



#### EYE Lighting / Iwasaki Electric

EYE Lighting/Iwasaki Electric designs and manufactures the lighting source (lamps) and proprietary filters, in addition to solar simulation equipment. This integrated approach is unique in the marketplace. Any solar simulation system is only as good as the lighting source. EYE systems are designed from inception around the proper lighting source for the particular application, from PV cell development to production test equipment. EYE Lighting/Iwasaki develops and produces a complete range of lighting technology including metal halide, xenon, halogen, UV light sources, and optics equipment designed specifically for solar simulation applications.  
[www.eyesolarlux.com](http://www.eyesolarlux.com)

### Solar Pool Heating Solar Hydronics Corporation

Solar Hydronics Corporation (SHC), a wholly owned subsidiary of The LeverEdge, offers some of the most advanced solar pool heating systems on the market. Their collectors are manufactured to the highest quality control standards, and are produced in the most modern facility of its kind. With over 30 years experience in the industry, the SHC team provides the training and support needed to join this growing industry.  
[www.getsolarpoolheating.com](http://www.getsolarpoolheating.com)

### Solar Site Analysis & Assessment



#### The SolarPathfinder Company

The Solar Pathfinder allows each user to determine the amount of shading for their particular location in one quick glance. The Solar Pathfinder works great for PV and thermal assessments, ecological studies, and golf course design. 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. The newest version allows user to take a reading at ground level in most cases.  
[www.solarpathfinder.com](http://www.solarpathfinder.com)

### Staffing | Recruitment



#### CLP Resources, Inc.

In 2011 alone, CLP partnered with contractors to customize solutions for the installation of approximately 1.5 GigaWatts of solar power, helping make them the preferred staffing provider for the top solar contractors in North America. CLP's staffing experts understand the demand for proven solar experience in every tradesperson they provide, which is why they've been recruiting and hiring only the best people, matching them to specific project needs, no matter how remote the location, for nearly 25 years.  
[www.clp.com/solar](http://www.clp.com/solar)

### Gaia Human Capital Consultants

Founded in 2006, Gaia Human Capital Consultants is an executive search consultant in the renewable energy, cleantech, clean energy, alternative energy, and corporate sustainability industries—including in solar energy. Gaia has a successful track record and completed CEO, COO, CFO, and C-Level executive search assignments including: CEO's; CFO's; COO's; as well as other senior executive posts, such as VP's of engineering, sales and marketing, project management, technology, and administration.  
[www.gaiahumancapital.com](http://www.gaiahumancapital.com)

### Storage Tanks & Heat Exchangers

#### American Solartechnics

American Solartechnics manufactures modular thermal storage tanks that assemble quickly and easily. The unpressurized tanks use copper heat exchangers to interface with backup systems, solar collectors, and heat distribution.  
[www.americansolartechnics.com](http://www.americansolartechnics.com)

### Thin-film & Solar Assembly Materials



#### Indium Corporation

Indium Corporation is a premier materials supplier to the global electronics, semiconductor, solar, thin-film, and thermal management markets. Products include: solders; performs; fluxes; brazes; sputter targets; indium, gallium; germanium chemicals; as well as sourcing and Reactive NanoFoil. Founded in 1934, Indium has global technical support and factories across the globe.  
[www.indium.com](http://www.indium.com)

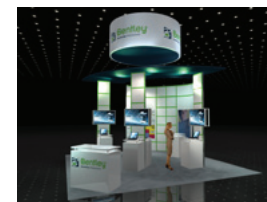
### Trade Association



#### SEMI PV Group

SEMI is the global industry association serving the nano- and micro-electronics manufacturing supply chains. SEMI PV Group represents SEMI member companies involved in the solar energy supply chain. SEMI member companies are the engine of the future, enabling smarter, faster and more economical products that improve lives. SEMI maintains offices throughout the world.  
[www.semi.org](http://www.semi.org) | [www.pvgroup.org](http://www.pvgroup.org)

### Trade Show Exhibitor Services



#### MC<sup>2</sup>

There were more than 200 clean energy trade shows in 2011. As an exhibitor, you know the landscape can be cluttered and competitive. MC<sup>2</sup> specializes in bringing companies to the trade show space with eco-friendly exhibit design and trade show-savvy marketing. Their EcoFlex Exhibit program offers recycled and recyclable exhibits that can be rented and are tailored to a brand, message, and program.  
[www.mc-2.com](http://www.mc-2.com) | [www.mc-2.com/eco-flex-exhibit-program.aspx](http://www.mc-2.com/eco-flex-exhibit-program.aspx)

### Solar Taiwan 2012

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**Figure 1.** An actual working circuit, which can measure pressure or temperature in a geothermal tool. This circuit survived a thermal shock over 427° C (800° F) and boiled in brine.

