VOLUME 14 | ISSUE 1

North American CleanEnergy

2020 SOLAR BUYERS GUIDE
Pg. 29

Digital Reality
It's time for boardrooms to get a grip on digitalization Pg. 8

Preventive Reconditioning
How an upfront investment can save you excessive costs down the road Pg. 16

Integrating Solar Microgrids
Reducing the impact of power failures Pg. 90

Plus Show-in-Print Features:
- AWEA Wind Project O&M and Safety Conference Pg. 26
- Intersolar North America Pg. 78
- Solar and Energy Storage Northeast Pg. 82

Pg. 22
Pg. 86

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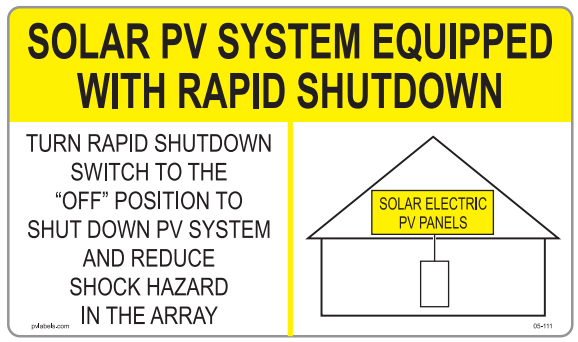

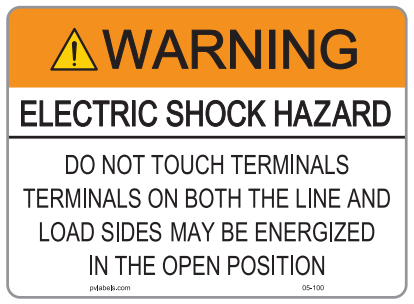

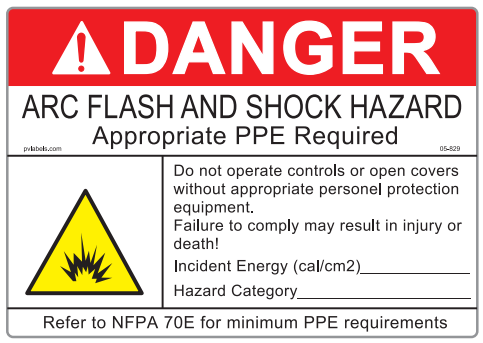

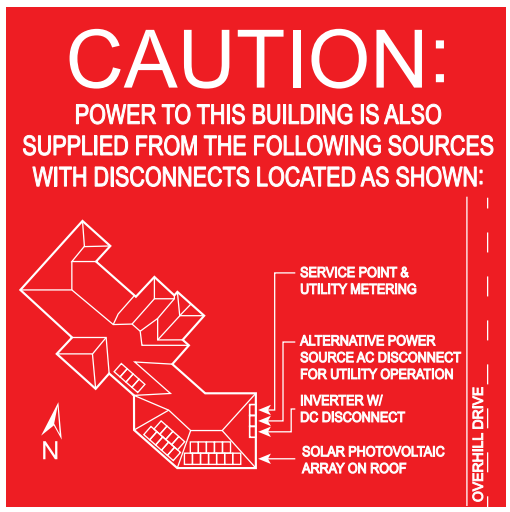

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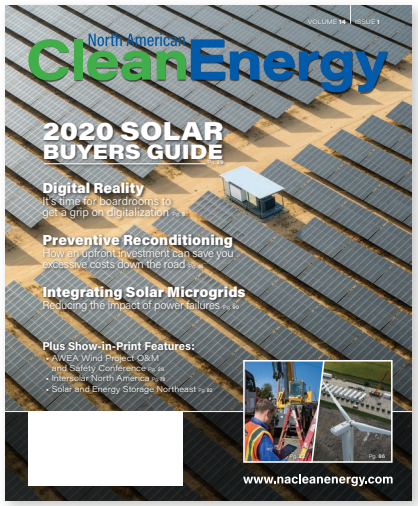
contents



On our cover...

Photographer, Frederic Neema, shot this image for EDF Renewables. Present in over 20 countries, the company develops, builds, and operates renewable power plants.

EDF Renewables
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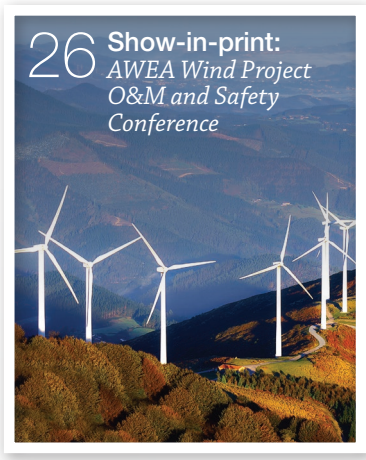
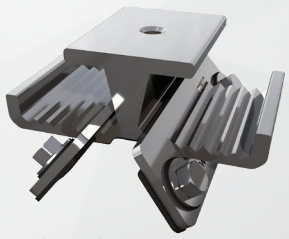
14 **Why Turbine Uptime is Crucial for Wind Farm Efficiency**

24 **Wind product spotlight:** *Performance Monitoring*



26 **Show-in-print:** *AWEA Wind Project O&M and Safety Conference*

36 **2020 Solar Buyers Guide** *Trojan Battery Company*



79 **Show-in-print:** *Intersolar North America*

89 **Energy storage product:** *Panasonic Corporation of North America*

92 **Building Resilient International Supply Chains** *What clean energy companies need to know*

departments

8 Top story
10 Wind power
23 Wind product spotlight: Safety & Fall Protection
25 Wind spotlight: Training
26 Show-in-print: AWEA Wind Project O&M and Safety Conference
29 2020 Solar Buyers Guide
78 Show-in-print: Intersolar North America
82 Show-in-print: Solar and Energy Storage Northeast
84 Energy storage
92 Energy efficiency
94 Events calendar & advertiser's list

8 **Digital Reality** *It's time for boardrooms to get a grip on digitalization*
10 **The Price of Safety** *Human performance improvement in wind energy*
12 **The Ultimate Recycling Process** *Regenerating transformer oil so it's good as new*
14 **Why Turbine Uptime is Crucial for Wind Farm Efficiency**
16 **Preventive Reconditioning** *How an upfront investment can save you excessive costs down the road*
18 **Innovation Removes Barriers to Wind in Remote Locations**
20 **Yaw Solutions**
22 **Tips from a Supply Chain Guru**
23 **Wind product spotlight:** *Safety & Fall Protection*
25 **Wind spotlight:** *Training*
26 **Show-in-print:** *AWEA Wind Project O&M and Safety Conference*
29 **2020 Solar Buyers Guide**
78 **Show-in-print:** *Intersolar North America*
82 **Show-in-print:** *Solar and Energy Storage Northeast*
84 **Current Kills** *Safety lessons from large scale energy storage deployments*
86 **Integrating Onsite Energy Management**
88 **Factory Finished**
90 **Integrating Solar Microgrids** *Reducing the impact of power failures*
92 **Building Resilient International Supply Chains** *What clean energy companies need to know*

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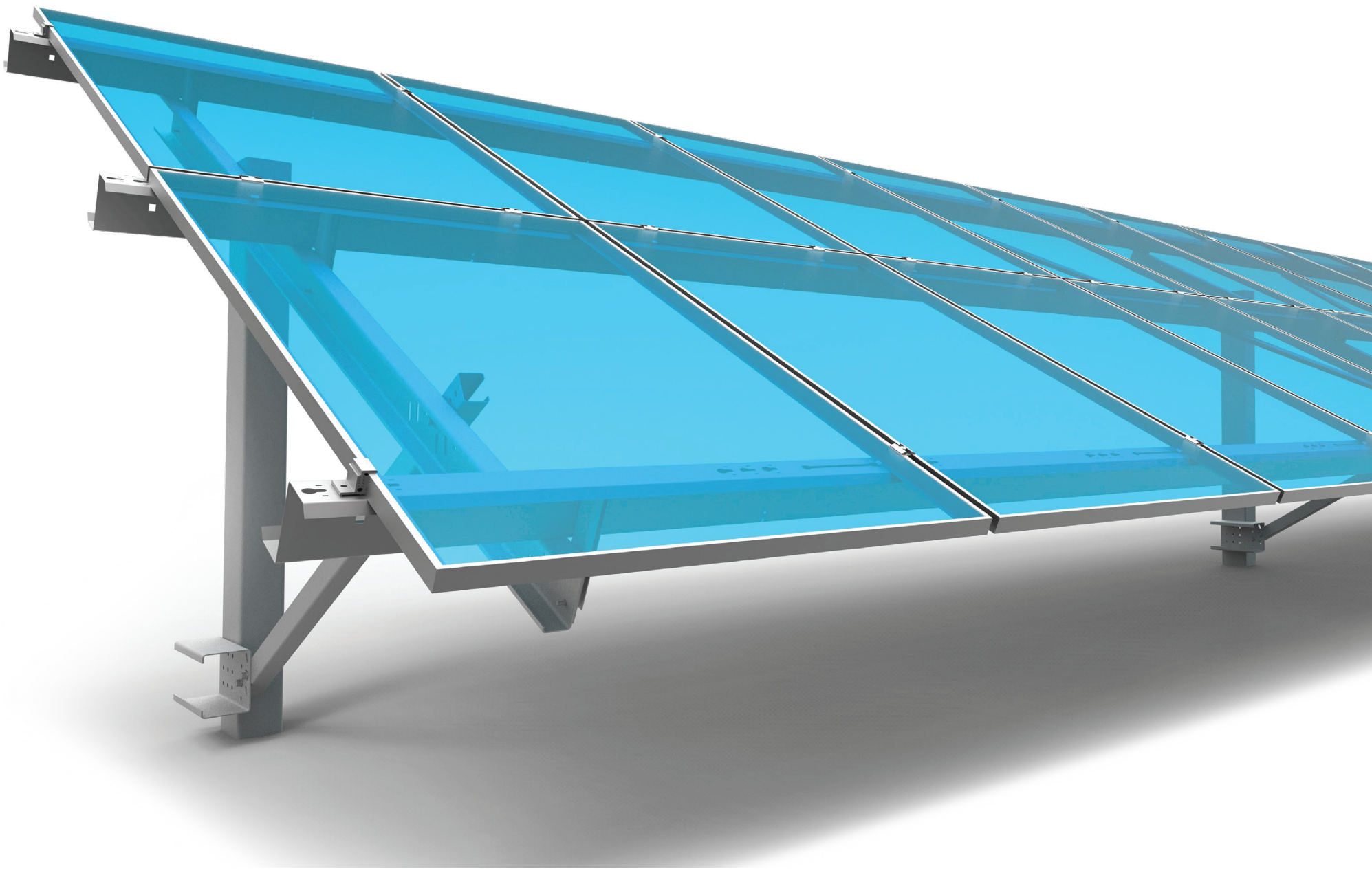

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Predictions for 2020

by Pete Maltbaek, General Manager North America, Smarter Grid Solutions

THE UCLA LUSKIN CENTRE FOR INNOVATION recently issued a detailed report on America's progress to 100% clean energy. According to the report, 1 in 3 Americans now live in a city or state that has committed to, or achieved, 100% clean electricity. It also revealed that renewable energy generation throughout the US has nearly doubled since 2008.

Last year saw significant developments in the climate and clean energy industries here in the United States. I firmly believe that we can all look forward to more positive developments for 2020.

Here are our predictions for US energy in 2020:

Science and policy

We expect greater clarity of communication and impact from the climate science, as well as practical experience and observation on climate change effects. There will likely be more climate emergency declarations, more 100% renewables policies enacted, more 'net zero target' setting, and rolling forward of timelines to reflect the urgency.

Regulation

We should see a stronger response from regulators on science and policy through market and system measures, along with a general opening and tilting of the sector towards clean energy. The value of customer participation, self-production, and flexibility will be ongoing trends, balanced by the need for all to pay for the grid. Regulators will work on getting out in front of the climate agenda to reflect the technical advances, opportunities, and system changes. All while incentivizing utility business model changes, and the adoption of competitive, non-wires solutions to network capacity issues.

Customers

With the wider citizenry being more climate aware and motivated, we expect more innovative customer value propositions from energy and network companies, with greater reception from customers. This includes growth in corporate Power Purchase Agreements (PPAs) - to meet private and municipal energy targets; Energy as a Service (EaaS) solutions - for those needing capital support in pursuit of their goals; dynamic tariffs for smart/flexible cost-conscious customers; and multiple energy vector solutions - including flexible EV charging and heat solutions for those wishing a holistic approach to their energy needs.

Technology

Many of the technologies needed for the energy transition are either currently in place or imminent. Some of the newer tech advances will need to make the jump to commercial solutions to enable implementation at scale. Examples include end-to-end supply chain, productization, value engineering, and effective system integration (to manage the complexities of the electricity system and market).

Systems and business models

The goal is to deliver an energy system that exceeds those available today in terms of cost and performance. To help reach that goal, we need better coordination and co-optimization of the new clean energy technologies and customers, the grid, and the markets.

In the coming year, we expect to see increased deployments of connected energy solutions at a systems level, including renewable energy generation, electrified vehicle transport, marine transport, space, water and process heat, and other flexibilities from customers.

We should see the hybridization of technologies such as wind/storage, PV/storage, PV/EV, and the solutions to integrate these to grid and market at different scales. Business model innovation should continue from service providers and the supply chain (as a service, data focused, flexible licensing and leasing, and from customers).

Finance & investment

Look for the continued flow of greater investment finance into clean energy assets and other clean tech, with a manifestation in the onward rise of renewable energy and associated operational, market, and system integration solutions. The real economics of fossil-fired power generation will continue to divert investment dollars towards clean sources.

New players & entrants

We expect to see a greater prominence for new, emerging, and growing participants in electricity supply chains as well as direct market participants - EV provision, EV charging, energy storage, behind the meter aggregation, flexibility service providers, hybrid energy solutions, and heating and cooling (service) solutions. This will start to have a profound effect on the nature of clean, decentralized energy systems.

The coming decade...

We already see the effects of a decade of innovation, policy, regulation, and investment in the clean energy transition. These changes are just the starting point for the complete decarbonization of energy that will result in a smarter, more flexible, and more decentralized and customer focused energy system. The coming decade will see massive changes in the structure and experience of clean energy to all corners of the world.

Pete Maltbaek is part of the Smarter Grid Solutions global executive team. Based in California, he is responsible for the management and growth of the company's business throughout North America.

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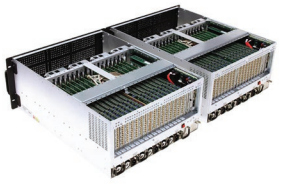
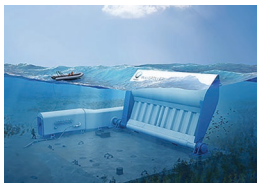


Race to create limitless clean energy

Fusion has long been viewed as the ultimate goal for energy generation. Smashing together deuterium and tritium atoms releases energy as they combine and is the reaction at the heart of the sun. With no dangerous waste products and a virtually limitless supply of these atoms from seawater, billions have been spent on fusion research. However, recreating the extreme conditions of temperature and pressure on earth are not easy. A British company, First Light Fusion (FLF), is developing a different approach to fusion and is on target to achieve fusion gain, more energy out than goes in, by 2024. In order to achieve the conditions needed for fusion, they launch a projectile to hypervelocities at a target which requires very high levels of precision to achieve and so they selected 32 digitizers from Spectrum Instrumentation to monitor the results. One of the challenges is ensuring synchronicity in the firing of all six limbs that has to have nanosecond level accuracy. The electrical energy is stored in 192 capacitors that are arranged in pairs and each of the 96 pairs is controlled by a bespoke switch which is capable of holding off the voltage and transferring the huge currents involved. After the firing, Spectrum M2i.4912-exp digitizer cards are used to acquire hundreds of machine diagnostics from each capacitor and switch along with numerous probes in the limbs covering current and voltage readings with a sampling rate of 10 MS/s (100 ns time interval). 32 cards are linked together in two banks of 16 using Spectrum's Star-Hub feature to ensure synchronicity across all 256 input channels. This configuration provides the flexibility of adding additional channels if required in the future.

Spectrum Instrumentation
/// www.spectrum-instrumentation.com



Plug into wave energy

A new energy technology substation for SURGE2 is being built on the coast of Peniche, Portugal to convert the energy from ocean waves into an endless source of sustainable electricity using WaveRoller technology from AW-Energy Oy (AWE) based in Finland. The installation team included AWE and a Spanish team from PROinSENER Energía who built it based upon Abengoa design specifications. Recently AWE was issued a manufacturing certification from Lloyd's Register. Multiple projects are underway around the world.

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Digital Reality

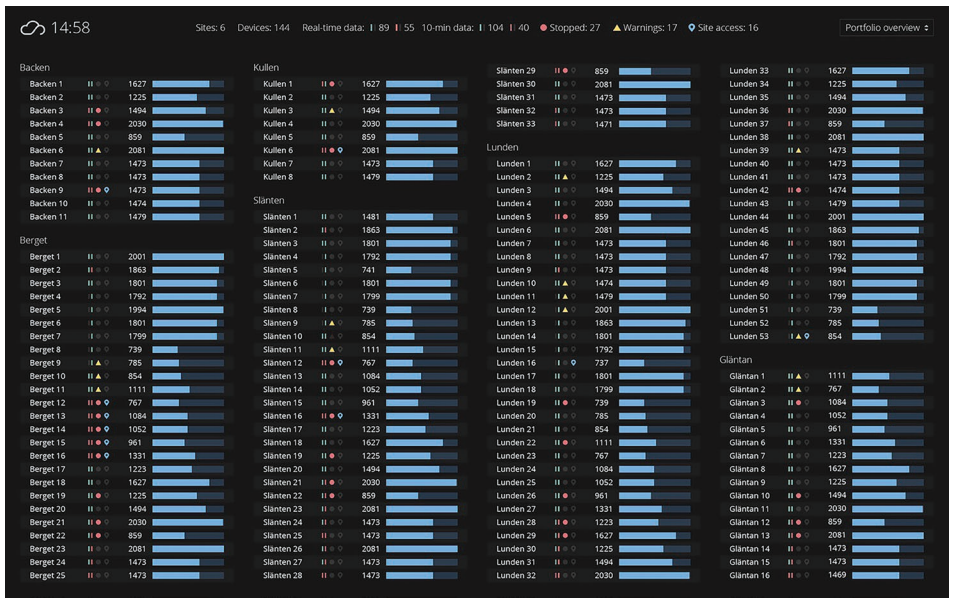
It's time for boardrooms to get a grip on digitalization

by Jonas Corné

Despite being responsible for many of the amazing technological developments in the renewables industry, including sophisticated performance monitoring and asset management, the benefits of digitalization are still not being fully recognized by top level executives, from asset managers to investors. Data managers are left with no choice but to push for data-led approaches from the bottom up.

This is a mistake, and a big one.

Digitalization plays a crucial role in today's renewables market - senior execs who ignore it, or treat it as a "nice to have", are missing out on an enormous opportunity to increase their revenue and decrease their costs. They're throwing away the opportunity for maximized asset productivity and availability. Ironically, many companies remain unaware of the wider financial and operational benefits that digitalization can bring, simply because they lack the data management abilities needed to effectively measure it.



Never before have portfolio owners been able to gather data with such speed, quality, and scale. The benefits are obvious for all who care to look. Identifying marginal gains, accurate forecasting of future issues, and recognition of good investment opportunities, are some valuable outcomes that enable renewable energy portfolio owners to better analyze and act on data.

While you can find a number of portfolio owners who have made asset management and monitoring software choices that ultimately led them down a "data dead-end", this doesn't mean that boardrooms should be hesitant about adopting a data-led approach.

Software developers have already begun creating versatile solutions that de-risk the investment for boardrooms, by creating technology and OEM-agnostic data hubs and marketplace-style app stores. This enables collaboration between software developers, portfolio owners, and asset managers - to not only ensure the highest standards of data management, but accelerate the pace of software innovation.

Sophisticated, investor-backed portfolio owners in the North American renewables sector already recognize the value that data-led approaches can bring. Obtaining data from technologically and geographically diverse sources, optimizing existing assets, and avoiding financial losses caused by lower asset availability, have made digitalization absolutely essential to the competitiveness of renewable energy portfolio owners.

Boardrooms need to get "on board"

The first step to realizing an opportunity is recognizing that there is one - renewable energy asset owner and investor boardrooms need to wake up to new data opportunities. Unless they stop seeing data-driven value as a "nice to have", they face the very real consequence of productivity and financial losses.

At a recent Forum event, data managers from almost 100 global renewable energy companies agreed that, in today's market, as new technology continues to develop and

outdate current practices (and without subsidies or full-service maintenance warranties), executives need to support and update data management strategies to keep up.

However, with over 40 percent of data managers believing that industry executives have only a partial understanding of their role, and 36 percent stating that their Board either allocates no financial value to their work or fails to give it any serious oversight, many renewable energy portfolios remain unable to effectively gather the data required to fully optimize their assets.

While data managers understand the opportunities digitalization can bring, they still need a top-down implementation of digital approaches. Boardrooms must follow the example of other sophisticated renewable energy portfolio owners in North America that have implemented a fully digitized approach, to create wide-ranging transparency on asset performance, and accountability amongst third party asset managers.