**Figure 2.** A set of actual well-monitoring electronics being subjected to extreme temperature shock under a torch. These electronics are not operating correctly while under the extreme heat of the torch; however, they recover and start working after cooling back down below 300° C (572° F).

## New VHT Electronics Survive Geothermal Well Temperatures

By Randy A Normann

**Figure 3.** The same set of well-monitoring electronics were boiled in salt water to simulate geothermal brine. Because the construction of very high-temperature (VHT) electronic systems require the elimination of organic materials, boiling water may short-out the circuit. Nonetheless, they will recover after the electronics are dried off.

**THE AEROSPACE INDUSTRY** is leading the development of new, very high-temperature (VHT) electronic components, which will greatly benefit the growing geothermal energy industry. Already new electronic tools for logging and monitoring hot geothermal wells are being marketed. These tools are based on VHT electronics created for future aircraft engine controls' systems.

Aircraft engine controls require high-reliability and high-operating temperatures. Using aircraft engine electronic components, new geothermal tools can operate without the heat-shield (or Dewar) needed by conventional geothermal logging tools. The heat-shield allows normal electronics to operate within the geothermal well for four to 10 hours. Eliminating the heat-shield saves on tool costs while, at the same time, allowing new tools to operate indefinitely inside the well. The use of new VHT electronics can greatly improve the reliability of geothermal well logging, while enabling future geothermal well monitoring never before considered possible.

### Understanding VHT

New VHT electronics are designed to operate at 225° C (437° F) within their specification for five years, as required by commercial aircraft engine control systems. As such, manufacturers “over” design their electronic components. Most of these electronic components operate reliably at 250° C (482° F) for years, and at 300° C (572° F) for over 300 hours.

VHT electronic devices are built using Silicon-on-Insulator (SOI) technology. SOI builds silicon circuits on top of an insulating layer of non-conductive silicon. In this way, each transistor has improved isolation from the bulk silicon used in conventional electronics. In bulk silicon, temperature dramatically increases the level of thermally generated free-electrons, which can swamp out circuit transistors. SOI reduces the creation of thermal electrons by nearly 100 times.

### VHT & geothermal use

Despite the success of very high-temperature (VHT) electronic components, there have been issues preventing the use of VHT electronics in geothermal logging tools. On the aircraft engine, for example, VHT electronics are built on square ceramic circuits that are approximately 7.5 cm x 7.5 cm (3 inches x 3 inches). However, geothermal logging tools require circuits less than 2.5 cm (1 inch) wide, and a board 20 cm (10 inches) or longer.

Fortunately, a solution exists with the development of ceramic circuits that are available in any size or shape. Now, VHT electronics can be designed for many geothermal applications. Even without the use of ceramic circuit boards, conventional polyamide circuit boards can be used up to 235° C (455° F). This lower temperature will cover most binary geothermal power plants. Plus, this technology is doing more than eliminating the heat-shield—it's enabling electronic control systems to stay in the geothermal well.

### The future of geothermal energy

The future of geothermal energy is based on the efficient collection of heat from the earth. The modern oil industry has evolved efficient well-construction practices, which are marvels at extracting oil and natural gas from the deep earth. Such oil industry well designs employ multi-lateral well completions that look like tree roots from a single surface well—in comparison, geothermal wells are still simple straws. A multi-lateral oil well employs electronic control systems and sensors to open or close control valves deep within the well. These control systems ensure the efficient drainage of the fossil energy reservoir and maximize the productive life of the well.

Future geothermal well monitoring systems, with VHT electronics for monitoring pressure, temperature, and flow, could allow the reservoir engineer to understand the energy contribution of each production zone of a multiple-production zone geothermal

well. Temperature and flow contribution of each zone provides the measure of energy from that zone, while temperature and pressure allows the reservoir engineer to measure the effects of changing production rates on the reservoir over time.

Technically, at some future date, producing geothermal energy anywhere in the world could be done using man-made geothermal reservoirs. Such reservoirs are more like giant heat exchangers located in hot rock formations found at significant depths. These geothermal wells will be about six to 10 kilometers in depth, and are extremely expensive to drill. Once a well has reached geothermal temperatures and found a competent rock formation, the reservoir engineer produces fractures in the rock, extracting heat using flowing water. The only means to create economic value from such deep resources is by having multiple production zones for each well drilled.

Ideally, each production zone requires a control system to assure energy harvesting is managed to maintain well temperatures and surface power generation. New VHT electronics are enabling future geothermal power plants more efficient geothermal power production. As efficiency increases, lower temperatures with greater production from each well drilled will increase the world's use of clean, 24-7 geothermal energy.

Randy A Normann is the general co-chair for the High-Temperature Electronics Conference (HiTEC), and also the CTO for Perma Works LLC.

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# Science Looks to Unlock Potential of Wood-based Energy

By Nancy M Hood



Hardwood seedlings at the SuperTree Nursery in Shellman, Georgia.

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Consider it a puzzle. An 80-foot tree is a towering and majestic package of sugars that can be made into things that dazzle you—such as high-definition television screens, the finest quality writing papers, or jet fuel. The list of products made from plant cellulose (sugar) includes rayon, smokeless gunpowder, film (think movies and Kodak), a thickener and stabilizer in food products, an inactive ingredient in pharmaceuticals, and cellulosic sponges and filters. Put simply, it's an incredibly versatile raw material.

With all its leaves, stems, branches, and roots, an average tree is roughly 65% sugar. So, here comes the puzzle: how do you get all that sugar out of the wood?

Give or take a couple of percentage points, the average tree is about one-third lignin, a tenacious, glue-like material that holds the skeleton of the tree together, keeping it upright and strong. Lignin helps the tree ward off disease and pests that want to feast on its branches. Lignin is good for the tree, but bad for processors who want to unlock that wonderful, high-quality, useful cellulose. To get to those precious sugars, manufacturers bombard wood chips with enzymes, acids, and heat—at a considerable cost and time—just to get that protective lignin to give up its treasure.

Modern science has been grappling with the puzzle of unlocking wood cellulose for decades. The paper industry has invested in significant research to find out which combination of enzymes, chemicals, heat, and processes can make lignin give up its hold on the sugar. The entire cellulosic ethanol industry is trying to solve the puzzle of how to unlock fermentable sugars from trees and other plants, and a variety of methods have been tried and proven. However, the challenge for science is not to find one solution, but to find the best solution.

### Researching solutions

A group of government and industry scientists have been hard at work trying to do just that. “We have been working in conjunction with the US Department of Energy’s National Renewable Energy Lab (NREL) on a lignin-modified Eucalyptus variety, which has been developed using advanced breeding techniques to create trees that do more to meet society’s demand for renewable materials,” said William H Rottmann, PhD, a senior scientist on the team. “By using a process of identifying a key gene in Eucalyptus that controls lignin production, and then inserting new instructions to reduce the activity of that gene, the lignin content and composition inside the tree has been successfully modified to more than double the amount of cellulose that can be unlocked and used for industrial purposes.

“A recent study showed that more than double the amount of biofuels could be produced from lignin modified Eucalyptus compared to unmodified Eucalyptus,” continued Rottmann. “This means that there is a potential to generate greater than 1,000 gallons of transportation fuel per harvested acre from Eucalyptus, which compares very favorably against other lignocellulosic feedstocks, such as switchgrass.”

There is still more work to be done on every side of the equation, but the science is showing tremendous promise. The research team has proven that reducing lignin content can be done effectively, which is a significant advantage for paper manufacturers and bio-ethanol producers. Ratios of different types of lignin could also be altered so that wood becomes more energy rich, making the resulting wood a better candidate for co-firing for electricity and reducing dependency on non-renewable energy sources.