Solving data dead-ends

Some businesses that chose to invest early in digital asset management approaches have been burned, which explains much of the current reticence among senior teams.

Data dead-ends that have been encountered (software provider insolvency, single technology support, reliance on bespoke, in-house systems) have undoubtedly slowed the pace of software innovation in the renewable energy industry. Fortunately, the creation of marketplace-style app stores and cloud computing data hubs shows that these obstacles are being overcome by software developers.

Portfolio owners need to be able to continuously evolve and collaborate with software developers and other industry players in order to expand and diversify their portfolio with new asset or Original Equipment Manufacturer (OEM) technologies. If they fail to do so, they will limit future growth opportunities and reduce their competitiveness.

This can be easily avoided by selecting a software platform that remains technology- and OEM-agnostic, allowing for flexibility when developing or acquiring new assets. Cloud platforms that act as "data hubs", with the ability to gather data from all sources irrespective of OEM technology or asset type, already exist, and can provide portfolio owners and asset managers with opportunities to innovate around the performance monitoring process.

In addition, "app stores" can accelerate the pace of software innovation by enabling portfolio owners to collaborate with multiple renewable energy software providers in the development of highly sophisticated applications. When integrated with cloud software, portfolio owners can choose from a greater range of software applications, allowing them to tailor their performance monitoring dashboards to their specific needs.

Boardrooms and top-level executives must begin to develop the same understanding of digitalization and its benefits as their data managers. An investment in asset management and monitoring software – providing it is in a versatile and "future-proof" platform – does not carry the same level of risk that it may once have. More importantly, it is no longer a "nice-to-have", but a critical part of portfolio management that is fundamental to profitable operation.

Jonas Corné is CEO of Greenbyte, a developer and enabler of smart data software to drive productivity in renewables.

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The Price of Safety

Human performance improvement in wind energy

by John J. Kumm

An operating wind plant in the Western US. Photo courtesy of POWER Engineers, Inc.

WHETHER YOU FIND YOURSELF IN A FIELD operating environment or active construction site, the safety risks are both evident and managed. Open trenches, moving machinery, energized apparatus and conductors, stored energy mechanisms: all these introduce risks into the construction and operational environment. Good teams examine those hazards that can produce serious injury or death; great teams don't wait for an incident to improve their awareness of hazards, but instead take near misses, good catches, and after-action reviews for the learning opportunities they are.

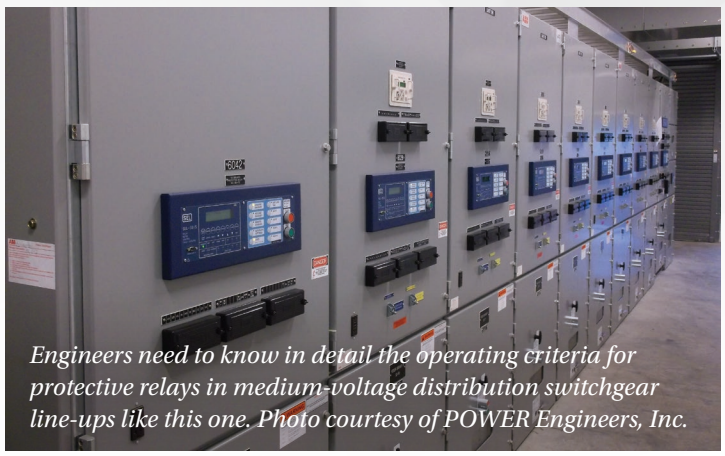
The field of Human Performance Improvement (HPI) (and generations of hard experience) tells us that we are fallible, prone to make errors while undertaking tasks simple and complex. HPI predicts those occasions when errors are more likely, and classifies them as error precursors. The following error precursors have proven to be excellent predictors of error risk:

- Time Pressure
- High Workload
- Imprecise Communication, and
- Distractions or Interruptions

These error precursors are as likely to be operative in the design environment as they are in the operating plant environment. And the consequences can be equally severe:

- Time pressure encourages a team to skip a peer check that could have detected a latent error in a dead-end structure design calculation. The resulting failure during construction postpones wind plant commercial operation.
- Imprecise communication leads to an incorrect protective device setting, resulting in the shutdown of a wind plant collector substation, rather than the desired trip of a single turbine.
- An interruption during order entry for switchgear leads to an incorrect device part number delivered and installed at a new facility.

You may say—rightly so—that we have processes in place to detect those kinds of errors and correct them. And yet, the statistics tell us that as talented and dedicated as our design teams are, there remains room for improvement.



Engineers need to know in detail the operating criteria for protective relays in medium-voltage distribution switchgear line-ups like this one. Photo courtesy of POWER Engineers, Inc.

HPI-based improvements in safety, quality, and construction accuracy at the design stage translate into bottom-line benefits to wind-plant owners and operators: for every incident that does not occur, for every design failure that doesn't leave the office, and for every construction error that never happens, the wind plant sees valuable increases in uptime, driving productivity and value to the owner.

Let's say a new team member is invited to perform the coordination of medium-voltage protective devices to relieve a team under a tight schedule. This scenario presents a clear error precursor: the new expert doesn't have the benefit of the project history and details known to the rest of the team. Specific HPI tools should be deployed to mitigate the risk that a new individual brings to the project.

- Use a **systematic project task turnover** to brief the new member into data sources (such as utility source impedances), owner protective relaying standards documents, and previously completed electrical model work.
- New team members should use a **questioning attitude**, not just assume a task is identical to prior, similar project sites.
- Use **independent verification of the completed work** prior to transmittal. Emphasis on points of intersection with the switchgear electrical design, turbine GSU protection, and utility protection coordination requirements, among other design items, further improves the chances that latent errors will not be released.

Active use of HPI tools improves our field team safety and operating plant productivity by eliminating risks created by design errors. Fewer errors means not only fewer safety incidents, but greater plant uptime and higher profitability – a direct reward for employing HPI principles. Further, just as software can be written for testability and products can be designed for manufacturability, our production environment can also be designed for safe constructability and maintainability. Make sure that your design team has the awareness and responsibility to hold safe construction and operation as an independent design objective.

As leaders in our field, we hold a responsibility to use the best available tools - not only to achieve our production goals, but also to facilitate a safe environment in which our teams can operate. Fewer incidents means more wind plant uptime. Our field teams and their families will thank us for our use of HPI tools. So will our plant owners.

A look at HPI Tools*

One of the strengths of Human Performance Improvement tools is their versatility: teams and individuals routinely think of new ways to employ them. Here are a few of the most useful:

Conservative Decision Making: Anticipates the worst-case risks and effects that could result from an incorrect decision. Selects solutions that meet needs within known constraints while minimizing undesirable consequences to the extent possible.

Flagging: Identifies components or equipment that is not to be touched or operated. Also used to draw attention to potential hazards or warn other workers of high-risk environments.

Peer-Checking: Performed by a qualified peer after self-checking (in the case of design work product), or shoulder-to-shoulder with the primary performer (in the case of a field technical activity). The purpose is to check the action or result, and then require necessary corrections before proceeding to the next step.

Pre-Job Briefing: Improves team and individual awareness before arriving at or initiating a project or task. Helps understand - beforehand - the hazards, risks, constraints, work environment, mitigations, along with the activity scope, roles, and responsibilities.

Stop and Collaborate: Used when there are uncertainties known before initiating a project or work-task step. Take the time to ask an expert for advice about the situation or process.

Turnover: The systematic transfer of information, tasks, and responsibilities between performers. A thorough and complete turnover provides time for the oncoming performers to establish an accurate mental model of the work, risks, and mitigations, before accepting the transfer.

John Kumm is Vice President for Field Services at POWER Engineers, Inc. His current responsibilities include overseeing POWER Engineers' substation testing team. With over thirty years in the electric utility business, John has specialized in protective relay design, application, and testing, with interest in power system reliability and Human Performance Improvement.

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**adapted from "Human Performance Improvement Pocket Guide," by POWER Engineers, Inc.*

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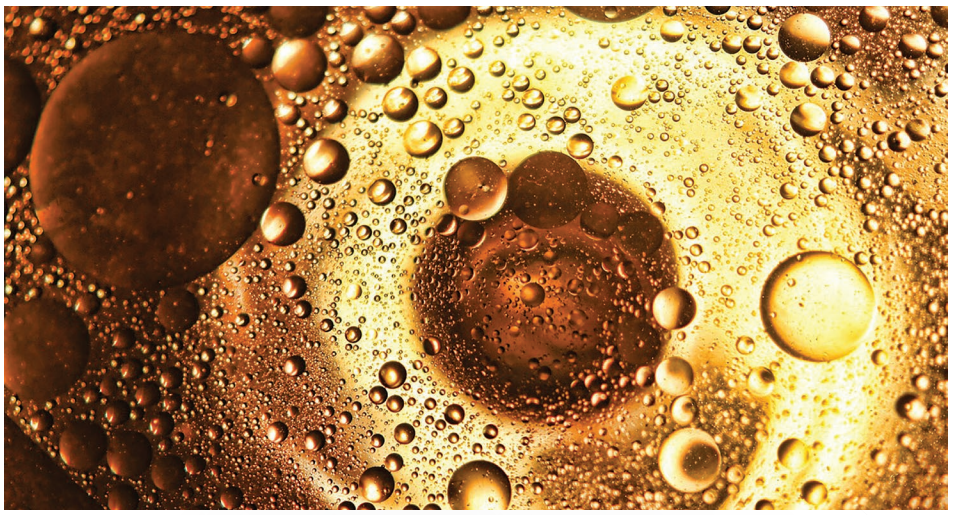
The Ultimate Recycling Process

Regenerating transformer oil so it's good as new



by Frank May

From their invention in the late 19th century to present day, transformers devices have become essential to everyday life. A transformer "transforms" voltage; they're all over your house, inside the black plastic cases you plug into the wall to make your electronics work properly, and all over your neighborhood, atop utility poles to run the grid.

In wind turbines, transformers connect the generator to the distribution device.

Over the 25 years of their normal life span, a vital step of transformer maintenance is the collection and disposal of the transformer oil. This oil insulates energized components, dissipates heat, and protects the paper insulation from moisture.

Hazards of transformer oil

Used transformer oil contains 38 chemicals with carcinogenic and mutagenic effects, including benzopyrene, PCB, dioxin, and furan. The Stockholm convention included two of these - PCBs and dioxins - on the list of the twelve most hazardous contaminants, and especially harmful to groundwater; under no circumstance should waste oil be allowed into the environment.

Recycling of used oil

Incineration is one of the most common ways to recycle oil. Oil can be added to liquid fuel and used for combustion, which is converted into heat. The biggest problem with this method is that hazardous contaminants, such as lead and sulfur, are released into the atmosphere. This means the oil should be prepared before burning, to minimize the negative environmental impact.

It's also possible (in theory) to use waste oil directly as fuel. However, since it doesn't meet fuel quality standards, the contaminants may damage fuel systems.

Some recycling methods can make oil products from waste oil, including thermal cracking, catalytic hydration, and vacuum distillation. But these require complex equipment; investing in the machinery is only viable for large facilities dedicated to oil recycling.

A rarely-used biological method involves bacteria that consumes hydrocarbons. The resulting inactive microorganisms can serve as fertilizer in parks and flower beds.

Figure 1. *Transformer oil before and after regeneration*

Transformer oil regeneration process

Oil regeneration can significantly reduce the amount of waste, decrease environmental footprint, increase oil service life, improve transformer reliability, and reduce waste oil replacement costs. Regeneration is a process of removing contaminants and products of aging from transformer oil, stabilizing the oil with additives, and restoring its quality so it can be re-used in electrical equipment.

Components that must be removed before the oil can be reused include:

- solid particles;
- water (emulsified and solved);
- air and gaseous products of oil decomposition;
- asphalt and resins;
- acids;
- sludge;
- metal organic compounds (soap);
- polyaromatic compounds;
- unsaturated hydrocarbons;
- remaining products of additive decomposition;
- other products of oil aging.

In order to remove all of these contaminants, regeneration must occur in stages. Although the terms "purification" and "regeneration" are often used interchangeably, each process leads to different results. Purification is a stage of the regeneration process - it cannot restore the oil to its original quality on its own.

Deciding on the method of regeneration depends on economic and environmental considerations. The chosen process must not only efficiently restore the properties of the oil, but also generate minimum waste

This can be achieved by combining several processes in one machine:

1. preliminary filtration to remove particulate matter;
2. adsorption to remove acidic compounds and aging products from the oil;
3. thermal vacuum drying and degassing;
4. mixing an additive into the oil to inhibit oxidation.

Preliminary filtration is straightforward, involving a mechanical barrier trapping solid particles larger than the openings in the barrier.

Table 1: The results of used oil regeneration

No	Parameter	Before Regeneration	After Regeneration	Specific Standards
1	Appearance	Turbid, dark brown	Clear, transparent	Clear, no sludge or suspended particles
2	Acid number, mg KOH/g, max	0.63	0.01	0.01
3	Corrosive sulfur	Present	Absent	Absent
4	Water content, ppm, max	170	5	30-40
5	Dielectric strength, kV, min	11	73	70
6	Dissipation factor at 90 °C, %, max	4.0	0.001	0.005
7	Gas content, %	12	0.1	-
8	Solid particle size, micron	50	0.2	Absent
9	Stability oxidation state: – acid number, mgKOH/g, max	-	0.2	1.2

The second stage deserves a more in-depth look. Adsorbents are natural or synthetic materials that absorb contaminants from the oil on contact. Transformer oil regeneration works well with a porous absorbent called fuller's earth*. Oil is pumped through a layer of fuller's earth, which traps contaminants in its granules, removing both soluble and insoluble sludge from the transformer oil. Sludge can be especially dangerous because it concentrates in the solid insulation, and its acidity is much higher than that of the oil.

In the third stage, the oil is pumped into a vacuum chamber with activator elements to increase the contact surface area of the oil. Heat and vacuum extract water and gas from the oil. Figure 1 shows two samples of the same transformer oil before and after regeneration. The color of the oil has been restored. Laboratory analysis confirms that oil quality parameters (acid number, dielectric strength, water and gas content etc.) are just as good as those of new oil (Table 1).In the fourth stage, the oil goes into a tank for mixing with an antioxidant additive.

When the adsorbent becomes saturated with the contaminants, it can be recycled. Saturated fuller's earth can be reactivated and used again and again, up to 300 times. The reactivation process clears the pores of the adsorbent, extracting and removing the contaminants into a special collection vessel. After the adsorbent is completely exhausted and cannot be reactivated, the process is performed once more to remove any remaining oil - the deactivated former adsorbent can then be used as a construction material or soil conditioner.

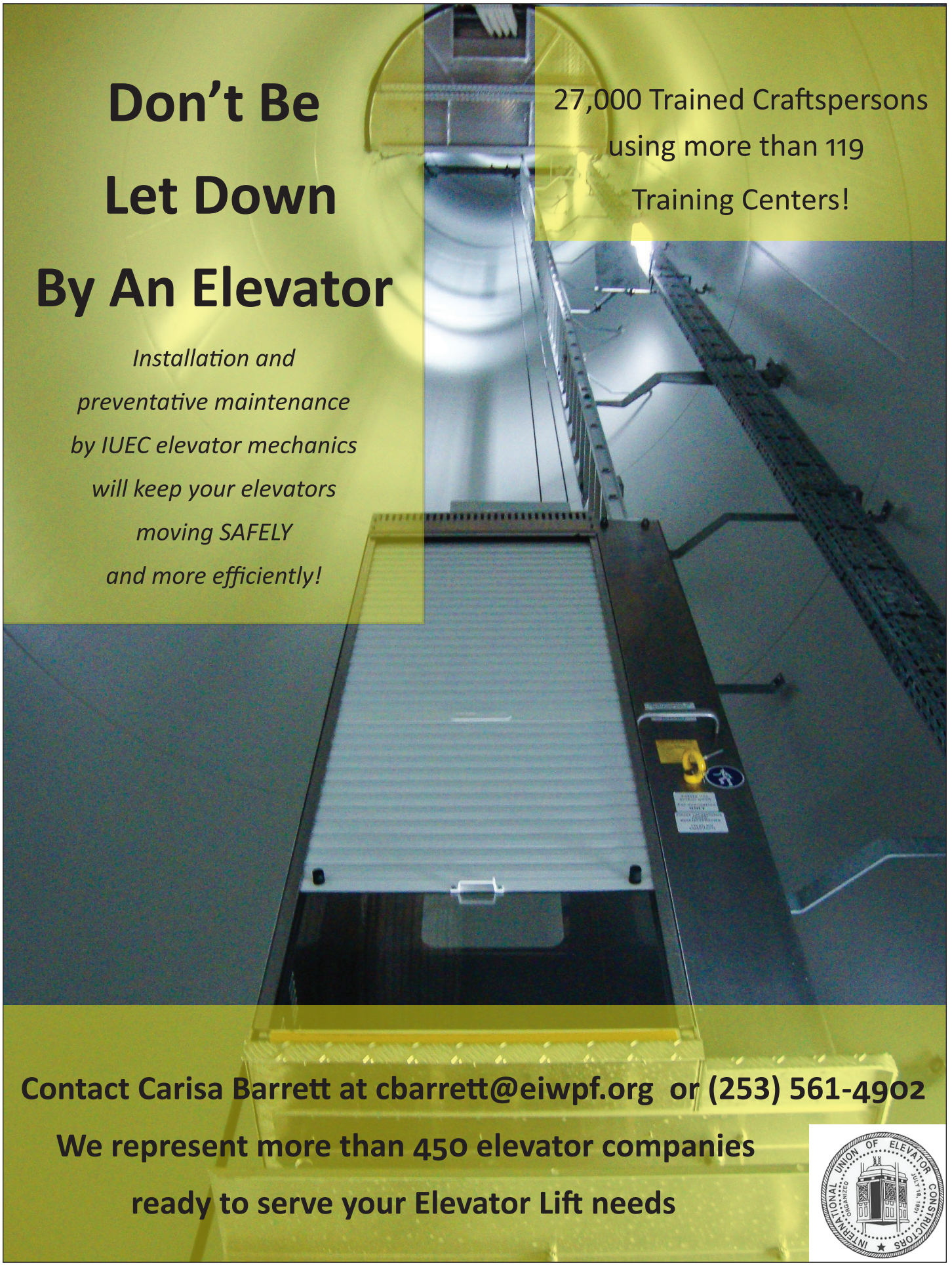
It is important to note that oil regeneration not only improves the oil, but also cleans the transformer (including noticeable restoration of solid insulation performance).

Transformer oil regeneration is a powerful tool for waste oil recycling. The economics and efficiency of the process stand out among all other methods. Regeneration saves the costs of oil replacement (the cost of the regeneration process is 40-70 percent lower than the cost of new oil). It aids transformer maintenance by improving transformer reliability and, if done correctly, does not create waste for disposal or storage. Instead, it allows insulation oil to be restored to good as new condition so it can be reused for insulation and cooling. Moreover, combining the regeneration system with special transformer protection devices (Transformer Safety System) makes it possible to regenerate oil in energized transformers. This eliminates power outages, and makes transformer maintenance easy - with no need to drain oil.

Frank May is a field service engineer at GlobeCore in Oldenburg, Germany. He has more than 30 years of practical experience in testing, commissioning, and maintenance of industrial equipment. He's currently researching electrical insulation oil purification and regeneration to improve transformer reliability and extend service life.