But there’s a fine balance that must be found to keep the tree growing strong and healthy. As global demand for these products increase, there’s also a need to reduce the impact and cost of mechanical processing of wood chips to release cellulose for fuel and renewable material. What the team knows

conclusively is that advanced techniques to alter the lignin in Eucalyptus are effective and don’t exhibit large reductions in growth previously associated with lignin reduction work.

### Ongoing studies

Multiple studies involving similar cooperation between government institutions, university scientists, and industry are taking place at various centers around the United States today. The BioEnergy Science Center (BESC) is a multi-institutional, multidisciplinary research organization focused on the fundamental understanding and elimination of biomass recalcitrance. The US Department of Energy (DOE) has also provided \$375 million in funding to three Bioenergy Research Centers in Oak Ridge, Tennessee; Madison, Wisconsin; and Berkeley, California.

Regionally, a recent \$15 million grant from the USDA’s National Institute of Food and Agriculture (NIFA) was awarded to study ways to accelerate the supply of bio-based renewable energy. The grant formed the Southeast Partner-

Ultimately, when government and industry cooperate, innovative solutions can be found to help solve the puzzle of how to feed the growing demand for food, fiber, and energy for an ever-growing population.

ship for Integrated Biomass Supply Systems (IBSS), which will focus on developing sustainable feedstock production systems for dedicated energy crops including purpose grown trees. The Center for Renewable Carbon, a program of the University of Tennessee Institute of Agriculture, will act as the lead institution for the IBSS, which will include several collaborating institutions throughout the Southeast.

Yet, another interesting study, this one led by a University of Florida research team (also including NREL), will advance Pine-based transportation biofuels. Funded by a three-year \$6.3 million grant recently awarded by DOE’s Advanced Research Project Agency–Energy (ARPA-E), the research team’s goal is to bring about a five-fold increase in the amount of terpene—those sticky, combustible substances that help pine trees ward off pests and conserve water, making it cost-competitive with petroleum-based fuels.

Ultimately, when government and industry cooperate, innovative solutions can be found to help solve the puzzle of how to feed the growing demand for food, fiber, and energy for an ever-growing population. When trees are purpose-grown for raw materials for fiber and energy, they help keep our high value conservation forests intact, and still enable a wealth of raw material to be produced in a sustainable, renewable, and environmentally healthy way.

Nancy M Hood is the director for Public Affairs and Sustainability at ArborGen, Inc.

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# Making Methane Gas Work for the Environment

By Stephen L. Johnson

**PROTECTING HUMAN HEALTH** and the environment have long been key issues in the United States. Over the past few decades, a variety of new technologies have come to fruition. Solar, wind, geothermal energy, and biogas are all sources that can be utilized to make renewable energy. The further technology progresses, the greater flexibility we have of finding new energy sources. And, sometimes, they come from the most unlikely of places.

It may be hard to visualize, but some of America's industrial sites (landfills, oil fields, coal mines, and wastewater treatment plants, to name a few) are also perfect candidates for cost-saving, pollution-cutting clean energy. It's all thanks to the methane gas naturally produced by a facility's operations. Though methane is well known as a harmful greenhouse gas—according to the EPA, it's 20 to 25 times more potent than CO<sub>2</sub>—it also holds an abundance of energy. However, the power potential has previously been thought of as unusable.

Now, there's a new technology on the marketplace that addresses both issues. Modular power plants are being created with the capacity to generate energy from the oxidized gas, simultaneously destroying methane, so that virtually no pollutants are exhausted. What's left from the original source of methane is a miniscule potency of well below one part per million (ppm) of NO<sub>x</sub>.

## Current practices

The current practice used at many facilities to destroy methane is not as environmentally friendly. The industry standard is something known as methane flaring, which openly burns methane gas, extinguishing it in the process. Although an easy and cheap solution, it remains a significant environmental and health hazard. Total NO<sub>x</sub> emissions from the process have been shown to cause significant problems. Additionally, it's a huge wasted resource, venting more than one gigawatt (gW) of potential electricity.

Up until this point, modular power plants have focused on extracting energy, rather than cleaning up the harmful gases they used. And, even if they did try and combat the environmental detriments, the range of gas levels and the amount of methane destroyed were severely limited.

Previous technologies had to directly compress the incoming fuel, which was an energy draining and costly expenditure. The new power stations are able to operate effectively due to the balance between incoming gas, compressed air, and a thermal oxidizer. With this technology, there exists the potential to harness 30 billion kilowatt-hours (kWh) of renewable energy domestically each year. That's comparable to saving more than 60 million barrels of oil.

On top of that, the technology is good for business. These power stations, on average, cost businesses \$4 per megawatt, compared to other biogas installations that cost anywhere from \$5 to \$12 per megawatt. Plus, the electricity produced can either be sold to a utility grid or used onsite by the operation, resulting in greater cost savings in these cost-conscious times.

## Modular power plants

The re-introduction of the modular power plant shakes up the notion of who and what we see as a benefit to the environment. Landfills, oil and gas operations, coal mines, industrial processing plants, and wastewater treatment plants, for the most part, conduct operations that naturally produce methane gases and other environmental hazards as a byproduct. Some of these operations, such as landfills, will continue to organically produce methane even long after they're turned off. Rather than simply chastising them, we can now take their byproduct and convert it into a product and real energy that cleans as it produces power.

There's no need for a new infrastructure either. They're called modular power plants for a reason. These power stations act as a "one size fits all," running on methane gas ranges of anywhere from 1.5% to 100%. They're also scalable, producing anywhere from 250 kW of energy to multiple megawatts of energy, based on the needs of each facility. All of this from a technology that takes up 240 square-feet of space—the size of a living room.

With a shift in technology comes a shift in thinking. Education and awareness will be vital to the growth of modular power plants as a long-term solution. But, even more important, is recognition of the unlikely mills, mines, fields, and plants that could serve as the next frontier of renewable energy. Industry and sustainability can fit together. In tandem, they can use new technologies to protect human health and the environment by curbing pollution, producing clean power, and putting more energy back on the grid.

*Stephen L. Johnson is the 11th Administrator of the Environmental Protection Agency, and current board member of FlexEnergy, a biogas company that turns methane into renewable energy.*

**FlexEnergy** | [www.flexenergy.com](http://www.flexenergy.com)

A recent example of modular power plant technology can be found at the Department of Defense's (DoD) Fort Benning facility in Georgia. This facility's landfill is utilizing the first commercial system that turns low-quality methane gas into renewable energy. Previously, the landfill had been flaring the methane gas produced naturally by its waste. In an effort to increase its energy independence, the DoD decided on purchasing a modular power plant.

The new system, which went online in November, was plugged in without difficulty to the landfill's current operations. Trial runs have shown the system will produce around 250 kW of continual energy for the Fort, which will produce enough energy for about 250 homes. The DoD is interested in seeing how this and other clean technology can be introduced to more of their facilities, all in an effort to deliver environmental protection, economic development and prosperity, as well as energy and national security.



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## The Hydrogen & Fuel Cell Sector

More than a “flavor of the month” in Canada

By Eric Denhoff

**A DECADE AGO**, the chatter about hydrogen and fuel cell technology verged on the sensational. Touted as an around-the-corner energy and environmental solution, it was believed that we’d soon all drive hydrogen-powered fuel cell cars, live in homes where fuel cells provided heat and electricity, and have conversations on our fuel cell powered mobile phones.

Fuel cells are electrochemical devices that produce electricity with only heat and water as by-products. Using a fuel, such as hydrogen, fuel cells can power a variety of devices—from cell phones to entire neighborhoods, in an efficient and environmentally friendly manner. Politicians, investors, and the media were drawn to the technology’s promise and, together with hydrogen and fuel cell technology developers, created an environment of hype and sky-high expectations. Interest was particularly focused on one particularly attractive, consumer-friendly application: automobiles.

Then, the inevitable happened. Hydrogen and fuel cells didn’t—in the blink of an eye—propel our cars and change the world. And, just as quickly as the initial excitement was built, a torrent of naysayers swept in to denounce the feasibility of hydrogen and fuel cells.

The truth is, we figured out that a transitional period over many years would be necessary to properly develop hydrogen-fuelling infrastructure and roll out fuel cell powered vehicles. Sadly, the technology didn’t get the chance. The technology became victim of “flavor of the month” thinking, an underachiever in an instant gratification world.

Consumers were being conditioned by the substantial year-on-year advances (faster, better, cheaper!) being made in the computer and Internet technology industries to expect the same from alternative energy technologies. But history has shown that incremental changes in the automotive and energy landscape can take time to play out.