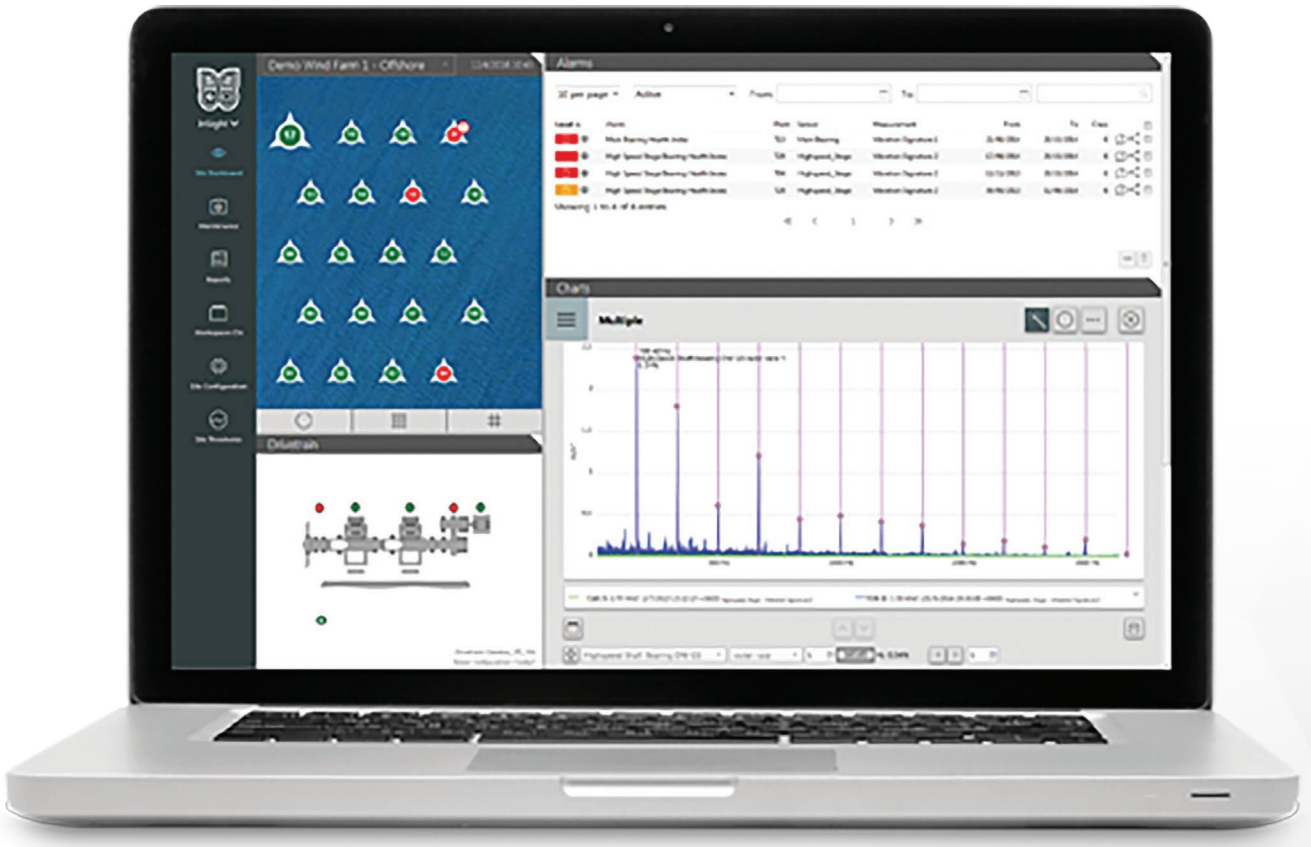
GlobeCore /// globecore.com

**The English word "fuller" originally meant a textile worker cleaning or "fulling" wool. "Earth" refers to the materials used by the fullers in their work. These materials were mostly minerals based on montmorillonite, which is known to have been used in Cyprus to clean wool as far back as 5000 B.C.*



Why Turbine Uptime is Crucial for Wind Farm Efficiency

by Bruce Hall



WIND ENERGY IS ONE OF THE FASTEST growing sources of energy production globally, projected to provide almost a third of the USA's energy needs by 2050 . In order to achieve these projections – and ensure the profitability of their assets - wind farm owners and operators must take advantage of the latest technologies available to them.

Why is turbine uptime important?

A key part of creating efficiencies to ensure profitability is maximizing turbine uptime. This is the core goal of wind turbine operations and maintenance (O&M). Turbine uptime, or availability, involves making sure that the assets on a wind farm are fully functional during critical energy generation periods. Essentially, it means they are working when the wind is high. The costs of failing to maximize turbine uptime can be considerable, and will only increase with the trend for larger turbines.

The missed potential profit due to the unavailability of a failed turbine can be up to $2,000 per day, per turbine, based on a 4.2MW turbine. With larger turbines, those losses will increase accordingly. The logistical difficulties in some regions of offshore turbine repair mean it can take weeks or months to complete a repair in this environment. With the advent of floating wind farms far out at sea, the complexity of onsite maintenance and repairs will become a greater challenge.

Bear in mind that these numbers don't include the repairs themselves (the costs for which are considerable due to the hazardous and labor-intensive conditions offshore). Offshore maintenance also involves specialized crew transfer vessels, highly skilled technicians and engineers, and cranes, as well as the replacement parts. Moreover, sending personnel up wind turbines is risky, and should be done only when necessary. All of this not only stretches O&M budgets, but also demands additional planning time from O&M teams.

How predictive maintenance increases turbine uptime

To prevent these costly wind turbine failures, it is necessary to catch problems before they become more serious. The best way to do this is through predictive maintenance, which strikes a balance between the expensive "run to fail" reactive model of O&M, and the preventative maintenance that spends unnecessary money on regularly scheduled replacements.

Predictive maintenance uses the latest digital technologies to enable a more intelligent, strategic method of O&M. Using cost-effective sensors installed in wind turbines to monitor data streams (including vibration, oil condition and temperature)

predictive maintenance providers can train artificial intelligence/machine learning algorithms to spot trends in turbine monitoring data, which could indicate potential problems. Expert engineers then analyze these trends to diagnose issues well before they materialize. This prevents further damage to the component in question, and limits the consequences of a failure.

Predictive maintenance has a number of benefits. For instance, lead time on repairs can be extended by as much as 18 months. This means that orders of new components can be placed well ahead of time, saving significant costs. Advance warning of potential problems also means that any repair and replacement work can be consolidated; there are fewer trips for personnel, lower crane hire costs (because they are planned), and less fuel used by vessels transporting personnel and equipment. Using predictive maintenance can deliver savings of up to 30 percent on a wind farm's O&M budget. One of the biggest ongoing costs of a wind farm is O&M, so it is vital to ensure that savings are made without compromising on safety.

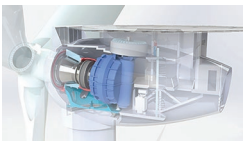
Predictive maintenance significantly reduces the risk of catastrophic failures. Instances where undetected failure of generator bearings result in generator shaft damage can cost an operator an additional $150,000 to repair. Similarly, undetected gearbox defects in parallel stage can result in complete gearbox replacement - something that could have easily been avoided with predictive analytics.

Additionally, predictive maintenance makes it easier to manage machine performance, and keep turbines online until a suitable weather window can be found to make repairs. Replacing a wind turbine gearbox when the wind is still doesn't result in lost revenue because the wind turbine wouldn't be generating energy at that time anyway. With the flexibility to deal with problems strategically, O&M departments can maximize turbine uptime.

The bottom line is efficiency. Predictive maintenance can deliver an average reduction of 3 percent on the levelized cost of electricity. Delivering lower cost energy is vital if wind energy is to build on its reputation as a reliable and cost-effective source of electricity. Headlines about idle wind turbines brought to a standstill by damage, wear and tear, or failure, risk losing public trust in wind farms and driving investment away. On the other hand, by showing it can reduce costs, the industry builds confidence in production technologies, making the industry more attractive to investors.

Bruce Hall is the CEO of ONYX InSight, which delivers smart predictive analytics to help wind energy asset owners and managers make informed decisions.

ONYX InSight
/// onyxinsight.com



Powerful new wind turbine concepts

Dutch company VerVent, has an offshore wind turbine that is scalable up to 16MW comprising a 1.5 stage bevel-type gearbox and a counter rotating generator. This design comprises minimal moving parts as well as a limited amount of active material, i.e. permanent magnets which are in use. Their new design is compelling and noteworthy because it minimizes technology and commercial risks by utilizing a set of supply chain partners including Siemens, Renk, Eolotec, Geislinger, and Siempelkamp in an effort to maximize margins and minimize Cost of Energy (COE). This is achieved through a drivetrain architecture which has been used on other types of high-torque applications in the past and is being adapted for use in wind energy. Coupled with a stringent testing regime, the VerVent technology can be a market-ready solution in as little as 24 months, which allows this technology to be fully exploited in emerging offshore markets with high growth potential including the United States, Japan, Viet Nam, South Korea, Turkey, India, Australia, Azerbaijan, and Brazil.

VerVent /// www.vervent.nl

Cable entry system offering

LUTZE Inc introduces the new Cablefix X cable entry system to complement their existing cable and cable management portfolio. Featuring multi-layered X-seal technology, Cablefix X is designed to simplify installation without compromising ingress protection. The X membrane seals are closed by default, eliminating the need to plug unused entry points. These cable entry systems achieve Type 4X, 12, and 13 with a protection class of IP65. Cablefix X is available with 12 or 23 entry points and provides a space saving alternative to traditional cable glands. Cablefix X requires only one enclosure cut out and can be installed onto enclosures of any wall thickness with four mounting bolts. For enclosures with a wall thickness of 1.5mm, Cablefix X is available with a snap-in mounting option.

LUTZE Inc. /// www.lutze.com

Preventive Reconditioning

How an upfront investment can save you excessive costs down the road

by Scott Carroll

If a wind turbine goes down, how significantly will this affect your business operations? For Wind Energy stakeholders, this can severely affect their business, and even their reputation. While serious incidents are unpredictable, a preventive reconditioning program can help keep your equipment reliable and extend its life expectancy.

When equipment is operational and business is able to maintain production, capital expenditures unfortunately tend to take a back seat. An effective preventive reconditioning program can drastically reduce the number and severity of electrical and mechanical malfunctions, improve equipment safety, and keep the maintenance, repair, and overhaul expenses economical.

What is preventive reconditioning?

Preventive reconditioning, otherwise known as planned maintenance, is an important aspect in effectively maintaining or servicing equipment in an effort to increase productivity, reliability, and the overall life cycle of the equipment. In many cases, planned reconditioning can prevent catastrophes (such as those caused by electrical fires).

The importance of preventive reconditioning

Wind turbines are extremely expensive pieces of equipment that are required to operate in harsh environments. We expect them to withstand constant impact to extreme heat, extreme cold, dust, sea mist, lightning, humidity, and other contaminants. In the face of these hazards, it is vital to have an effective preventive reconditioning program in place to keep the equipment operating optimally and extend its longevity.

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The benefits of investing in preventive reconditioning include:

- Reducing the number and severity of electrical and mechanical malfunctions
- Improving the safety of your equipment
- Making the maintenance, repair, and overhaul expenses more economical
- Extending the life expectancy of your equipment
- Eliminating premature replacement
- Preventing future business interruption/lost production time
- Investing in the reliability of your equipment

How does preventive reconditioning work?

Preventive reconditioning is more than just cleaning the surface of operating equipment. Before a glitch turns into a major problem, preventive reconditioning enables you to locate it and prevent future operational failure. Infrared scanning, for instance, is a thermal imaging technology used to pinpoint locations with elevated temperatures. Identifying the presence of elevated temperatures could indicate that the equipment is malfunctioning – possibly by a loose electrical connection, which may cause a fire.

Instead of bringing in an equipment restoration company after an incident has occurred, when you are under time constraints to fix a problem, performing preventive reconditioning before a loss occurs allows you the extra time to locate the right partner to work with, and keep your wind turbines operational. Once you find a trusted partner to perform the preventive reconditioning, they can provide an overall assessment and evaluation of the equipment's current condition. From this initial analysis, they can offer suggestions for improvements to the equipment operations and performance.

It is much less stressful and, ultimately, less costly to work with a maintenance partner to develop a schedule, which can be based on either calendar dates or usage. Because preventive reconditioning occurs while the equipment is operational, you have the flexibility to head off trouble in a way that will not interrupt production or affect operations.

Preventing vs. Reacting

Preventive reconditioning is an upfront investment that helps avoid repairs and asset failures, increasing the longevity of a turbine. On the other hand, reactive maintenance means that a turbine operates until it breaks. When that happens, repairs are needed immediately to bring the turbine back to operational condition. Generally, no planned maintenance is conducted between operating failures. While this may initially seem like the best option in terms of cost-savings, it can actually be the more expensive route when the equipment does fail.

In addition to the costs of repairing the equipment, other costs associated with reacting to an incident include lost production and business interruption. By not being able to predict a breakdown, you also cannot prepare for the repairs in terms of labor and parts, which ends up incurring even greater costs.

An upfront investment in your equipment is an investment in the improvements in your operational costs and processes, including but not limited to increased productivity, reduced equipment and labor downtime and a reduction in unexpected replacement costs.

Scott Carroll is the Global Sales Director for AREPA located in the Chicago, Ill. office. Scott has over 20 years' experience in disaster recovery and specialty cleaning projects. For over 35 years, AREPA has provided comprehensive recovery solutions following property loss to critical equipment and systems. AREPA provides turnkey rapid response to insurance claims professionals, risk managers, and corporations around the world.

AREPA /// www.arepa.com

Next-generation blade pitch technology

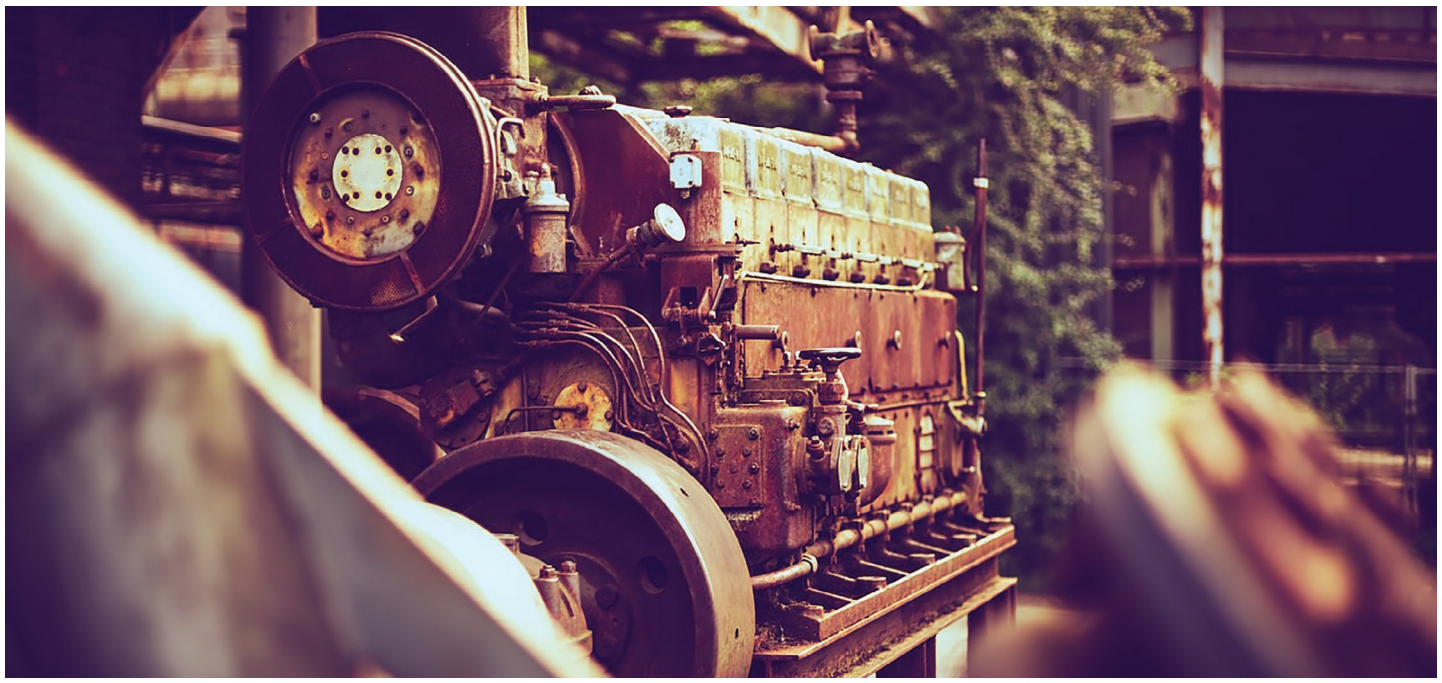
Mita-Teknik launched its blade pitch system for onshore and offshore wind turbines. The new Mita Pitch System has been designed to effectively minimize O&M costs, reduce downtime, and improve productivity. The Mita Pitch System is a flexible pitch solution for turbines up to 12MW, with a design life of 30 years. It has been designed to maximize the availability and performance of wind turbines, while applying minimum loads to the structure. High availability is ensured by fast commissioning, a Built-In-Self-Test scheme for on-the-fly evaluation, simple maintenance procedures, and digitalization. The system features a modular pitch design with integrated drives, based on various standardized sizes of Hub Units, Blade Units, brushless PM Servo Motors, Asynchronous Servo Motors as well as energy storage based on either ultracapacitors or long life VRLA batteries. It is designed as an open system allowing OEMs to integrate their own software in the hub controller. This robust system has been designed to sustain the harsh environment of the rotating wind turbine hubs and can deal with operating temperatures ranging from -22°F to 140°F (-30°C to 60°C), as well as continuous vibrations and forces. By removing the traditional "cabinet in cabinet" approach, Mita-Teknik was able to maximize the system reliability, avoiding high ambient temperatures inside the cabinet. The Mita Pitch System offers innovative features such as ruggedized IP65 seawater resistant aluminum housings, smart energy management extending component service life, as well as touchless blade angle monitoring.

Mita-Teknik /// www.mita-teknik.com

Power price forecasting service

Wood has launched a new power price forecasting (PPF) service to help provide customers with greater certainty around the financial return they can expect from investment in renewable energy projects. Wood's new PPF service will provide customers with clarity on real-time electricity costs, plus an ability to simulate future costs based on a range of different scenarios. This dynamic solution enables them to see where the investment risks and potential upside opportunities could lie throughout the lifecycle of a renewable project based on forecast electricity prices.

Wood /// www.woodplc.com



Innovation Removes Barriers to Wind in Remote Locations

by Debbie O'Hara

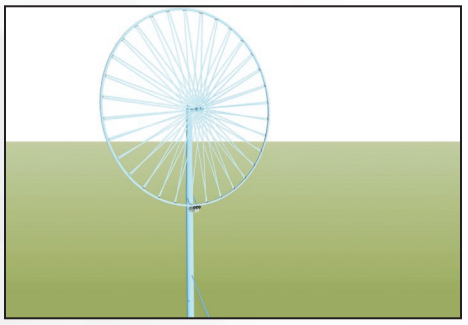
MANY OF US PICTURE ISLANDS AS PRISTINE environments, destinations for vacation travel, even paradise. The reality, however, is that thousands of islands and other remote communities are struggling to keep up with their basic energy needs. They rely on expensive, dirty, diesel fuel systems for their electricity. It would seem that renewable energy solutions would be ideal replacements for these diesel systems, especially in the Caribbean islands where sun and wind are abundant. Unfortunately, when it comes to taking advantage of cleaner technologies, the costs are prohibitive. Land is at a premium in these island nations, so large solar farms are not always viable. Wind offers an alternative, but the costs of transporting large turbine components to smaller islands - with limited port and roadway infrastructure - creates big challenges.

How can we ease this pain for small islands and other remote communities, and provide them with viable, accessible, and affordable energy that will drive economic growth, while ensuring that both their economies and communities are less vulnerable to severe weather events?

It's time to systematically eliminate the barriers for renewable wind energy. We have the knowledge and resources to create a solution that is:

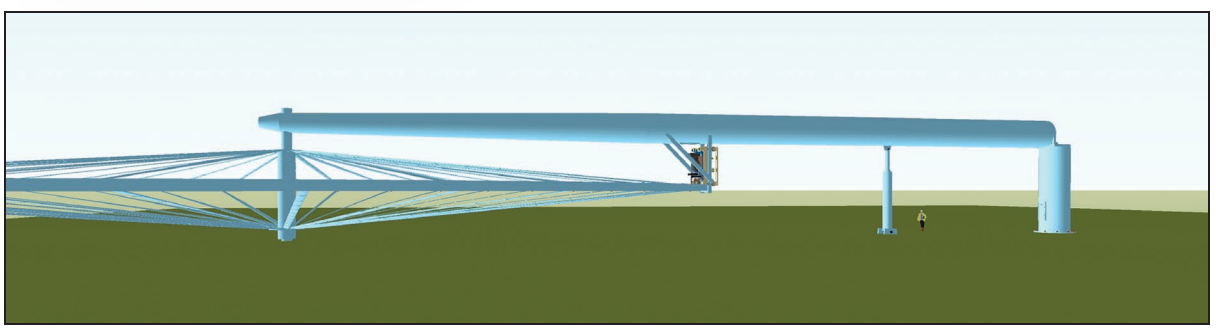
- Less expensive to purchase
- Less expensive to transport to an island or remote location
- Easier to transport on limited roadways, often with sharp twists and turns
- Not dependent on a large, expensive crane to erect
- Less expensive to operate and maintain

In order to achieve all of the above, we need to:



- Eliminate the expensive nacelle and gearbox
- Eliminate large blades and subsequent over-sized shipping charges
- Make all components transportable in standard shipping containers
- Make the turbine self-erecting
- Eliminate the need for oil changes and gearbox repairs

This is not an impossible task. Rather than trying to adapt current wind technology to reach these goals, however, maybe it would make more sense to borrow from a different industry. Amusement rides may seem like a farfetched idea when considering options for clean energy, but the engineering involved in, say, a Ferris wheel, isn't too



different from what we see out on a wind farm. In fact, the technology has been around for ages.

The mechanics are fairly straightforward: Large Ferris wheels use two rubber truck tires that press up against the rim to turn the wheel. Instead of utilizing a heavy and expensive nacelle and gearbox, it's possible to add a rim and utilize the drive tires. Additionally, we would eliminate the risk of fire and the expense associated with gearbox maintenance and replacement.

Rather than utilizing blades that stretch 100 feet, an alternative would be to use 20 five-foot blades (which would act as airfoils) on 64 spokes that extend from the hub to the rim. Each blade would individually pitch and customize their collective twist to current wind conditions, ultimately being more efficient than a larger blade with a permanent twist. An even greater advantage: all 1,280 blades can ship in a standard container.