Fast-forward several years. Now, ethanol, carbon sequestration, and battery technologies are regarded—like hydrogen and fuel cells before them—as potential silver-bullet solutions to the energy and environmental challenges. Once again, we’re looking for a quick-turnaround answer. And, if the payoff isn’t immediate, next year it’ll be some other technology.

So, maybe it’s time to reconsider the hydrogen and fuel cell sector.

In Canada, the hydrogen and fuel cell sector has undergone a remarkable transformation since the early 2000’s. It has grown to become a solid contributor to Canada’s R&D capacity, investing more than \$150 million per year in technology and product development. The sector is also home to world-class researchers, entrepreneurs, workers—some 2,000 strong clean energy jobs from coast to coast. Most notably, real progress is being made in commercial and industrial applications. Although, perhaps, not as exciting as fuel cell powered cars, success in early commercial applications has led to more widespread, consumer use of the technology.

In particular, Canadians are paving the way in hydrogen storage and smart-grid applications, enabling renewable energy developers to store and then reuse excess wind and solar

power, for when the sun isn’t shining or the wind isn’t blowing. The potential of this application shouldn’t be underestimated. For example, Germany essentially wasted 30 million Euros worth of wind power because it didn’t have a suitable storage solution. Ontario companies are now exporting these products to countries, such as Germany, where renewable energy systems are being deployed at a significant pace.

Corporations from Walmart to Whole Foods to Coca Cola are using hydrogen fuel cell powered forklifts by the hundreds to solve their material handling challenges, and benefitting from decreased greenhouse gases, better reliability, and less costs. In developing countries, such as India and Indonesia, Canadian-produced fuel cell backup power units are keeping cell phones working in emergency situations and grid outages. Large stationary fuel cell power plants are providing clean electricity utilizing a variety of fuels such as hydrogen and natural gas, from California to South Africa to Ontario. Plus, the world’s largest fleet of hydrogen powered, zero-emission buses are operating in

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Canada today, and they have the same or better availability and reliability as the regular buses, in cold winters and dusty hot summers.

When Mercedes-Benz recently reviewed ideal locations to place its \$50 million next generation fuel cell manufacturing facility, it eventually chose British Columbia due to recognition of the region's expertise. Fuel cell powered vehicles are more of a tangible reality than ever before, especially in countries such as Germany where governments, automakers, and infrastructure companies plan to roll out consumer fleets of automobiles by 2015.

There's no "big bang" coming, but the Canadian hydrogen and fuel cell sector continues to make incremental, tangible progress. It's certainly no flavour of the month, but a permanent long-term player in the ever-evolving clean energy landscape.

Of course, Canada is not alone in the pursuit of hydrogen and fuel cell technology. For example, the United States has approximately 3,600 direct jobs in the industry and the US Department of Energy is funding research at a total of about \$300 million per year. Seems the time is right to help improve the sector's impact on a larger, global stage. Let's move away from looking for the "next big thing," and revisit the solid solution that's been waiting in the wings all this time.

*Eric Denhoff is president and CEO of the Canadian Hydrogen and Fuel Cell Association.*

**Canadian Hydrogen and Fuel Cell Association**  
www.h2fcc.ca



### Body calibration sources

Wahl Instruments, Inc. has announced the addition of a new product line to its Test & Calibration Instruments catalog. New Black Body Calibration sources are used for calibration and verification of infrared temperature instruments. Twenty-two different models are available to suit a variety instrument specifications. Both cavity and hot plate types feature dull, black surfaces, to achieve an emissivity of as close to one as possible. Models with built-in or stand-alone temperature controllers are available to provide stable, repeatable temperatures for uniformity, while also displaying the temperature of the target area.

By knowing the emissivity and temperature values of the calibration source, virtually any infrared temperature instrument with a spot-size diameter less than the aperture diameter can be calibrated. Communication ports are available on some models, allowing users to set points for automatic test applications. NIST Traceable Certificates of Conformity are available on request.

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BinMaster Level Controls introduces a newly designed weight and cable "bob" style, SmartBob-TS1 continuous level sensor, with a sealed electronics compartment to meet the challenges of dusty environments. This continuous level measurement and inventory monitoring sensor is designed to prevent the ingress of dust into the electronics cavity of the sensor to protect critical components and enhance durability. The SmartBob-TS1 is proven accurate and reliable in applications when the sensor is used to measure powders or granular materials in bins, tanks, and silos, where high levels of dust are present especially after the filling operation.

The SmartBob-TS1 can be used in bins, tanks, or silos up to 60' tall, and in any type of operation that needs to monitor inventories of bulk solids or powders. It is highly suitable for feed and milling operations, grain bins, sand silos, and more. With the use of a sphere float bob, the SmartBob-TS1 can also be used in a variety of liquid and slurry applications. It offers a variety of communication options, including an optional built-in 900 MHz wireless modem, ZigBee compatibility, RS-485 communications, and 4-20 mA output to a PLC (programmable logic controller) or HMI (human machine interface). Individual bin measurements can be sent to the eBob PC software or a control console where measurements can be displayed as distance to product, height of product, and percent full.

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## re-li-able

- 1: suitable or fit to be relied on
- 2: giving the same result on successful trials



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- 13-14 EnerCan West 2012: Energy and the Environment**  
Delta Regina Hotel—Regina, Saskatchewan; http://enercanwest.com
- 14-15 SEIA Installer Safety Seminar & EXPO**  
Westin Mission Hills Resort & Spa—Rancho Mirage, California  
www.seia.org/cs/iss
- 14-16 SOLAR Power-Gen Conference & Exhibition**  
Long Beach Convention Center—Long Beach, California; www.solar-powergen.com
- 15-16 AWEA Wind & Transmission Workshop**  
Indianapolis, Indiana; www.awea.org/events
- 22-24 Offshore Wind Power USA**  
Hynes Convention Center—Boston; Massachusetts;  
www.greenpowerconferences.com
- 27-28 Inverter & PV System Technology Forum—USA 2012**  
San Francisco, California; www.solarpraxis.de/en/conferences
- 27-1 Solar Power Finance & Investment 2012**  
Rancho Bernardo Inn—San Diego, California; www.infocastinc.com
- 28-29 AWEA Wind Power Project Siting Workshop**  
Las Vegas, Nevada; www.awea.org/events

**MARCH**

- 6-7 AWEA Wind Power Supply Chain Workshop**  
Chicago, Illinois; www.awea.org/events
- 7-8 23rd Annual GLOBALCON Conference & Expo**  
Atlantic City Convention Center—Atlantic City, New Jersey  
www.globalconevent.com
- 7-10 9th Annual Green Energy Summit and Exposition**  
Frontier Airlines Center—Wisconsin, Milwaukee; http://greenenergysummit.us
- 14-16 GLOBE 2012**  
Vancouver Convention Centre—Vancouver, BC; www.globeseries.com
- 19-21 PV America**  
San Jose Convention Center—San Jose, California; www.pvamericaexpo.com/west
- 21-22 AWEA Wind Power Transmission Seminar 2012**  
Indianapolis, Indiana; www.awea.org/events

**APRIL**

- 3-4 Good Jobs, Green Jobs**  
Philadelphia, Pennsylvania; www.greenjobsconference.org
- 12-13 AWEA Wind Power Finance & Investment Workshop**  
New York, NY; www.awea.org/events
- 17-18 Utility Solar Conference**  
JW Marriott Star Pass Resort & Spa—Tuscan, Arizona;  
www.utilitysolarconference.com
- 18-20 Advanced Lithium Ion Battery International Symposium— 2012**  
Charlotte, North Carolina; www.wplgroup.com/aci/conferences/advanced-lithium-ion-battery-international-symposium.asp
- 25-27 4th Annual Wind Energy Operations & Maintenance Summit USA**  
Dallas Marriott City Center—Dallas, Texas;  
www.windenergyupdate.com/operations-maintenance-USA/

**MAY**

- 13-17 World Renewable Energy Forum**  
Colorado Convention Center—Denver, Colorado; http://wref2012.org
- 23 GEA International Geothermal Energy Showcase**  
Washington, DC; http://geo-energy.org/events.aspx

**JUNE**

- 3-6 WINDPOWER 2012 Conference & Exhibition**  
Georgia World Congress Center—Atlanta, Georgia; www.windpowerexpo.org

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