In fact, all the components can be designed to ship in standard shipping containers. With the axle, rim segments, and tower segments all measuring less than 40 feet, transportation logistics are greatly simplified. Smaller sized components could be easily shipped to ports with limited access, to reach more remote locations lacking developed infrastructures.

Without the nacelle and gearbox, the turbine would be light enough to be lifted into place using a hydraulic cylinder. This cylinder would be a permanent installation that would offer an added advantage - it could be used to lower the turbine for maintenance, or in advance of severe weather.

Because this turbine model would be less expensive to purchase, install, and maintain, it would be an economically viable solution for stand-alone situations, ideal for distributed generation applications or mini/micro-grids. The rated capacity would be 800kW, but the more efficient design means the turbine would deliver a higher annual output of electricity. For example, in a wind regime of 7 m/s, the turbine would produce 3GW of electricity in a year's time.

The flexibility of this turbine model has the potential to harness the world's natural resources, making expensive diesel systems obsolete, and providing economic opportunity for remote communities in the Caribbean, Alaska, Canada, Sub-Saharan Africa, and any other place in the world hungry for affordable, accessible, and environmentally friendly energy.

Debbie O'Hara is Chief Marketing Officer at BarberWind Turbines, LLC, which offers low cost wind turbines for the mid-sized market.

BarberWind Turbines
/// barberwindturbines.com

Hi-visibility rainwear

The Pyramex ANSI-Rated Hi-Vis Rainwear line includes a rain jacket (RRWJ31 Series), pants (RRWP31 Series), bib pants (RRWB31Series), and raincoat (RRWC31 Series) and is designed to work with the technician's body as they maneuver through wet conditions. All four outerwear pieces are rated for ANSI Type R Class 3. Built tough, the Hi-Vis lime material is made from breathable polyester with a polyurethane coating to keep moisture out. Two-inch silver reflective material adorns arms, waist, and leg areas for appropriate 360° visibility at dawn, day, dusk, or night. The pieces are constructed with care and quality with sewn and sealed waterproof seams. The rain jacket and coat feature a zipper front closure with a metal button storm flap and an attached drawstring hood which stows away in the collar. The jacket and coat also have a cape back and underarm vents, elastic cuffs, and slash pockets on the front for easy access. The raincoat has a vented bottom for maximum breathability. The pants and bib pants feature metal take up snaps at the bottom of the pant legs for easy wear over boots and work shoes. The pants and bib pants are designed to allow for maximum movement without any hinderance. They are also built for comfort with an elastic waistband. The bib pants have heavy-duty material at the knees for extra durability and removable kneepads as well as adjustable suspenders for a custom fit. All rainwear pieces are available in sizes small through 5XL.

Pyramex Safety /// www.pyramexsafety.com

Fully integrated, loop-powered displacement transmitter

Brüel & Kjær Vibro (B&K Vibro) announces the release of the DT-12x series of transmitters. These fully integrated, loop-powered displacement transmitters offer a unique streamlined solution for shaft displacement and vibration monitoring capability for a wide range of industrial machines. The DT-12x series are fully integrated transmitters which means the driver (oscillator) and signal conditioning electronics (vibration monitor) are built directly into the sensor. This simplifies installation by eliminating the need and space requirements for a driver, vibration monitor, and eventually a protective housing. Due to this design, the transmitter can directly be connected to a DCS or PLC using it's standardized 4-20mA output. The transmitter is loop-powered, so its 4-20mA signal is not affected by long wiring distances, voltage drops, or noise. This simplifies installation when connecting to a DCS or PLC, since only two wires have to be connected in the current loop. The DT-12x series displacements transmitters are versatile from a monitoring perspective. In addition to the 4-20mA outputs, there are also buffered output wires for transferring voltage signals to portable monitoring instruments for analysis and data storage. The transmitters are also built for harsh industrial environments. The DT-12x series of displacement transmitters are available in three different mounting configurations.

Brüel & Kjær Vibro
/// www.bkvibro.com

Yaw Solutions

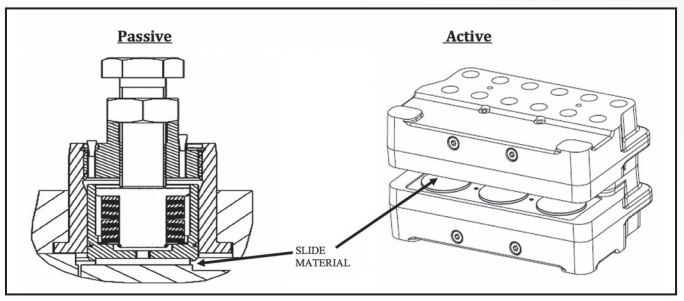
by Bruce Hammett and Denny McKissic

One of the most prevalent problems found across all Wind Turbine platforms happens in the yaw system design components. Further, from a point of view of the neighborhood community, noise emitting from the troublesome Yaw system (commonly referred to as "fog-horning") is a deterrent to both community relations and to new development. This article will review several of the components that are known to be troublesome from the design, repair, and obsolescent issues.

The turbine computer algorithm controlling the positioning into the wind (or out) initiates yawing dozens of times per hour. The nacelle-mounted electrical gear Yaw motors engage simultaneously, forcing the nacelle left or right, then disengage upon signal. The platform rotates on a steel disk fixed to the tower; the bearing is a simple set of friction discs or pads placed between the nacelle and the steel ring surfaces, acting as a movement deterrent and brake.

The most common turbine yaw systems use components that provide a basic slip-type deterrent pad and/or a clamp-brake design to control the movement of the turbine yaw. Most yaw motors have an integrated electrical brake.

Two Yaw-slip deterrent typical types:



The most popular slide system is the passive. It includes a system of skid-disks, or pucks, in conjunction with a brass piston. Springs are housed internal to the piston, creating a defined but adjustable pressure downward to the steel that limits Nacelle movement caused by side-winds. Service technicians must regularly monitor the disc thickness and adjust the force onto the yaw-disc.

Turbines are located in all environments; local conditions including ambient air temperatures, moisture content, altitudes, and even simple maintenance practices, can become detrimental to reliable operation. The friction system components and associated electro-mechanical components are negatively affected by these conditions, causing operational problems in several areas.

SLIDE material

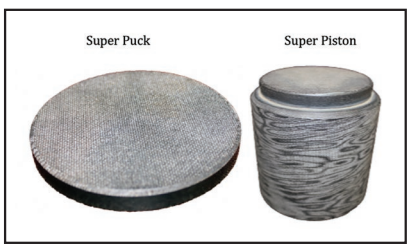
All Yaw systems are prone to vibration and noise (including the disturbing fog-horning noise), maintenance, and the skid-materials choice. Whether pad or puck, the various materials used to provide the slip-deterrent and yaw braking devices have undergone great research.

One model of turbine platform uses the passive design. This design requires multiple points of consistent downforce, exerted through spring pressure and delivered through placed brass pistons, which push onto and slide material referred to as slide pucks. There are 12 or 18 pistons per turbine, each requiring regular observation and maintenance. Experience with the piston-to-yaw ring interface has proven to have several inherent original equipment design issues, all needing solutions. Similar applications on other turbines use similar methods of implementation.

SLIDE-PUCK replacement

The frequency of replacement of the slide puck is determined by the user through experience, and is dependent on local conditions. During normal operation, the combination of puck and piston can also cause "fog horning" due to the sound of non-lubricated metal to metal contact. Turbines require either 12 or 18 pucks to operate.

Several OEM and 3rd party solutions have been offered with varied results. In 2016, testing began on a new composite alternative: a self-lubricating material surface called the "Super Puck" (in collaboration with several operators across diverse environmental locations). Super puck was subjected to long-term testing in various environments, under several corporate nationwide maintenance protocols. An extension of the Super Puck is the Super Piston. By using the same proprietary material, the one-piece Super Piston, integrated with the puck, replaces the brass piston; this offers extended life with the additional benefit of reducing the brass-piston generated noise and maintenance headaches.



YAW PISTON SPRING maintenance

Periodic maintenance or noisy operation may dictate a close inspection of the OEM puck, which requires extraction of the brass piston. Replacement with new springs should be an inherent part of the repair operation whenever new pad sets and holders or pistons are required. Excessive wear (as found on a worn-out brake pad) can expose the piston itself to contact directly with the steel yaw ring. This causes expansion of the brass outside of the sleeve hole onto the steel yaw ring surface. "Mushrooming" exposes the steel ring to resurfacing, which makes the extraction of the damaged piston extremely difficult and awkward; this situation may need several field-technician special techniques such as grinding and using hydraulic tools to remove the brass piston. To remove the damaged brass piston, a specialty tool system "Kit" has been developed with specifically designed hardware to ease the removal of a stuck/seized Brass piston.

Piston Extraction Kit

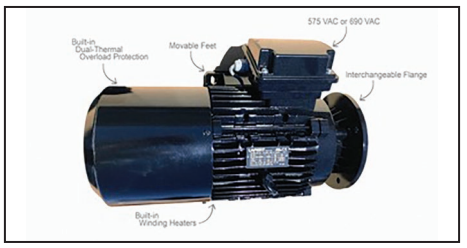
YAW PLATE repair

If the tower fixed steel yaw ting has experienced damage, a number of repair methods can be applied, including a special puck to resurface and repair the damage without requiring removal from the tower.

UNIVERSAL YAW MOTOR

Each turbine within a fleet has the unfortunate prospect of having been delivered with a slightly different yaw motor-gear design of the adjacent platform, despite a nearly identical electro-mechanical operation. These differences may include voltage, mechanical connection placement, thermistor counts, bearing and such. This problem can be solved with a new, universal yaw motor to meet the variable needs for the various OEM platforms.

With the proper tools, and service by knowledgeable and experienced technicians, keeping every turbine's yaw system operating smoothly is the solution to avoiding bigger problems down the line.



Bruce Hammett is President and CEO of WECS Renewables, and Denny McKissic is the National O&M Account manager. WECS is a distributor of components designed to extend the life of wind turbines. WECS works with vendors worldwide to provide factory replacement components, OEM alternatives, updates, and obsolescence alternatives.

WECS Renewables
/// wecsrenewables.com

Smart automation not only increases turbine efficiency, but also helps to structure and connect the ever-increasing masses of data involved.

Maintenance Advantage:

Make your condition monitoring data work for you

WITH AN AGING FLEET COMES INCREASED EXPENSES, unexpected failures, and unplanned downtime. Regain control over your turbines with CMS and start planning for your tomorrow.

Condition monitoring systems (CMS) equip turbines with sensors that continuously monitor vibrations across the drivetrain at key locations from the main bearing to the generator. As components begin to wear and degrade, very specific patterns appear within the vibrations which are acquired by the sensors and identified by the CMS unit. In near real-time, these patterns are analysed to localize the defect, diagnose the issue, and assess the severity. With this knowledge, operators can then plan targeted maintenance activities around an optimal schedule (low wind speeds, multiple repairs, etc.), resulting in reduced O&M spending and a quick return on investment. "Bachmann also has products that are tailor-made for wind turbines and wind farms. They are easy to retrofit, control integrated and user-friendly. The knowledge from 20 years of monitoring wind turbines in Europe is combined in our wind power SCADA, atvise® visualisations and in the highly robust hardware", says Brian Hill, General Manager of Bachmann's North American office.

THE COMPETITIVE EDGE: BACHMANN'S PLC INTEGRATED CMS

Utilizing the existing turbine controller to operate the CMS unit doesn't only save money by making use of the existing controller and tower communication, but it provides a future oriented solution. Fully integrated CMS opens the door to smart automation driven by machine health and resulting in optimal yield. With system security at the core of Bachmann's M1 platform, this means safe and reliable results for years to come. "With a capable Bachmann controller already in place, it becomes very cost effective to install a Bachmann integrated CMS with only a few new pieces of hardware. Saving cost by not needing additional networking infrastructure when compared to traditional stand-alone systems," emphasizes Hill. Stand-alone CMS options are also available for wind turbines not controlled by a Bachmann M1 system. "Depending on the design, an integrated installation can be aimed for here as well as a stand-alone solution," adds Brian Hill. ◆

There is a 30 per cent cost difference between being able to use all the available data and not having it at your disposal.

bachmann.

The Security You Need, the Access You Want

Flexible and secure SCADA solutions by Bachmann

Is your fleet at risk for cyber-attacks?

Wind power is rapidly growing and with it comes increased cyber-security issues. While legacy SCADA systems can provide the access owners want, they carry inherent security vulnerabilities. Upgrading to a new SCADA system doesn't mean you have to settle for restricted access.

Bachmann's **W**ind **P**ower **S**CADA (**WPS**) solution delivers layer-based security, including end-to-end encryption (SSL/TLS), continuous security logging and user-defined access levels.

Security uncompromising

Cutting edge communication based on international standards, such as OPC UA and IEC 61400-25, WPS provides safe and reliable web-based access to all of your turbine data from any smart device, pc, or tablet. Gain access to mixed fleets with a single flexible SCADA platform and create the visualization specific to your business' needs.

Contact us today
Bachmann electronic Corp.
Charlestown, MA 02129, USA
T: +1 617 5803 301
office.boston@bachmann.info

Come see us at
AWEA Wind Project O&M and Safety Conference
February 26–27, 2020
Coronado, CA, Booth 129

www.bachmann.info

Tips from a Supply Chain Guru

by Kris Van Dalen

With the labor market tightening, companies need to create more efficiencies. Whether it's ensuring a worker has the optimal tools to reduce cycle time, or adding wearable technology to alert when there's a stoppage on the production line, every step in the supply chain has an opportunity to be leveraged.

What does this mean for companies? Simply put, the push for productivity has more to do with existing resources than new technologies. Here are three questions to help you to get the most out of your supply chain.

What does it mean to leverage a supply chain?

Leveraging the supply chain is about core competencies and expertise. Every successful company in the world was created to address a specific need in the market.

Over the last couple of decades, much of the focus has been about "cost savings" in the procurement process. In more recent years, that has extended beyond piece price to the concept of TCO.

That's all well and good, but simply improving the efficiency around product acquisition and consumption isn't leveraging the supply chain. That all can be accomplished through outsourcing labor.

True supply chain leverage is bringing something to your business from your supply base that is unique – a level of collaboration and achievement that neither organization could accomplish on its own.

Given the changing philosophies around product acquisition, suppliers that want to be successful in the long run need to bring a level of expertise that sets them apart from the competition; otherwise, they're just labor and a commodity supplier.

Try to look at the impact the supply chain partner can have on the customer's customers. How is the supplier affecting quality, delivery, and the overall customer experience? When that impact is positive, leverage is occurring in supply chain utilization.

Companies can use the supply chain to increase revenue in a multitude of ways - starting at the most basic leverage point of productivity and output, all the way to improved quality and elevated market perception and status. Increasing capacity through supply chain integration can be a revenue and profit differentiator for high-output operations.

Some organizations heavily publicize their supply chain relationships to sell their progressive and innovative approach, in an effort to improve competitiveness and win business from their customer base. Whatever the purpose, the supply chain leverage points are vast, and the importance of finding the right partners for what's important to your organization can't be overstated.

One executive truly believed that his supply chain, the expertise each partner brought to the business, was the differentiator in his company's ability to be competitive and produce quality products on time for their customers. He viewed it as his supply chain competing against his competitors' supply chains. For him, the end product is kind of like the scorecard in a larger competition of supply chains.

How can a company change the culture?

Culture is definitely a dark horse variable in the success of supply chain integration, and can make a big impact on the enterprise. Typically, the more vertically integrated and self-sufficient the organization, the more challenging it is for them to relinquish control of non-core processes and competencies.

That said, it's important to understand that it's not about changing the culture; it's about organizational awareness. What does your company do really well? What fundamental principles have made it successful? How can you find supplier partners who will support those principles, but also provide complementary expertise and services to enhance the enterprise?

At some point, every organization – large or small, public or private – operates with constraints. They have to make choices about where to invest and allocate resources.

> ***"To put it simply, don't hesitate to engage supply chain partners interested in making you look good."***

When you collaborate with your supply base to reduce costs, it unlocks resources for investing in business improvements. When they introduce ideas to reduce delays and touches, that's time you can redirect toward production and customer service. A strategic supply chain integration doesn't change your culture – it strengthens it.

Do you have to already be perfect?

For some supply chain professionals, just the idea of change is paralyzing. They look at any change as giving up control. They'll delay it with common refrains like, "We aren't ready," or "Let us fix this first."

Because they believe they are solely responsible for the changes, they end up leaving a wealth of outside expertise and resources on the table. The mistake is in thinking of the supply chain as something to be "managed," rather leveraged through collaboration. When you find the right partners, bring them in and show them your dirt, your scars, and your deficiencies, but also share what's important.

The best of the best will be your agent for change. They will improve the speed at which you can realize the benefits of their involvement. They will measure what's important, and help you sell the benefits to stakeholders in your company. To put it simply, don't hesitate to engage supply chain partners interested in making you look good.

Kris Van Dalen is Fastenal's Vice President of Onsite Solutions. He has been with Fastenal for 15 years and has lead teams in the installation of hundreds of onsite solutions.

Fastenal /// www.fastenal.com

With point-of-use vending, workers can get the items they need without losing time due to walking and waiting.

Safety & Fall Protection Equipment

According to the National Safety Council, falls are one of the leading causes of deaths in the workplace. Perhaps more than any other type of workers out there, those who erect and maintain wind turbines are exposed to some of the most serious, and potentially fatal, fall hazards. With many turbines reaching heights of well over 100 feet tall, wind farms are only growing upwards in many cases, and exposure to high winds can make work at high elevations even more hazardous. Here we highlight some of the latest in safety and fall protection equipment—a must for the growing industry.

SEE AD ON PAGE 25

Blaklader LLC

Product: 1636 FR work pants

Application: Work pants for the renewable energy sector

Description: Blaklader FR gear is tested and compliant with NFPA 70E for wearers' protection. 1636 workpants are HRC 2 compliant, with an 11 calories/cm² arc rating. 88% cotton, 12% polyamide, twill flame retardant 10 oz, Arc Rating 330 g/m²

Key Features:

- Built in utility pockets;
- Built in Kneepad pockets;
- Triple stitched seams;
- Bellowed and lined back pockets;
- Knee protection pockets with two placement level options.

www.blaklader.com

SEE AD ON PAGE 24

TeSuCon Technical Support & Consultancy

Product: The Evacuator

Application: Fireproof collective escapes and emergency descent solution

Description: Designed to save the lives of those working at altitudes ranging up to 984ft (300m), the Evacuator is a fast, simple, and easy-to-use (click and go) fireproof collective escape and emergency descent solution. Fireproof units are customized for each turbine model and can be installed inside or outside of the nacelle, onshore or offshore. Emergency descent is fully-automatic and mechanically controlled at a speed of 3.3ft/sec (1m/sec), without use of electricity. Units are compact and easy to maintain.

Key Features:

- Fireproof units are 3182°F (1750°C) for 30 minutes or 2192°F (1200°C) for 90 minutes;
- Suitable for onshore or offshore applications;
- Certified in compliance with ANSI Z359, CSA Z259

www.tesucon.com

Hi-Line Utility Supply Co.

Product: Hi-Grip Xtreme Glove Protectors

Description: The Hi-Grip Xtreme glove protectors are now Arc rated to ASTM F2675 / F2675M-19 standards: Up to 28 cal/cm2 and ANSI cut-resistance Level 2 on the entire glove. The Hi-Grip Xtremes feature a full, silicone grip palm providing supreme control with a Kevlar underlay and Kevlar stitching for maximum strength seams. The secure straps have been upgraded to reinforced leather in addition to the all leather cuff. New sizes and mitt-style protectors are available with an improved thumb design that provides greater dexterity. They have been field tested for durability and include a wear guard on top of the hand for extra protection.

www.hilineco.com

Power Climber Wind

Product: IBEX

Application: Turbine climb assist

Description: The IBEX climb assist from Power Climber Wind sets the standard for performance, safety, and ease of installation in any new or existing turbine. Its intelligent control system delivers a comfortable and responsive climb. Using a continuous closed feedback loop, the IBEX instantaneously adjusts to changes in climbing speed or direction, allowing for a safe, smooth, and confident climb. With more than 70 years of performing productively at height, Power Climber Wind designs products that, like IBEX, drive low total cost of ownership and user satisfaction.

www.powerclimberwind.com

3S Lift

Product: Climb Auto System CF-120E

Application: Ladder mounted technician lift for wind turbine generators

Description: The Climb Auto System is wind's next Climb Assist, improving safety and reducing the cost of ownership. The Climb Auto System is a single technician ladder-mounted lift, retrofittable to any new or existing wind turbine ladder, that completely removes the physical and mental stress of climbing, allowing technicians to keep their mind on the job, not on the climb. With over 21,000 units installed globally and certifications from CE, UL, ANSI, OSHA and more, the Climb Auto System is a safe and cost effective way for technicians to ascend a tower.

www.3slift.com

FallTech

Product: FallTech for Tools

Application: Dropped object prevention

Description: Falltech for Tools is a complete ANSI/ISEA 121-2018 tested and compliant range of solutions that feature tool attachments, tool tethers, premium self-fusing no-heat tool tape, speed clip attachment tethers, a wrist anchor attachment system, and hard hat tethers. FallTech for Tools is designed to accommodate the most commonly used tools in construction trades, general industry, oil and gas, utilities, and other industries. These include tools with captive eyes, open and closed handle tools, open and closed handle tools with triggers, including impact hammers, wrenches, screw drivers, spud wrenches, power tools, and many others.

www.falltech.com

Checkmate by PSG

Product: Xplorer Fall Protection Harness

Application: Fall protection

Description: Comfortable harness featuring a rear D ring for multiple loadings with a small amount of vertical adjustment that stops strap migration, large front ring for multiple attachments, key-way entry exit buckle with Velcro security wrap for a safe final connection. Hardware is ergonomically suited to reduce wear on webbing, for easy connections and critical pivot points for greater articulation. Unique curved webbing that follows the contours of the body for a closer fit and innovative sub-pelvic assembly for support and comfort when suspended. Meets EN 361:2002, EN12277:2007 Type A, EN358:2000, ANSI Z359.11-2014.

www.checkmateuk.com

SEE AD ON PAGE 15

Sterling Rope Company, Inc.

Product: Raise and Rescue Elite

Application: A pre-rigged mechanical advantage system designed for simple and efficient victim raising and multidirectional transfers.

Description: When paired with the PDQ2 escape system, the Raise and Rescue Elite makes for a light, compact rescue package. The mechanical progress capture feature allows for secure raising and simple operation, and the mesh sleeve surrounding the 6mm cord prevents tangling during storage and deployment. Two wire anchor slings allow the rescuer to create an anchor around ladder supports or rails, or structural members, and the HollowBlock2 allows for rescue from fall protection lanyards or longer distance hauling with resets. Kit Components: Mini Haul System, 2 Wire Slings, 19" HollowBlock2, and 2 Osprey Autolock Carabiners.

Key Features:

- Preassembled haul kit, ready to use;
- Progress capture feature allows for secure raising;
- Simple and efficient system for raising a disabled worker from lanyards or cable grab;
- Steel anchor slings allow user to create a secure anchor where needed.

www.sterlingrope.com

SEE AD ON PAGE 9

SKYLOTEC North America, LP

Product: SKYLOTEC CLAW

Application: Ladder Climbing Safety

Description: The new SKYLOTEC CLAW vertical fall arrest cable sleeve is designed to fit 3/8" and 5/16" diameter wire rope and travels smoothly up and down while providing fall arrest when needed. Weighing only 2.2lbs, the stainless steel CLAW is durable and incorporates redundant safety features reducing the risk of improper installation. The CLAW is independently tested to meet ANSI Z359.16, ANSI A14.3-08, CSA 2259.2.5-17, and OSHA requirements.

Key Features:

- Smooth travel up and down the vertical system;
- Replaceable shock absorbing pack;
- Anti-gravity locking system;
- Combinable with all types of chest D-rings;
- Two handed operation for increased safety.

www.skylotec.com

Motion Industries

Product: Miller AirCore Wind Energy Harness

Application: Designed specifically for wind turbine construction and maintenance

Description: The lightweight design is customized for workers building and servicing wind turbines while reducing fatigue for all-day endurance. This new line of harnesses from Honeywell keeps workers comfortable and safe while increasing productivity.

www.motionindustries.com

Ropes Park Equipment

Product: Elephant Hub and Phoenix Hub

Application: Rescue and evacuation

Description: The MARK Elephant Hub and Phoenix Hub lifting and lower device is able to lift the personnel upward to unweight their lanyard by easily turning the wheel. After unclipping the lanyard, the person can be lowered to the ground with automatic speed limiting. The participant is never unattached from a safety system during this procedure.

www.ropesparkequipment.com

THRIVE Workwear

Product: THRIVE Workwear - apparel

Application: Wind Industry/FR Apparel

Description: Thrive Workwear's protective work apparel has been providing solutions to the wind industry for over 10 years. Their line-up of clothing includes Flame Resistant work pants, FR work shirts, FR base layers, and FR outerwear designed specifically for wind technicians and construction workers. Their work pants feature full-time knee protection built-in with patented SQUISH pad technology.

www.thriveworkwear.com

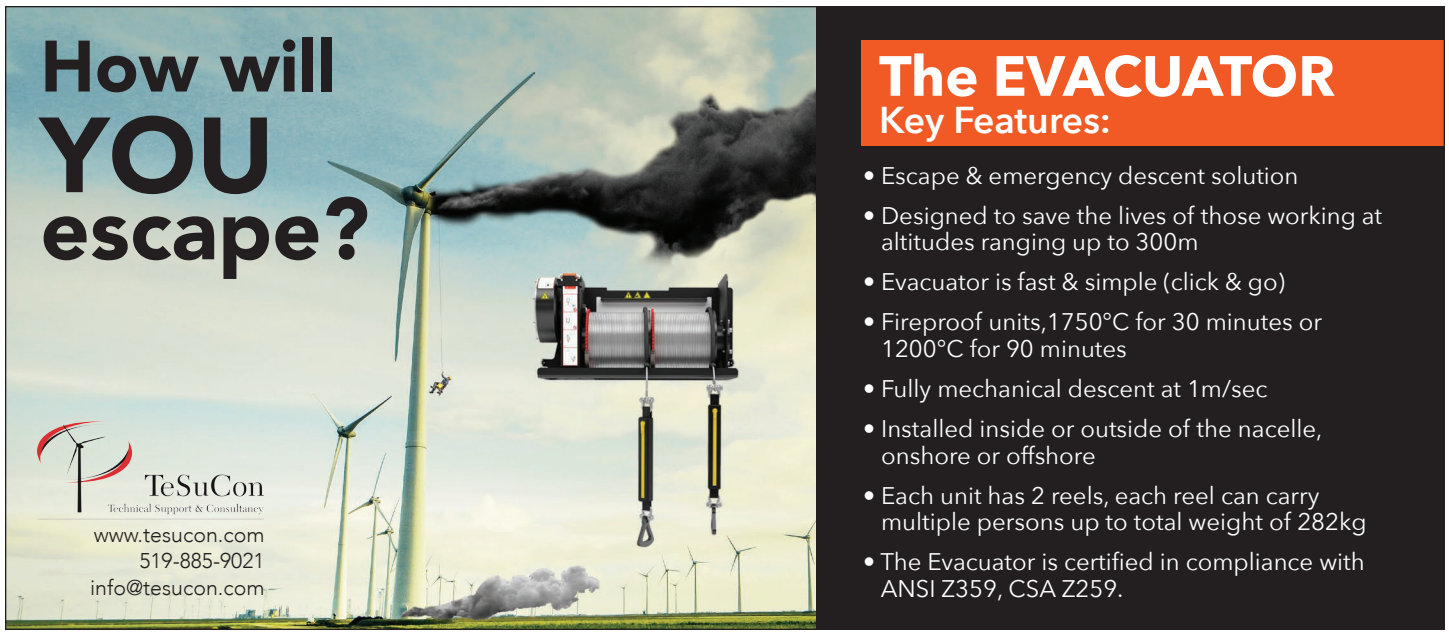
Skysaver Rescue, Ltd.

Product: IIE Portable Kit – Incapacitated Injured Evacuation Kit

Application: Evacuation of injured or incapacitated workers

Description: A single worker, equipped with a SkySaver IIE Portable Kit, can help lower the injured or incapacitated worker to safety. The easy-to-use SkySaver IIE Portable Kit, which includes a controlled descent device (CDD), portable anchoring accessories, and an ergonomically designed harness, is built to evacuate workers as high as 80m above ground level, within three minutes.

www.skysaver.com



Petzl America

Product: VOLT Harness

Application: Fall arrest, work positioning, and work inside wind turbine towers

Description: VOLT harnesses are easy to put on with the FAST LT automatic buckles. A wide, semi-rigid waistbelt provides excellent support. The VOLT WIND harnesses have dorsal wear protectors to reduce wear on the straps when moving inside a turbine tower. The new harness line is available March 2020.

www.petzl.com

Training

The wind energy industry is developing more projects than ever and needs a skilled and qualified workforce to produce America's clean wind power. Workers and technicians may need specialized training to succeed and advance in their careers. Check out some of the training opportunities, professional certifications, workshops, and events offered across the country and online.

SEE AD ON PAGE 18

Abaris Training Resources, Inc.

Training program: Composite Windblade Repair (Basic and Advanced)

Hours: 36 hours each

Classroom/Online/Onsite: Classroom and workshop, at Abaris' facility or client's

Number of participants: 12

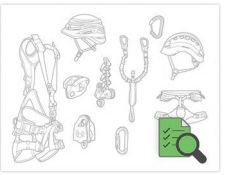
Certifications: Abaris Certificate (Qualifies student for ACMA Certification)

Course description: Two courses; basic (R-5) and advanced (R-15) composite windblade repair. Designed for field technicians, inspectors, supervisors, and others responsible for performing structural repairs to blades and nacelles. Students are challenged with progressively more complex repair scenarios from skin and core repairs in the basic course to tips and carbon spar repairs in the advanced course. Adapting aerospace methods and techniques, they teach students how to regain structural fiber axial loads through the damaged area while maintaining a critical aerodynamic surface. The R-5 basic course is a prerequisite to the R-15 advanced course.

Key Features:

- These courses promote teamwork utilizing multi-person teams to perform repairs as if in the field;
- Student teams are introduced to hot-bond repair equipment and proper field use procedures;
- Learn how to manufacture tooling to aide in maintaining aerodynamic critical surfaces;
- Custom courses available for working groups or teams.

www.abaris.com



Petzl America

Training program: PPE Competent Person

Hours: 3 days

Location: Onsite

Number of participants: 12

Certifications: PPE Competent Person Certificate

Course description: Learn to competently examine work-at-height personal protective equipment using the Petzl protocol and to create an effective PPE-management system. The course covers: Risk assessment, associated decision making and potential hazards associated with the use of PPE for protection against falls from height; Legislation and current requirements regarding the management of PPE; Necessary tools and work environment to efficiently perform PPE examination; General principles and uses of PPE; Employer and PPE inspector responsibilities; Understanding a technical notice; Principal actions of the examiner: maintenance, returns under warranty, removal of products from service, etc.

www.petzlsolutions.com

TEAM-1 Academy Inc.

Training Program: Working/Rescue at Heights - Wind Turbine Series

Hours: 8 - 16 hours

Classroom/Online: On their site, or on client's site

Number of Participants: 4

Certifications: GWO (Global Wind Organization), MOL WAH

Course Description: TEAM-1 Academy provides safety and rescue training in North America. This course is the global standard for getting wind turbine technicians trained to work safely and effectively using the on-site rescue/evacuation equipment.

www.team1academy.com

AWEA WIND PROJECT O&M AND SAFETY CONFERENCE

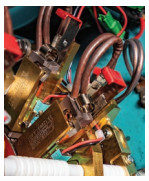
February 26th-27th, 2020
Hotel Del Coronado
San Diego, CA

www.awea.org

In the United States, there are now over 56,000 wind turbines with a combined capacity of 100GW of wind energy in the ground and 22GW expected offshore by 2030. This impressive growth, coupled with leaps in technology, has renewable energy companies looking at their operating assets for profits. But what does operations look like in the 2020s? Larger turbines, advances in storage and predictive maintenance are the types of technology trends that have the potential, if done right, to create more efficiencies and more reliable energy. A successful wind project requires more than top-notch technology; its most important asset are the people who maintain the projects. Despite wind and solar technicians being the two fastest growing jobs in the country, the industry is struggling to meet the needs of a growing number of projects, many of which are coming off warranty. Owner operators are faced with the daunting task of meeting these needs on a tighter budget while continuing to keep the safety of their techs as the top priority. How can the industry practically leverage technology like digitalization, crane-less work, and drones to ensure the safety of their workers? What efforts are underway to properly prepare and train workers? This year's O&M and safety conference will focus on these important workforce issues for owner operators.

show in print

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



Carbon brushes and brush holders

Helwig Carbon is a manufacturer of carbon brushes, brush holders, and quick disconnect fittings for wind turbine generators. They offer complete wind generator upgrades for longer service life. They also make a wind pitch motor bearing protection kit designed to protect pitch motors from premature bearing failure.

Helwig Carbon Products, Inc.
www.helwigcarbon.com

Condition monitoring software

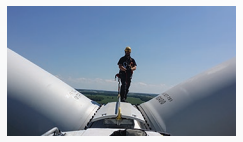
Bently Nevada's System 1 Wind software solution serves power generation assets, including delivery of solutions for more than 33,000 wind turbines, and System 1 Wind represents the next generation solution for reliability. Key features include data replication for cybersecure operation, OPC connectivity to other data systems, remote notifications, advanced plotting and trending capabilities, configurable workspaces and a modern user interface.

Bently Nevada
www.bently.com/wind

Cost-effective synthetic lubricants

AMSOIL synthetic lubricants use sophisticated additives to provide cost-effective choices for prolonging equipment life, reducing maintenance, and increasing performance. AMSOIL PTN 320 is approved with all gearbox manufacturers, including Winergy/ Flender, NGC, Gearbox Express, Moventas, and ZF, and their lubricants are used as a global factory run-in for Winergy, NGC, and ZF.

AMSOIL, Inc.
www.amsoilwind.com



Professional safety and rescue training

TEAM-1 Academy, Inc. specializes in training for Working at Heights/Fall Protection, Confined Space, HazMat/Spill Response, many forms of Rescue, and much more. They provide Professional Safety and Rescue Training, Equipment Sales + Service + Inspections, and Consulting Services for the renewable energy sector, utilities, energy sector, Fortune 500 companies, industry, construction, health care, fire services, police, EMS, military, MOE, government, and numerous others.

TEAM-1 Academy, Inc.
www.team1academy.com

Condition monitoring services

Using current technology and proven testing methodologies, Fluid life helps their customers reduce maintenance costs and improve equipment reliability. Offering a wide range of condition monitoring and reliability services backed by in-house labs, they deliver fluid analysis and reliability solutions accurately and on-time. At Fluid Life, their flexible approach is designed with their customers' individual needs in mind.

Fluid Life
www.fluidlife.com

Wind turbine slip rings

United Equipment Accessories manufactures low-maintenance, high-quality slip rings for OEM and aftermarket clients. These slip rings feature a new brush technology designed to provide long life in harsh environments. UEA's design engineers work with customers to custom build slip rings that meet their wind turbines' specifications. UEA can take current slip ring specs to design an interchangeable slip ring for wind turbines. Single brushes can be replaced at any time, removing the need to replace entire units or sets of brushes. UEA products maintain functionality in a wide range of electrical/ electronic circuits, environmental conditions, and rotational speeds.

United Equipment Accessories
www.uea-inc.com

Lightweight and comfortable helmet

Petzl helmets focus on all-day comfort for technicians and at-height workers. The STRATO is a lightweight and comfortable helmet due to the dual inner foam construction. The liner incorporates an EPP (expanded polypropylene) and EPS (expanded polystyrene) foam to reduce weight and achieve superb shock absorption. The helmet comes in vented and unvented versions, as well as hi-viz yellow and orange for increased visibility. The STRATO is an ANSI Z89.1 and Type I Class E rated helmet. Multiple accessories are compatible with the STRATO helmets; eye shields, headlamps, nape protector, hearing protection, and name tag holder for personalization.

Petzl America
www.petzl.com

Versatile and durable torque tester

SmartCheck is a newly launched small sized, versatile, and easy-to-use torque tester suitable for any workshop and service vehicle. Its compact dimensions coupled with its rotatable display and the ability to mount it horizontally or vertically, provides versatility in any location. With a splash-proof display and keypad, it can be operated through power supply or battery. SmartCheck quickly provides information on whether or not a torque wrench is within the prescribed tolerances or if it requires adjustment. The integrated visual and audible overload protection mechanism and impact resistant plastic housing ensure the durability associated with STAHLWILLE products.

STAHLWILLE
www.stahlwille-americas.com

Dependable renewable services

Wanzek offers a single source for wind services including construction, management, monitoring and maintenance of civil, crane, turbine, blade, substation and T-Line collection, as well as continuous improvement services. They specialize in comprehensive wind power maintenance services using a regional deployment strategy, helping their clients maximize their investments in renewable power generation. Wanzek Renewable Services provides a suite of self-performed maintenance and repair services to assist in meeting manufacturers' and owners' requirements for wind turbine, electrical collection system, substation and civil components of a wind power generation site. Wanzek Renewable Services has dedicated industry experienced leadership, regional managers, project managers and wind technicians. They deliver renewable services in a skilled and professional manner on a turnkey basis or by providing services as required. They have the regional locations, leadership, financial stability, training, equipment, and experience to be a valuable resource for the successful operation of a wind site.

Wanzek Construction
www.wanzek.com

Wind blade services

WindCom's AI inspection tool, Chronos, provides quality images without stopping the turbine. WindCom's on-line database and reporting system enable repairs for technically demanding damages. WindCom is fully committed to safety and provides services that ensure success.

WindCom
www.windcomservices.com

Tools for in-situ slip ring machining

The Mersen portable lathe for up-tower generator slip ring resurfacing is a quick method to bring a slip ring back into operational specification. By eliminating the need to swap out an affected slip ring, maintenance crews can reduce downtime associated with slip ring issues. Ground rings are known to be susceptible to wear in the brush track under certain operating conditions. Poor grounding ring surface conditions can also lead to erratic temperature readings in a wind turbine and affect other electrical components. The portable lathe allows technicians to resurface just the affected ground ring and bring the turbine back online. Advanced tools to verify slip ring surface condition after machining and the Total Indicate Runout (TIR) are also available. Mersen offers technical training and hands on up-tower training sessions to use these tools which help maintenance crews increase availability numbers at their respective wind farms.

Mersen
www.mersen.com

Customizable SCADA analytics

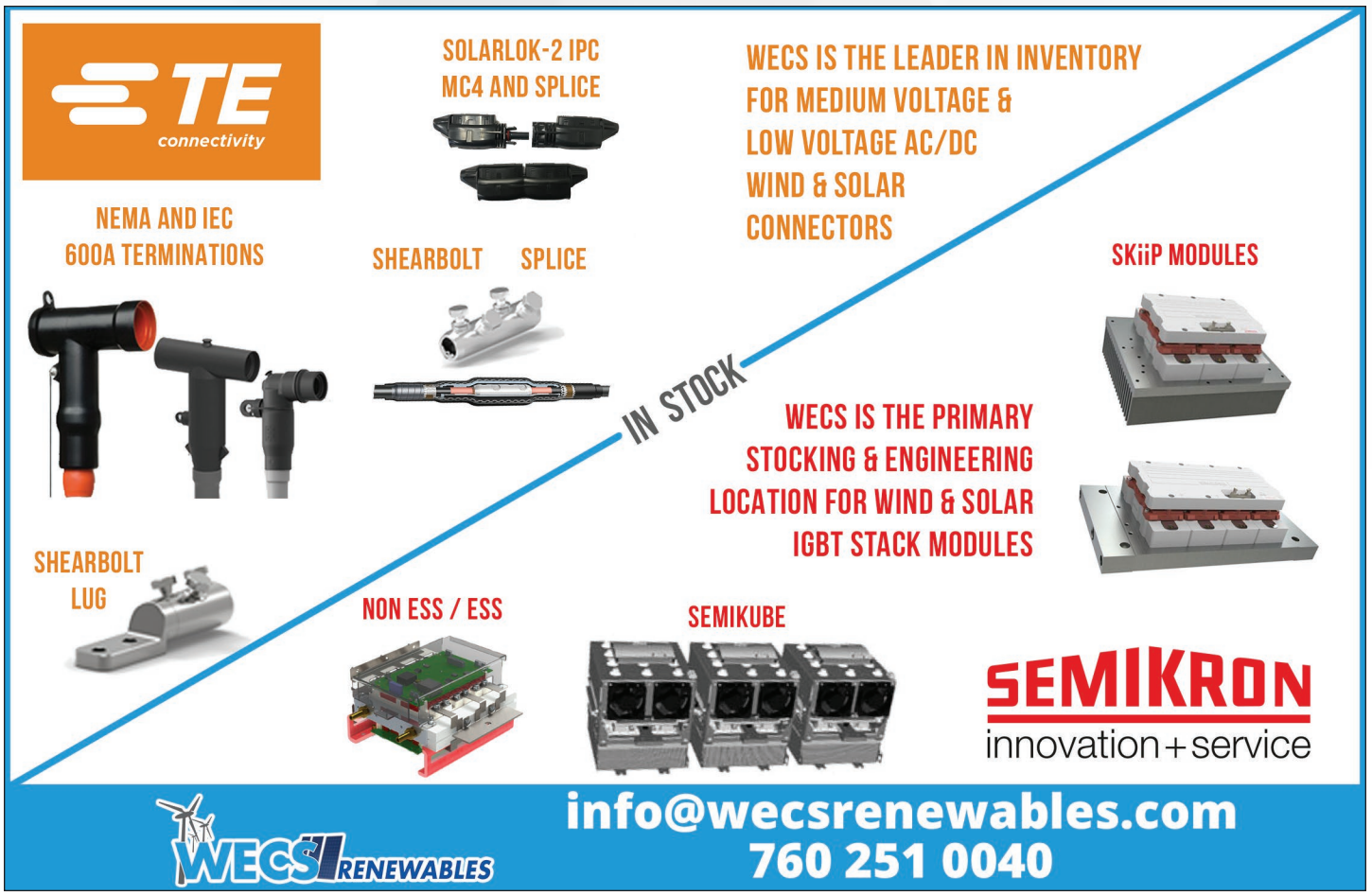
Bachmann's Wind Power SCADA is a customizable, easy-to-use solution that helps manage wind farms. Maximum flexibility ensures rapid implementation, ease of operation, and the possibility to expand the installation efficiently. Users can prioritize the information they want to see and achieve the security levels required to keep data and assets safe. Live data from different farms and turbines can be compared to support detailed analysis, including power curve, wind distribution, energy production, and switch counters in the form of graphs and/or tables. Bachmann's Wind Power SCADA is based on pure web technology, allowing for a wide range of devices; a browser is all that's needed to access secure, extensive, and detailed information on an entire fleet.

Bachmann Electronic
www.bachmann.info

Natural hazard monitoring and alerting

The Indji Watch solution partners with and delivers data from trusted and reliable sources to provide customers with accurate real-time weather alerts, and hourly-updating forecasts. Their Plan of Day dashboard helps to quickly identify rapidly changing weather at-a-glance, allowing users to be more proactive in mitigating potential impacts to the operation and employee safety. From a system-wide overview right down to an individual asset, Indji Watch will ensure that their customers have an accurate picture of what the weather will be doing in the near future, as well as analytic capabilities to what happened in the past.

Indji Watch
www.indjiwatch.com



Lightweight, comfortable, and durable safety harness

The new IGNITE SKYFIZZ has extremely durable front and rear anchorage points made of sturdy steel. Due to the individual adjustment, the central d-ring sits optimally on the body. The comfortable and breathable back and leg pads makes it suitable for distributing weight when work positioning and suspension. The double-wrapped and firmly sewn terminations secure loose webbing and prevent slippage. The IGNITE SKYFIZZ is independently tested to meet ANSI Z359.11, ANSI Z359.3 and CSA Z259.10.

SKYLOTEC
www.skylotec.com

Secure bolting solutions

Nord-Lock Group offers four key technologies: Nord-Lock original wedge-locking washers with wedge locking technology that makes unintentional loosening impossible, even when exposed to severe vibration and dynamic loads. Superbolt mechanical tensioners that can accurately and safely achieve high preloads while using only hand tools. Expander System pivot pin replacements that provide a permanent solution to lug wear eliminating the need for expensive welding and line boring, and Boltight hydraulic tensioning tools which can provide a low profile solution for space-restricted applications demanding high and accurate preloads, such as wind turbines.

Nord-Lock Group
www.nord-lock.com

Long lasting, self-lubricating piston system

The WECS Super Piston system is a solution to the repair materials needed to eliminate fog-horning and costly repetitive replacement of the pads and pistons systems required for the GE 1X platform nacelle yaw operations. The new design incorporates the function of the brass piston and various types of skid puck designs into one single long lasting, self-lubricating, non-vibrating light weight system that reduces the mean-time-to-replace and removes easily. A brass-piston removal kit is also available. Similar yaw brake mechanical systems are supported by other WECS Renewables designed pads. WECS also can provide solutions to replacement of IEC motor frames, cooling systems, IGBT systems specialty tools, and more for all turbine platforms. WECS supports all North American construction efforts with a wide array of MV and substation components also.

WECS Renewables
www.wecsrenewables.com

Environmentally conscious workwear

Blaklader has been manufacturing functional workwear since 1959. They produce their garments in environmentally safe factories with functionality, quality, design, and sustainability. Blaklader allows wearers to focus on the job, while being comfortable and environmentally friendly at the same time.

Blaklader
www.blaklader.com

High performance filters

Wanhe Filtration's low cost and high performance gearbox and hydraulic filters exceed OEM requirements. Veteran owned and operated.

Wahne Filtration
www.whfilter.com

Elevator safety and training

Highly trained elevator mechanics from the International Union of Elevator Constructors not only keep elevators running, they keep them running efficiently, and above all else, safely. They have over 28,000 trained professionals with over 8000 on the job hours and over 2500 classroom hours. Whether it's installation, repair, maintenance, or inspections they are ready to serve. As well as compliance and safety inspections and repairs across the US, their staff sits on the ASME A17.8 committee that writes the codes for these elevators.

Elevator Industry Work Preservation Fund
www.eiwpf.org

Tool tethering products

From tool lanyards and tie-off points to holsters and pouches, Dakota Riggers stocks a full selection of 3M tool tethering products. With the recent publication of the ANSI/SEA 121-2018 Dropped Objects Standard, fall protection for tools is quickly becoming a necessity in the wind industry in order to protect those working below.

Dakota Riggers
www.dakotariggers.com

2020 SOLAR BUYERS GUIDE

DIRECTORY

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AERIAL IMAGERY SOLAR REPORT
ALUMINUM EXTRUSION & METAL FABRICATION
BACKSHEETS
BALANCE-OF-SYSTEMS (BOS)
BATTERY | ENERGY STORAGE
BRACING & ANCHORING
CAPACITORS
CATHODIC PROTECTION
COMPONENTS | ELECTRICAL PROTECTION
CONSULTANTS | BUSINESS & ENVIRONMENTAL CONSULTANTS
CONTRACTORS | EPC
EDUCATION | RESEARCH DEVELOPMENT
ELECTRICAL WIRE, CABLE, & CONNECTORS
ENCLOSURES | COMBINER BOXES
ENERGY STORAGE SYSTEM
ENGINEERING | OPERATIONS & MAINTENANCE (O&M)
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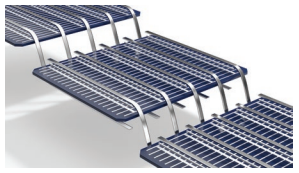
EQUIPMENT MANUFACTURER
FINANCIAL SERVICES
FLOATING SOLAR PLATFORM
FOUNDATIONS
GROUND COVER SEED
GROUND SCREWS | ANCHORS
INDUSTRIAL NETWORKING
INVERTERS
IPP
LEGAL SERVICES
LIGHT SPECTRUM SYSTEMS
MICROGRIDS
MICROINVERTERS
MODULES
ONLINE B2B EXCHANGE
PERFORMANCE MONITORING
PORTABLE SOLAR
POSITION SENSORS
POWER ENGINEERING & CONSULTING
PV DISTRIBUTORS
PV INSTALLERS
PV MANUFACTURERS & EQUIPMENT
PV WASHING SYSTEM
RACKING & MOUNTING SYSTEMS
RADIANT HEATING
RESEARCH & DEVELOPMENT | TESTING
ROLL FORMING
SAFETY
SEMICONDUCTORS
SITE ASSESSMENT & FORECASTING
SOFTWARE SUPPLIER
SOLAR COATINGS
SOLAR FASTENERS
SOLAR HOME ENERGY MONITOR
SOLAR INTEGRATION
SOLAR LIGHTING
SOLAR PILE DRIVER
SOLAR RADIOMETER CALIBRATION
SOLAR RIBBON
SOLAR SUPPORT STRUCTURES & CARPORT SYSTEMS
SOLAR THERMAL MANUFACTURING & EQUIPMENT
SOLAR THERMAL SYSTEMS
TESTING & CERTIFICATION | TESTING CHAMBERS
TOOLS
TRACKING SYSTEMS
TRANSFORMERS
TRANSPORTATION | LOGISTICS
UTILITY SCALE SOLAR | PV
VALVES
WIRE MANAGEMENT

Adhesives, Sealants, Tapes & Pastes

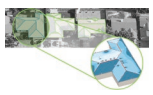


Henkel Corporation

Henkel provides electrically conductive adhesives (ECAs) and has a broad technology toolbox and ECA formulation expertise that spans well over 50 years. The company's photovoltaic ECAs and processes are designed to enable heterojunction, shingle, and other solar cell and module types. Henkel supplies unique technology, enabling high volume quality and providing deep process know-how. Henkel's capabilities translate into high quality and low cost per kilowatt-hour for both module OEMs and consumers.

www.henkel-adhesives.com

Aerial Imagery Solar Report



EagleView

EagleView Inform Advanced for solar delivers a detailed property report with precise and consistent measurements, 3D models, and solar access values through high-resolution aerial imagery, and computer vision so solar installation companies can gain operational efficiency, better satisfy customers, and grow their business.

www.eagleview.com

Aluminum Extrusion & Metal Fabrication

Alexandria Industries

Alexandria Industries provides customers with creative manufacturing solutions that make sense for their solar racking and mounting product needs. Its market experts, experienced engineers, and application technicians help develop next-generation solar systems, working to understand their customers' product's essential functions, how these interact and affect mating parts and the end-product solution.

www.alexandriaindustries.com

Hyundai Aluminum Americas, Inc.

Hyundai Aluminum Americas, Inc. is a subsidiary of The Aluko Group of Seoul, S. Korea. With 5 aluminum extrusion and fabrication facilities in S. Korea and Vietnam, they supply solar panel manufacturers with punched, mitre cut, anodized aluminum extruded panel frame sets. Their frames come with corner keys pre-inserted into the short frame, saving time and eliminating waste. Their new (2017) facility near Hanoi, Vietnam has available extrusion and fabrication capacity.

www.hyundaialuminumamericas.com

Backsheets

Griff Paper and Film

The Griff Network provides a wide variety of sheets, films, and polymers to support the creation of high quality solar panels. Their solar back-sheets have dielectric properties to act as an insulator for the power generating modules.

www.thegriffnetwork.com

Balance-of-Systems (BoS)

KATEK Memmingen GmbH

Climate-friendly and convenient refrigerators made by KATEK are now filled with the new R290 refrigerant and also include an interior LED lamp. They are fully programmable and the inside temperature, as well as the other configuration values, can be set by the user. Therefore, the appliances are suited to DC applications. Efficient use of energy can be guaranteed by the optimum electronic controls and speed regulation of the compressor.

www.steca.de

MORNINGSTAR PROFESSIONAL SERIES
World's Leading Solar Controllers & Inverters

Morningstar

TriStar MPPT Solar Controller is an advanced maximum power point tracking (MPPT) controller for larger off-grid PV energy systems up to 3kWp. A solution for solar installations around the globe and a choice for designers of systems where failure isn't an option. High peak efficiency for off-grid controllers: 99% (TS 150 model). Advanced thermal engineering eliminates cooling fans, unique in this power range. 30A, 45A, and 60A versions up to 150Voc. PWM versions also available.

www.morningstarcorp.com

shoals technologies group

Shoals Technologies Group

The BLA (Big Lead Assembly) takes all the guesswork out of wiring a solar field. Using Shoals' latest in-line fuse and wire manufacturing technology, they offer a site free of DC string combiners. The entire load is combined into a single pair of aluminum conductors running from the string combiner to the inverter. There's no need to trench for DC feeders or hang string combiner boxes. And when terminated with the BAC connector, the whole array is plug-&-play.

www.shoals.com

SOLAR BOS

SolarBOS

SolarBOS offers Balance-of-System solutions for photovoltaic systems, including Rapid Shutdown solutions, DC and AC Combiners, and Wire Solutions. Rapid Shutdown Solutions represent low-cost and space-saving solutions for commercial solar systems utilizing string inverters. AC Combiners combine multiple string inverter outputs. Wire Solutions include custom Wire Harnesses and Source Circuit Conductors. All solutions are highly configurable to fit any application and are built to customers' specifications. SolarBOS products are designed and manufactured in the USA with emphasis on clean design, quality, and cost-effectiveness. SolarBOS products are listed to UL-1741.

www.solarbos.com

Tigo Energy, Inc.

The TS4-A-M (Monitoring) and TS4-A-S (Safety) are the newest add-on units to join Tigo's patented UHD-Core TS4 Platform. The add-on solution has improved lightweight hardware and lower labor costs to address a range of functions and budgets. Snap to standard module frame or rack mounting for quick and easy installation. Both units are being UL-certified with more than 15 module manufacturing brands and offer module-level monitoring via Tigo's SMART website and mobile app. The TS4-A-S is NEC 2017 rapid shutdown compliant.

www.tigoenergy.com

SOLARFIX | FIXED-TILT RACKING

Set it and forget it!

- *Bifacial capability*
- *Cost-effective solution*
- *No maintenance*
- *Perfect adaptation to plot*
- *Flutter Free*
- *Special steel coating*

Solarfix is a solid and robust solution that ensures a perfect adaptation to any type of terrain and plot shape. With no moving parts, **Solarfix** is able to maintain any configuration firmly fixed to the ground, regardless of the weather conditions of the area and without inconvenients caused by fluttering. It is completely configurable, supports any type of module, including the bifacial, and its structure requires little or no maintenance. In addition, we protect our structures with a steel coating which offers an excellent corrosion resistance, three times better than galvanized steel on the entire surface and cut-edges. **Solarfix** is the most economical, easy to install and cost-effective solution for fixed-tilt solar plants of any size.

Do you prefer some movement?

Ask us about our wide range of single-axis solar trackers for utility-scale projects.

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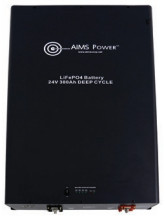
UL 3703

pvhardware.com/usa

PVH

Battery | Energy Storage

AIMS Power



AIMS Power introduces its Lithium (LiFePO4) deep cycle battery 24V 300AMP or 48V 150AMP available, packed with power. Delivers large amp capacity in one battery and eliminates the need for multiple batteries without losing amperage. Loaded with automatic safety features, such as a Battery Management System (BMS), which maintains individual cell integrity, low and high voltage protections, reverse polarity, and temperature management. The battery also uses automatic cell balancing, requires almost no maintenance and includes RS485 and CAN monitoring. This one battery can replace multiple battery banks and cables.

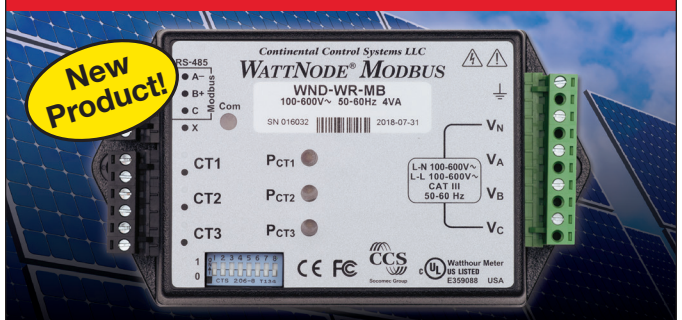
www.aimscorp.net

BAE Batteries, USA

BAE Batteries USA provides an advanced lead-acid battery energy storage solution with its PVV and PVS product offerings. Using a lead-selenium (PVS) and a gelled electrolyte (PVV) construction, 3,000 to 5,000 cycles can be obtained. Lead-acid is a reliable and safe technology with installations spanning over 100 years. To support clean energy objectives, the products are 99% recyclable.

www.baebatteriesusa.com

WATTNODE®
WIDE-RANGE MODBUS ENERGY METER
NOW AVAILABLE with up to 84 SINGLE CIRCUITS
(or 28 three-phase circuits)



One Model for all Utility Services
• Supports 100 to 600 Vac
Corrects Wiring Errors Remotely
• Reconfigure the CTs Polarity
ANSI C12.20 Class 0.5 Accuracy
• Uses Safe Low-Voltage (0.333Vac) CTs
Modbus RTU, RS-485 Communication
Adjustable Baud Rates to 115K

Continental Control Systems, LLC
1-888-WattNode (928-8663) • ctlsys.com

Battery Systems

Battery Systems provides their customers with battery products combined with efficient service, offered at competitive prices in ever expanding markets.

www.batterysystems.net

Bender, Inc.

Insulation monitoring devices detect symmetrical insulation and DC faults that often occur in control circuits and DC voltage networks such as those found in battery energy storage systems. When insulation resistance is monitored, trend curves and other predictions can be made. A permanently installed iso685 from Bender, Inc. is a solution for monitoring battery energy storage systems because faults and locations are automatically detected and displayed. This significantly reduces time and effort required for maintenance work.

www.benderinc.com

Bioenno Power®
www.bioennopower.com

Bioenno Power

Based in Santa Ana, California, Bioenno Power offers lithium iron phosphate (LiFePO4) batteries for various solar and industrial applications. The company's "BLF-" series offers a 10-year service life, 1/4 the weight of SLA batteries, and built in circuitry that balances/equalizes cells, protects against overcharging, overdischarge, overcurrent, and overvoltage.

www.bioennopower.com

BlueSolutions by Bolloré

BlueSolutions

BlueSolutions' globally deployed solid-state Lithium Metal Polymer(LMP) energy storage technology is an advanced solid-state battery and energy storage design with important attributes of safety, high energy density, and high performance. Solid-state technology is insensitive to external temperatures, does not require cooling, and will not be subject to thermal runaway events. The LMP outdoor racks are suitable for hot, harsh environments, and remote locations. Its robust warranty is not subject to operating temperature or depth of discharge.

www.blue-storage.com

BMZ USA, Inc.

A modular, lithium-ion based Energy Storage System, the ESS 7.0, ESS 9.0, and ESS X batteries can store a surplus of collected solar energy for later use and be used for both on-grid and off-grid applications. Energy can either be directed into the storage system or be fed into the public grid via an inverter. The ESS batteries have a usable capacity range from 5.4kWh to 8.05kWh and up to 12 ESS can be connected in parallel. This means meeting the energy storage needs of small residential locations to larger commercial systems is no issue. The ESS are compatible with 48V systems which avoids hassles seen with high voltage. Simple to set up and use, BMZ ESS batteries make energy storage easy.

www.bmz-group.com

Can Solar, Inc.

Can Solar, Inc. presents their Solar Power Bank for Home, which receives up to 2kW solar power, kept in 2.5kWh or 5kWh LiFePO4 batteries and then converts to 110VAC power, with utility charging capability. Users only have to connect their solar modules. The all-in-one design puts necessary functions into a compact enclosure, bringing conveniences to users. Users can check Power Bank status through an optional mobile phone app.

www.cansolarenergy.com

Concorde Battery Corporation

Sun Xtender deep cycle AGM batteries are chosen for a variety of applications. Solar utility trailers use Sun Xtender batteries to provide dependable power, power lighted construction signs, harness energy from solar panels and wind turbines to power integral equipment. Sun Xtender batteries are maintenance free, housed in shockproof, high impact reinforced cases to restrain from bulging. Sun Xtender terminals and hardware are constructed with copper alloy, corrosion free materials for low impedance connections and maximum conductivity. All Sun Xtender batteries are produced under a quality system in the USA. Capacities in 2V, 6V, 12V for grid tied and standalone systems.

www.sunxtender.com

OMCO CHOICE™
Direct-Bolt Fixed Tilt

- Pre-assembled tilt bracketry components to reduce on-site labor, accelerate assembly
- Flexible bridge beam design
- Integrated grounding to eliminate third party grounding devices and speed assembly

OMCO ORIGIN™ Tracker

- Up to 5% more MW per acre - longer rows and minimal gaps maximize ground coverage
- Unique bearings adjust 8 ways on-site to solve post misalignment issues
- Universal: mount any module width up to 1.3 meters, and any frame height up to 50 mm

OMCO FIELD-FAST™
Slide & Stay Fixed Tilt

- Lowest total installed cost for community scale and commercial projects
- Pre-assembled, no crane needed, safer installation
- Ideal for “get-in & get-out” situations

No Matter Your Direction,
We’ve Got a Factory-Direct* Solution

OMCO SOLAR®
A DIVISION OF OMCO HOLDINGS

www.omcosolar.com

* Unlike other solar mounting competitors, we actually manufacture our fixed tilt and tracker components... in our own plants. You get reduced lead times, lower shipping costs and responsive customer service.

Structural Components Made in the USA

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OMCO CHOICE, OMCO FIELD-FAST and OMCO ORIGIN are trademarks and OMCO Solar is a registered trademark of OMCO Holdings

Crown Battery Manufacturing Company

Crown offers low or no-maintenance energy storage solutions. Their FreedomBloc Energy Storage Systems are safe, affordable, and scalable from 10 to 20kWh. This tough array provides energy independence and peace of mind for both Off-Grid and Grid-Connected UPS.

www.crownbattery.com

Darfon America Corp.

The Darfon B09ULF is a battery solution for those who need energy storage but have limited space. The B09ULF is a 9.6kWh battery that can be installed floor-standing or wall-mounted. If more reserved power is needed, the B09ULF can be stacked for 19.2kWh. The enclosure installs empty, to minimize installation weight and make it easy for one person to install. All wiring uses quick disconnects to speed up the installation process. With full communication with Darfon's H5001 hybrid inverter, the B09ULF's status and performance can be monitored through Darfon's web portal. Since the B09ULF uses LiFePO4 chemistry, it has a long life span and is safe.

www.darfonsolar.com

e-On Batteries, Inc.

e-On Batteries, a Fort Worth, Texas area supplier with national scope, is developer of lithium iron phosphate (LiFePO4) based energy storage systems with a focus on product safety. The company's UL 1973 listed and CEC approved and listed modules are engineered as scalable building blocks to enable larger systems, and its 19" rack-mounted modular systems are easily configured from 12.8kWh residential systems to 4.8MWh container-based systems and more. With over 20 million deployed calls and zero catastrophic failures, combined with cell-level BMS monitoring and control systems, expert engineering liaison and certified installers, e-On Batteries provides full value to their customers.

www.e-onbatteries.com

EnerSys

The Genesis G200EP battery, the largest amp-hour battery in the Genesis EP line, is a high-performance 12V battery that features Thin Plate Pure Lead (TPPL) technology, making it a solution for grid-tied solar power applications. It offers a nominal capacity of 200 amp hours, fast and efficient recharge, and excellent cycle performance. In addition, the Genesis G200EP battery has a two-year shelf life, performs well in high-temperature and high-vibration environments, and is flame retardant by meeting the UL94V0 specification. TPPL technology also enables it to provide more power in a small footprint. The Genesis G200EP battery is built with high quality materials, including built-in lifting handles for rapid installations.

www.enersys.com

ESS, Inc.

The Energy Center (EC) is a "battery-in-a-building" platform based on the same second-generation module used in the Energy Warehouse (EW), with a design-build approach that enables systems to be tailored to meet virtually any project size with storage durations ranging up to 10 hours. These wide-ranging capabilities make the EC suitable to support large-scale renewable energy projects, as well as transmission- and distribution-level services, without cycling limits. To support all deployments, ESS Inc. has partnered with Munich Re to implement an insurance-backed warranty on its flow batteries.

www.essinc.com

Fortress Power

Fortress Power engineers announce the new eVault 18.5kWh battery. The eVault uses safe Lithium-Iron-Phosphate technology. It has a user-friendly front display to monitor batteries' capacity and power output. It is compact, powerful, and able to stack up to 12 batteries in parallel (222kWh). Competitively priced, the eVault battery also comes with a 10-year warranty and 6,000 cycles.

www.fortresspower.com

LEOCH Battery Corporation

Leoch's Pure Lead + Carbon Technology has been specifically engineered to support partial-state-of-charge applications where the batteries are cycled regularly. These high power, energy dense batteries offer super-fast charging from 0% to 90% in 1hr and a long deep cycle life of 3000 cycles at 50% DoD. The ABS-Polycarbonate jars provide rugged durability and a wide operating temperature of -40°F to 131°F (-40°C to 55°C). Tested to IEC standards.

www.leoch.us

Lithium Werks

Lithium Werks manufactures lithium ion batteries that can be arranged in systems between 12V-1000V, from kWh to MWh. As a result of stable, high-quality, lithium iron phosphate (LiFePO4) chemistry, Lithium Werks' diverse offerings of 12V, 24V, and 36V modules have a high cycle life and float life, suitable for energy storage markets such as renewables and UPS. Through this intuitive design, lithium ion batteries can act as a "drop-in" replacement for lead-acid batteries or be easily assembled into larger systems of any voltage and capacity.

www.lithiumwerks.com

MK Battery

The Deka Unigy II 2-volt battery from MK Battery is available as either a single cell or system design, and features a wide range of capacities to fit the varied requirements of renewable energy applications. Exclusive IPF Technology optimizes power capacity, cell consistency, and long-term reliability. Advanced AGM technology eliminates periodic watering, corrosive acid fumes, and spills. Microcat Catalyst lowers float current, decreases internal temperatures, and the risk of dry-out, to ensure long battery life.

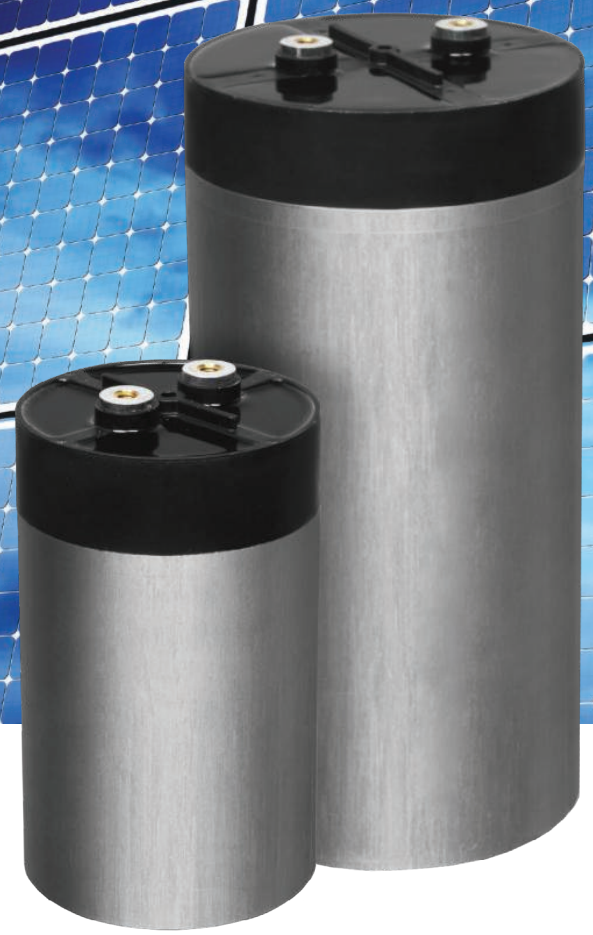
www.mkbattery.com

naak, Inc.

Naak delivers optimized energy services for residential and commercial energy consumers, developers, and the grid. They leverage the benefits of behind the meter load control, ensuring energy service offerings are optimized and cost effective. The Digital Loads Panel offers market differentiation, increased customer savings, reduced installation costs, multiplies revenue streams, and ensures outcomes with less risk over the long term. naak provides plug and play battery storage kits with the common brands.

www.naak.io

Reliable inverters use DC link capacitors from CDE.



Type 947D Power Film Capacitors

Next Generation wind and solar power inverters demand reliable DC Link capacitors. 100% of our DC Link capacitors are conditioned at accelerated temperature and voltage before they leave the factory. We've demonstrated that this process produces the most thermally and electrically stable DC link capacitors available today.

If that's the kind of reliability you're looking for, trust the one company where it's burned in.

For technical information, visit cde.com/solutions/inverters

TYPE 947D POWER FILM CAPACITORS

85, 90, 100 & 116 mm CASE SIZES

CAPACITANCE VALUES TO 3600 µF

APPLIED VOLTAGE TO 1500 Vdc

RIPPLE CURRENT RATINGS >100 A_{rms}

CDE ENERGIZING IDEAS

CORNELL DUBILIER

GROUND MOUNT WIRE MANAGEMENT

- Most cost-effective ground mount wire management option on the market
- Holds 25+ PV wires in a single Hanger (tested using #8 PV wire, 7.95mm dia.)
- Opening/Closing function means NO NEED TO EVER REPLACE
- Round material = no sharp edges ever coming in contact with cables

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

NINE FASTENERS INC.

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

Phocos Americas, Inc.

The Phocos CIS-MPPT Series of charge controllers offer a solution for off-grid applications such as telemetry, outdoor lighting, SCADA, and monitoring. This product was developed to ensure reliable battery protection under extreme weather/environmental conditions that often results in damaged electronics. The robust CIS-MPPT Series also has advanced lighting controls, programmable load timing, is IP68, and can offer 2 years of performance data (with accessory).

www.phocos.com

Rolls BATTERY ENGINEERING

Rolls Battery Engineering

Designed to deliver long-term reliable energy storage in a heavy-duty, dual-container design, Rolls 5000 Series 2 volt 2 KS 33P model offer heavy-duty thick plate construction with Advanced NAM carbon for more efficient charging, extended cycle life and durability, convenient modular cell assembly, and high Amp-Hour capacity (1837 AH @ 20 Hr), backed by a 5-year full replacement warranty.

www.rollsbattery.com

TROES

Based on LiFePO4 technology, TROES develops, designs, manufactures, and delivers safe, long-lasting, cloud-based energy storage systems that integrate TROES' proprietary IoT and AI-based modular Battery Packs, Battery Management Systems (BMS), Enclosures, and Power Conversion System (PCS). These systems are rigorously tested. TROES offers "Customized-Off-The-Shelf", scalable design and can cover a wide range of energy needs from 56kWh to over 100MWh and competitive financing/leasing terms and short manufacturing lead times. TROES' product has already passed CSA/UL certification and TROES has deployed systems in North America.

www.troescorp.com

TROJAN BATTERY COMPANY

Trojan Battery Company

Trillium, Trojan's Intelligent Lithium battery is designed and engineered in the USA and is available in 3 popular sizes that can be used in a variety of applications in solar. From its cell and battery design to its intelligent, built-in diagnostics, Trillium offers a range of advanced safety, environmental, and electronic features. With life expectancy over 5,000 cycles, Trillium will deliver outstanding return on investment over time. Trillium is designed as an easy replacement for existing lead acid batteries.

www.trojanbattery.com

U.S. Battery Manufacturing Company

U.S. Battery Manufacturing

U.S. Battery Manufacturing has been building flooded lead acid batteries since 1926 and manufactures deep cycle batteries specifically for many industries, worldwide. The company's RE Series batteries are designed to provide high peak capacity, long cycle life, and reliability for use in industrial or residential renewable energy applications. RE Series batteries utilize the company's XC2 formulation and Diamond Plate Technology to create an efficient battery plate, delivering high watt-hours per liter and watt-hours per kilogram.

www.usbattery.com

VRB Energy

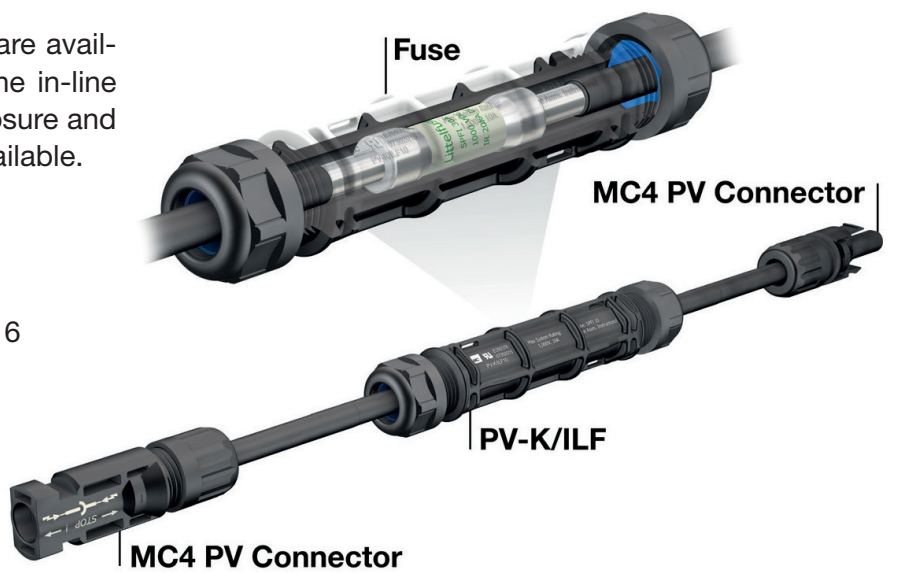
VRB Energy's vanadium redox batteries (VRB) store energy in liquid electrolyte in a patented process based on the reduction and oxidation of ionic forms of the element vanadium. Based on a 250kW containerized module, VRB-ESS is typically 1MW / 4MWh up to 10MW / 80MWh in size installed at utility, commercial, and industrial sites, in support of solar or wind farms, or in isolated microgrids. Typical configurations use 4, 6, or 8 hours of storage depending on the amount of energy required. The battery is safe, reliable, and non-toxic. Components can be nearly 100% recycled at end-of-life, dramatically improving lifecycle economics and environmental benefits.

www.vrbenergy.com

Small Components. Big Impact!

Stäubli Electrical Connectors' MC4 photovoltaic connectors are the global industry standard and can be found on more PV modules than any other connector system in the world. Stäubli Electrical Connectors, with more than 1.5 billion installed PV connectors across the globe, is an integral part of more than 240 GW (over half) of the worldwide PV capacity.

The MC4 family of PV connectors are rated up to 1500 V UL, 70 A, and are available for 14 through 8 AWG cable configurations. We are also offering the in-line fuse PV-K/ILF: up to 1500 V, up to 30 A, and featuring a robust IP68 enclosure and crimped fuse connection for the most reliable and robust configuration available.



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Bracing & Anchoring

Gripple, Inc.

Gripple's Photovoltaic (PV) Solutions for ground-mounted arrays provide a reliable, low-cost alternative to traditional methods. Their products provide protection to the array against active forces such as strong winds, natural earth movements, storms, earthquakes, and temperature expansion/contraction, thus eliminating torsion, tension, and compression issues. The bracing and anchoring kits are lightweight, easy to install, and are versatile enough to be either specified into a site or retrofitted into most existing systems, making them suitable for repairs and refusals.

www.gripple.com

Capacitors

Cornell Dubilier Electronics

Next generation inverter designs for renewable energy demand reliable DC link capacitors with higher capacitance values, voltage, and current ratings. 100% of Cornell Dubilier Electronics' 947D DC Link capacitors are conditioned at accelerated temperature and voltage before they leave the factory. They've demonstrated this process eliminates infant mortal failures and produces highly thermally and electrically stable DC Link Capacitors.

www.cde.com

Cathodic Protection

LP Hoying, LLC

LP Hoying solar power supplies are used in the cathodic protection industry and are used worldwide for the protection of assets including oil and natural gas well casings, pipelines, and associated infrastructure. They are available with cathodic protection current ranges from zero to 50A (more in specialized cases) and the associated voltage levels necessary to provide this current. The controls can be configured to provide constant voltage, constant current, or automatic potential control depending upon the application. Their systems come with all components needed for installation, and are easily assembled in the field.

www.lphoying.com

Components | Electrical Protection

ABB Installation Products

ABB Installation Products is a solar-power system component and connections supplier. Some of ABB's products that are available for the solar power industry include metal framing, current-limiting fuses, connectors, conduit and fitting systems, and UV-resistant cable ties. For example, the T&B Fittings Sand Cast Aluminum Form 7 Conduit Body is made of CoroStall aluminum alloy, which is a highly corrosion-resistant aluminum alloy. ABB also provides training for the correct installation and maintenance of their products.

www.tnb.com

Allied Industrial Marketing, Inc.

Allied Industrial Marketing has over 30 years of experience specializing in power quality and helping clients diagnose problems through engineering analysis and computer simulation, and they provide recommendations on problem solving methods. For OEMs of power quality solutions, they offer power quality components; Mangoldt Filter Reactors, Line/Load Reactors, Current Limiting Reactors, Low and Medium Voltage Reactors, Frako Capacitors, Contactors, and Power Factor Corrections Controllers. Educational power quality seminars are also available.

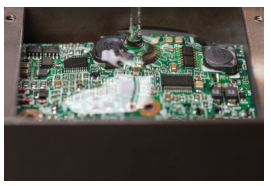
www.alliedindustrialmarketing.com

Anderson Power Products

Solar SPEC Pak is a multi-pin IP68 approved connector meeting the photovoltaic industry requirements specified in UL 6703A and is rated for operating temperatures of -40°F to 194°F. It has power handling capabilities up to 600V and up to 60A per UL. Solar Spec pack features a locking latch that complies with NEC 2008 section 690.33 (C) requirements. Designed for wire to wire applications, Solar SPEC Pak is capable of handling up to 5 individual lines which reduces the number of traditional connectors needed in solar applications, minimizing the amount of space needed while lowering installation costs.

www.andersonpower.com

CHT USA



Silicone encapsulants and sealants offer environmentally friendly, long-term protection to meet the demands of a variety of solar panel applications, from panels to junction boxes. UV resistant encapsulating grades outperform organics. CHT USA offers optically clear and non-yellowing systems, with corrosion-resistant properties, as well as thermally conductive grades for heat management. UL rated, flame-retardant, potting grades are also available for junction box applications. Additionally, silicones with primerless adhesion are offered for bonding to a variety of plastics.

www.silicone-experts.cht.com

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Class A Instrumentation for Site Selection, Prediction and Performance Testing of PV Power Plants

www.EppleyLab.com
The Eppley Laboratory INC. USA +1.401.847.1020

NEW! QB2

Patent # 8448407

ERROR-PROOF COMPRESSION

The QB2 doesn't leave any room for user error when it comes to Microflashing® compression. **Once the Dual Drive Shoulder Screw is secured, the Microflashing® is compressed!**

ONLY 3 COMPONENTS

The QB2 is comprised of Microflashing®, an L-Foot, and a Dual Drive Shoulder Screw. **No more Nuts needed to tighten and secure the L-Foot!** Not only does this simplify the installation process, it also cuts down the installation time!

DUAL DRIVE

The new Dual Drive Shoulder Screw design can be driven using a standard ½" Hex Nut Setter or a 6mm Hex Driver. **Installers can use the drive that works best with the rest of the components of their array.**

THE FASTEST, SIMPLEST, MOST EFFICIENT QUICKBOLT DESIGN YET!

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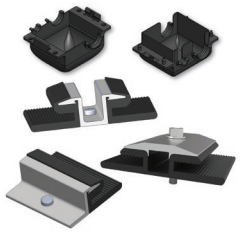

Clark Rubber & Plastic

Clark Rubber & Plastic is a custom manufacturer of UL extruded and molded rubber and plastic components used in the solar industry. Clark Rubber & Plastic develops and manufactures custom rubber and plastic quality components such as clamp inserts, grommets, rub strips, and fastening applications.

www.clarkrandp.com

Eaton

Eaton's Power Xpert Energy Optimizer controller is a modular, scalable, and repeatable solution designed to help simplify and optimize the deployment of complex microgrid systems. Standardized communications enable easy system configuration for establishment of stand-alone power systems using existing and new assets with the adaptability to easily meet future needs.

www.eaton.com/microgrid

EMA Electromechanics, Inc.

EMA Electromechanics is the designer and manufacturer of the VDH/GSMI combined outdoor vacuum circuit breaker and high speed, mechanically interlocked grounding switch. 38kV class, 200kV BIL, 1200 A continuous current and 25, 31.5, and 40kA interrupting capability ratings, VDH/GSMI is a patented system specifically designed for switching and grounding of solar energy collector system, reducing magnitude and duration of ground fault overvoltages and load rejection overvoltages, and maintaining effectively grounded conditions of the collector system when the inverters are not in operation.

www.emaelectromechanics.com

Fusetek

FUSETEK is an independently-owned supplier of CSA-approved circuit protection and control devices. They have been providing products to the Canadian electrical market for the last 35 years. Their solar line includes a wide range of products from trusted brands like SIBA and Littelfuse fuses, IMO drives and controls, and Vynckier fiberglass enclosures to name a few. They carry a substantial inventory to provide fast, reliable delivery for their solar customers.

www.fusetek.com

ILSCO

ILSCO's solar combiner nodes are manufactured from high strength aluminum alloy for maximum conductivity and strength. Configurations offer 18 to 42 string inputs and up to 4 outputs for application versatility. The conductor input side accepts a wire range of 4 – 14 Class B and C conductor, while the output side accepts 1000kcmil – 6 Class B, C, G, H, I, K, M, and DLO. This series can be used with mechanical or compression connectors, and a majority have NEMA mounting hole configurations.

www.ilsco.com

Mersen

Mersen's Dual Fuse series is designed specifically for the protection of enhanced PV systems employing increased string current aggregation. Their precision resistance matched fuse construction ensures balanced load sharing, making them suitable for continuous temperature and current cycling withstand adding to system longevity. The 1000VDC-rated HP10M and 1500VDC-rated HP15M, designed for low minimum breaking capacity capabilities of 1.35 times the fuse rated current value, allow for safe circuit interruption under typical low fault current conditions produced by PV arrays. The tin plated Crimp Cap (CC) wire-crimpable and solderable terminals accept #8 AWG stranded copper PV wire.

ep.mersen.com

Phoenix Contact

Phoenix Contact's new TRIO Solar DC-to-DC power converter connects directly to 1500V utility-scale solar arrays. The TRIO Solar converts high voltages DC to 24VDC, eliminating the costs and hassle of trenching to supply power for combiner, re-combiner, and other monitoring applications. The TRIO Solar is part of a family of wide DC voltage input range DC-to-DC power converters with models suitable for 1000V and 1500V nominal array voltages. The TRIO Solar can be wired in parallel with the user of a decoupling diode for higher current applications and combined with a UPS for reserve power applications.

www.phoenixcontact.com

Raycap, Inc.

Raycap provides strong protection for DC applications. Raycap's Strikesorb 35 and ProTec PV products, specifically designed for DC power protection, are a surge protection product for solar power applications worldwide.

www.raycap.com

Sensata Technologies - Gigavac

Sensata Technologies' GIGAVAC brand HX Series EPIC (Extended Performance Impervious Ceramic) hermetically sealed High Voltage DC Contactors are small UL508 approved contactors for 1000V hot switching. Utilizing the EPIC seal means these high voltage contactors exceed sealing requirements of IP67 and IP69. Going beyond hermetic sealing the HX series can withstand the rigors of virtually any harsh environment whether underwater or in the desert sun. HX series High Voltage Hermetically Sealed Contactors are a solution for inverter systems, battery packs, and combiner boxes in solar or wind power systems. The HX Series includes packaging options with the HX21, HX22, and HX200.

www.sensata.com/gigavac

SIBA Fuses

SIBA Fuses are available for protection of PV panels, sub-arrays, arrays, energy storage (ES) systems, inverters, filters, and transformers and switchgear tied to the grid. Fuses for DC side of the inverter are available in the voltage range from 400VDC to 1500VDC and current ratings from 1A to 2500A. Fuses developed for energy storage (ES) have a high current breaking capacity and low L/R. On the AC side of the inverter SIBA is capable of meeting voltage applications up to 40.5kV with for bus protection, capacitor filters, PT transformers step-up transformers SSK fuses specific for wind, solar and energy storage application, and switchgear with medium/high voltage fuses.

www.siba-fuses.us

STEGO, Inc.

For over 35 years, STEGO, Inc. has produced products for energy efficient thermal management of electronic components. Convection heaters, fan heaters, and filter fans are just a few of the products STEGO produces which keep enclosed electronics on small and large scales running safely, economically, and reliably, from corporate server racks to wind turbines in extreme environments. With locations in 13 countries and partnerships around the world, STEGO serves a global customer base engaged in a large portfolio of industries.

www.stegousa.com

Woehner LLC

Woehner produces DIN-rail and busbar-mounted fuse holders rated for 1000Vdc PV applications. These fuseholders are targeted at North American solar combiner box manufacturers who build to the UL1741 standard. The products offer a UL4248 marking at 1000 volts DC for 10x38 fuses as large as 30 amps. They are available with or without LED-indicator lamps. The busbar mounted holder clips directly to UL-listed metric dimension busbar, eliminating the need for fabricated comb-style busbars.

www.woehner.com

wöhner®

Woehner LLC

SECUR Panel is for North American solar combiner box and inverter manufacturers who build to the UL1741 standard. The product offers a UL4248-18 listing at 1500 volts DC for 10x85 and 14x85 fuses as large as 30 amps. The 10/14x85 fuse holder is suitable for use with both 1500Vdc rated UL2579 listed PV fuses or IEC60269-2 certified gPV fuses. The SECUR Panel is IP20 touch-safe and provides a safe, tool-free fuse insertion and extraction, for easy fuse installation and replacement. This fuse holder uses an advanced grade plastic material in the fuse carrier to satisfy the higher operating temperatures associated with PV fuses.

www.woehner.com

wöhner®

Woehner LLC

QUADRON Panel for photovoltaics is a family of 1500Vdc fuse holders suitable for mounting NH1XL fuses from 50 to 250 amps and NH2XL or NH3L fuses up to 600 amps. Available in bolt-to-bolt configurations, for connecting lugged cables to M10 or M12 bolts on either side of the fuse; or bolt-to-busbar configurations, allowing current to be combined to a metric dimension busbar on the secondary of the fuse, in combiner box and inverter applications.

www.woehner.com

Consulting Services | Business & Environmental Consultants

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ECI
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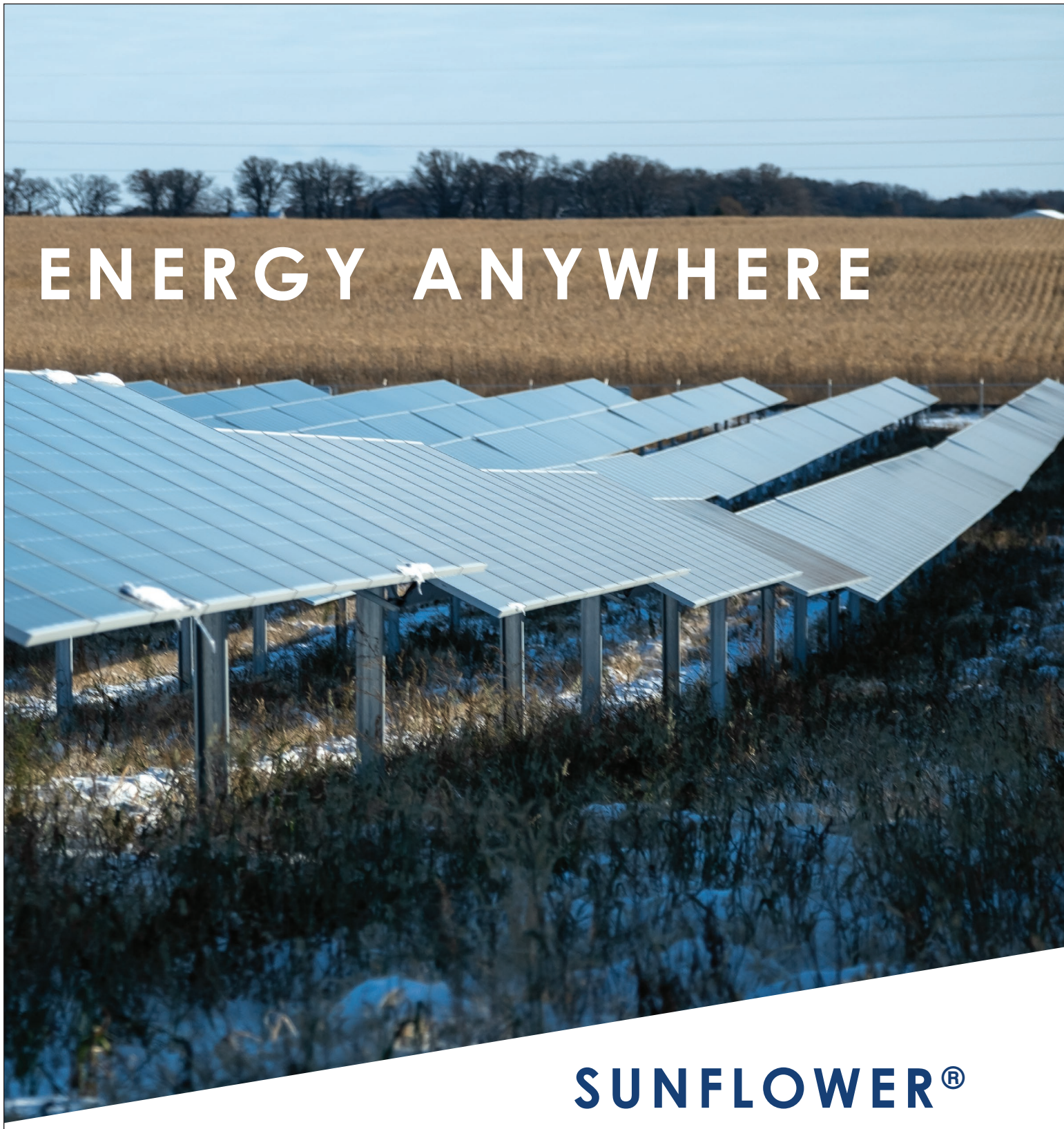
Electrical Consultants, Inc.

Electrical Consultants Inc. (ECI) is a power delivery engineering firm which brings power delivery services through 500kV to their clients. ECI provides services including: overhead and underground transmission engineering, substation and switchyard design, industrial power systems design, land survey and construction staking, right-of-way services, environmental planning, project management, construction management, and procurement services to utilities.

www.electricalconsultantsinc.com



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- NO SPECIAL TOOLING REQUIRED
- OVER 500 MW DEPLOYED
- TERRAIN FOLLOWING CAPABILITIES

Schlesinger Consulting

Schlesinger Consulting provides consulting services for general management, marketing, and electrical engineering for the renewable energy industry. Specific expertise includes wind and PV projects, and for the mitigation of the effects of lightning on electrical systems.

www.schlesingerconsulting.com

The C Three Group

The C Three Group offers subscriptions to cloud-based databases with up-to-date project-tracking for North American infrastructure projects in transmission, generation, oil and natural gas, and telecomm. Add-on services include custom reporting, market forecasts, and deep dive segment analysis.

www.cthree.net

Contractors | EPC

Arntjen Clean Energy Solutions

The Arntjen Group was founded in 1978. With solar as their grass roots, they expanded into clean energy, electromobilty, and conservation, offering solutions to help clients find better ways to minimize the dependency on fossil fuels. Arntjen Clean Energy Solutions (ACES) continues meeting the changing needs with sustainability being their focus.

www.arntjencleanenergy.com

Black&McDonald

Black & McDonald, Inc.

Black & McDonald Inc. is a family-owned and operated, integrated, multi-trade service provider that safely delivers high quality construction, facilities management, and technical solutions. With offices across North America, they deliver customer-focused solutions.

www.blackandmcdonald.com

BLATTNER ENERGY

Blattner Energy

Blattner Energy is an EPC contractor in renewable energy construction with more than a century of large-scale project experience and over 30,000 megawatts of renewable energy installed across North America. Blattner provides EPC services for solar, energy storage, wind, and high voltage transmission and substation projects. Within the solar market, Blattner's services include: project feasibility; engineering and design capabilities; material procurement and management; pre-construction activities; full-service construction; testing and startup; operations and maintenance (O&M); and collaborative construction management. Blattner delivers a construction experience with added value throughout all phases of the project lifecycle.

www.blattnerenergy.com

Hypower, Inc.

Hypower is a utility scale self-performing BOS/EPC solar contractor based out of Fort Lauderdale, FL. The company works nationally, currently licensed in over 30 states. Hypower has over 600MW of experience in the solar industry focused solely on ground mount projects over 5MW.

www.hypowerinc.com

Invaleon Solar

Established in 2011, Invaleon has been in business since the start of the solar boom in Massachusetts and takes solar projects from the initial planning stages through commissioning. Invaleon in-houses all services, providing full engineering, procurement, and construction (EPC) with no subcontracting. Invaleon has installed 35MW of solar in Massachusetts since its inception.

www.invaleonsolar.com

Lenzi Incorporated

Lenzi Incorporated is an EPC full service general contractor whose primary focus is to build commercial grade solar plants and facilities. They specialize in turn-key installations including, ground mounts, roof mounts, tracker systems, and shade structures. Lenzi Incorporated also offers complete module installation subcontractor services. Their installation crews are staffed with qualified and proficient personnel and they have an installation model that can be effectively implemented anywhere in the world.

www.lenzicon.com

Rosendin Electric

Rosendin brings its experience and unique capabilities as a diversified electrical contractor to its role as a full-service design build EPC for behind the meter distributed generation and utility-scale solar farms. They have designed and installed over 2.4GW of solar in active solar markets across the US, representing over $1.5B of work. Project sizes range from 100kW to more than 500MW, utilizing PV or thinfilm technology in any mix of rooftop, canopy, or fixed and single axis tracker ground mount installations.

www.rosendin.com

Signal Energy Constructors

Signal Energy is an EPC contractor for North American and Australian energy companies and provides solutions, delivers results, and attracts and develops a quality work force. Signal Energy has 8000MW of utility-scale renewable project experience and 2000MW of solar project experience. They support their customers with an in-house Pre-construction Solutions Group, internal mechanical installation resources, and engineering and design capabilities. This allows Signal Energy to control and coordinate the critical project components reducing schedule risk for their customers.

www.signalenergy.com

Sunpin Solar

Sunpin Solar provides solar energy project development expertise with regional offices and personnel in Illinois, Massachusetts, Ohio, New York, Texas, Maryland, and Pennsylvania. The company offers services from start to finish including development, asset management, financing, engineering, procurement, construction management, and operations. Sunpin Solar has established relationships with corporate energy buyers, landowners, housing authorities, municipalities, electric utilities, and financiers. Sunpin currently has over 1100MW in its development and acquisition pipeline and is working towards providing more renewable green energy to states across the country.

www.sunpinsolar.us

Education | Research Development

Appalachian Energy Center

Appalachian Energy Center in Boone, NC has an annual clean energy workshop series that provides solar and building science related professional workshops for continuing education credits. Solar workshops include Introduction to Photovoltaic System Design and Construction with NABCEP PV Associate, 2017 NEC and PV Systems: Inspecting and Designing, and PV Systems: Tools and Techniques for Operations and Maintenance.

www.energy.appstate.edu

Interplay Learning

Interplay Learning's Skilled Trades training course catalog gives users the confidence and skills to do the job right. On a phone, tablet, computer, or in virtual reality (VR), this is online training for on-the-job skills. Foundational video-based courses provide the building blocks to understand the core concepts behind the science and technology of solar, and 3D simulations deliver field-like experiences safely and quickly. Interplay Learning's solar curriculum covers everything from array assembly, electrical installation, to mechanical commissioning. Interplay Learning's online, on-demand training course catalog gives users the opportunity to advance their career anytime, anywhere.

www.interplaylearning.com

Solar Rollers

Solar Rollers is a high-tech, customizable solar-powered radio-controlled race car built from scratch by high school students all over the USA. Solar Rollers require hands-on building, innovation, and teamwork. A functional, competitive vehicle requires key components such as a chassis, solar array, bearings, steering, and more. All of this is designed, built, tested, and raced by students. The program includes a complete kit, a comprehensive online course, and registration to one of the regional races. Students can build with their school, scout troop, or local club in an area Solar Rollers are currently racing. Regional races in Colorado and Nevada.

www.solarrollers.org

Electrical Wire, Cable, & Connectors

4SProducts

4SProducts increases its manufacturing capacity for PV cables. 4SProducts solar cables are manufactured in a wide variety of conductor sizes and are rated RHH/RHW-2 as per UL44, UL4703, and UL854 standards. Their solar cables are also certified to meet H1Z2Z2-K to EN 50618 and TUV 2 PFG 1169 standards. To meet market demands, these PV cables can be packed with a wide variety of options. The halogen free cables have demonstrated outstanding results in harsh weather conditions and are offered with a 36-month warranty.

www.4sproducts.com

American Wire Group

American Wire Group (AWG) is a global supplier of wire and cable to the solar, wind, and utility industries. Specific to the solar power industry, AWG offers PV, power, control, transmission, and fiber optic cables. Handling large, utility-scale, as well as smaller, residential projects, AWG offers a variety of products to meet wire and cable needs, including the following: 15kV to 35kV TR-XLPE/EPR; ACSR/AAAC/AAC; PV AL cable; bare copper, aluminum, or copper clad steel; static/guy wire; OPGW; and related hardware.

www.buyawg.com

Cameron Wire & Cable, Inc.

Cameron Wire & Cable provides UL 4703 PV 1kV/2kV (aluminum and copper) cables and UL 1072 MV cables. Cameron offers affordable pricing and high performance cables for all applications and will customize the cable package, offering cut-to-length or bulk cables, accessories, labels, and lugs supplied in kits. Cameron also offers inventory management and will warehouse planned goods at no charge, and provides same-day shipping to satisfy tight job deadlines.

www.cameronwire.com

CTC Global

In association with 25 authorized manufacturing partners, CTC Global produces the high-capacity, low-sag ACCC conductor. The ACCC conductor carries twice the current of other bare overhead conductors with 25 to 40% less line losses. The use of ACCC can help reduce upfront capital costs for the tie line and also improve the overall economics of the generation project as reduced line losses translate into more power delivered for any given investment. The ACCC conductor has been deployed to more than 650 projects in 50 countries.

www.ctcglobal.com

Electrotech Sales Group, LLC

Electrotech Sales Group, LLC offers automation, control, and power products in the industrial market. They specialize in DIN rail terminal blocks, power supplies, counters, relays, motor control, circuit breakers, toggle switch terminal blocks, and more. They partner with synergistic manufacturers and suppliers in order to offer high quality products at competitive prices.

www.esgllc-usa.com

Industrial Control Direct

IMO's True DC isolators deliver safe, reliable DC switching in several applications. These products have been specifically manufactured to ensure effective isolation of DC voltages within numerous application areas, including solar energy. Specific design features ensure fast switching speed, minimal power loss, and the ability to withstand high temperature environments. This IMO contact system ensures power loss per pole is kept at a minimum and consistent over the life of the product. The switches are housed in thermoplastic enclosures to ensure durability in high-temperature environments. Available in 2 to 8 pole versions in a wide variety of mounting and handle configurations

www.industrialcontroldirect.com

Priority Wire & Cable

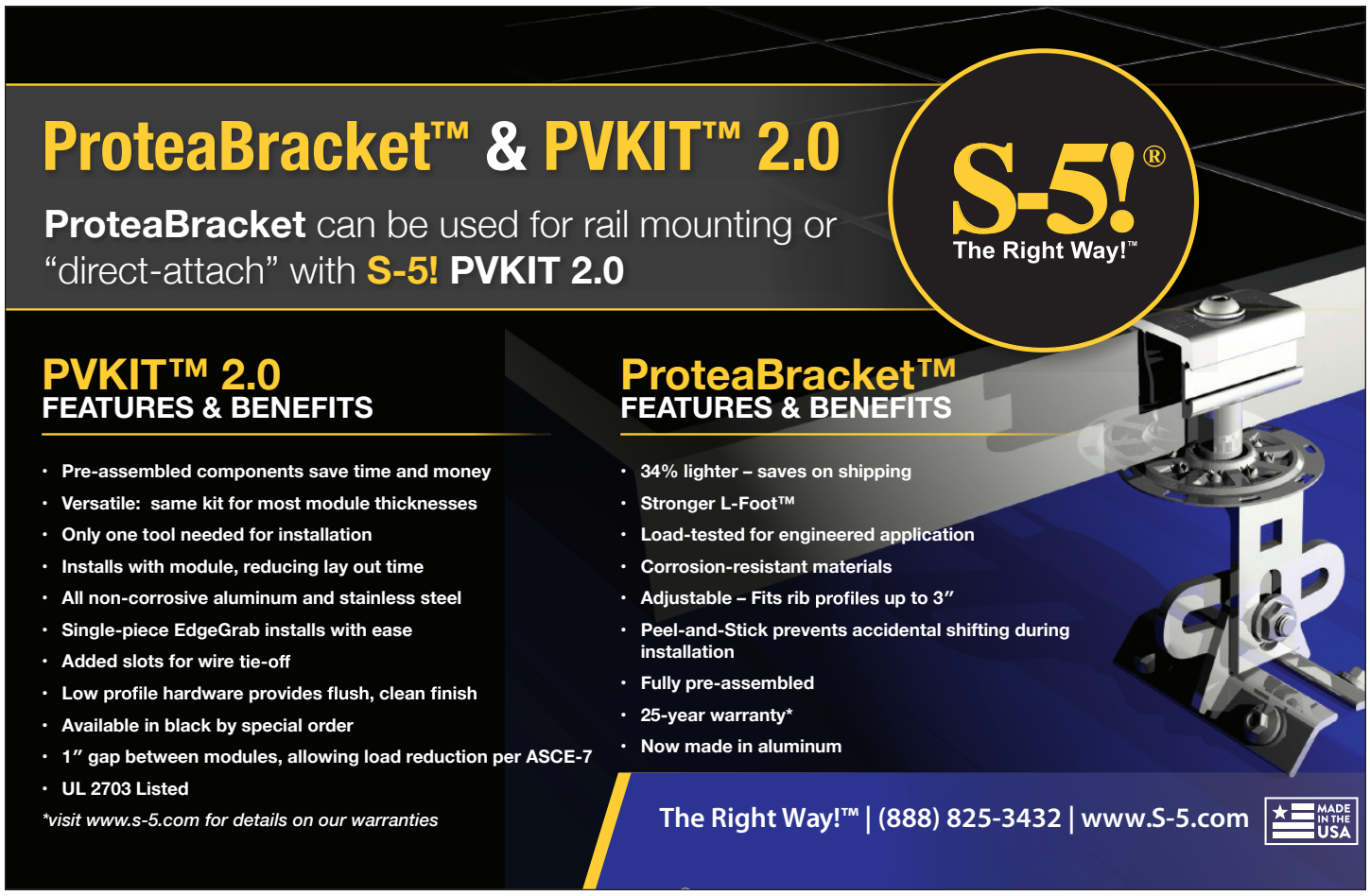
Priority Wire & Cable stocks a large inventory of aluminum DC feeder cables PV 2KV, 4 awg thru 1000 MCM, plus 8 and 10 awg copper 2KV string wire in black, white, red, and green. They have supplied wire to over 5GW of projects and can assist in eliminating unexpected costs, and reducing lead time, waste, and labor.

www.prioritywire.com

Stäubli Electrical Connectors

More than 1 billion photovoltaic connectors in the Stäubli MC4 connector family have been successfully connected worldwide over the past 20 years in harsh environments. The reliability of Stäubli products meet all the requirements of the global market and Stäubli is a certified manufacturer, who complies with international standards. Stäubli values field data, testing by customers, and provides long-term in-house product testing.

www.staubli.com



Enclosures | Combiner Boxes

American Polywater

Polywater InstaGrout Sealant is a two-part urethane foam that seals out pad-mounted equipment openings to prevent outages and service disruptions. Safe and effective to use, InstaGrout will not collapse during change-outs and adheres to various pad-mounted materials. Keep snakes, rodents, and insects out of critical electrical equipment and increase electrical reliability.

www.polywater.com

Energy Storage System

Atlas ESS

Atlas Energy Storage Systems are inexpensive, high performing lithium ion based systems. All Atlas ESS products have approvals from nationally recognized test labs. Atlas products comply with the new provisions for energy storage systems in the 2017 edition of the National Electric Code (NEC). Professionals and DIYers alike can assemble NEC compliant Energy Storage Systems using Atlas components. Cabinets, BMS, and controls are available separately or in pre-assembled systems.

www.atlas-ess.com

FIBOX
Enclosing innovations

Fibox

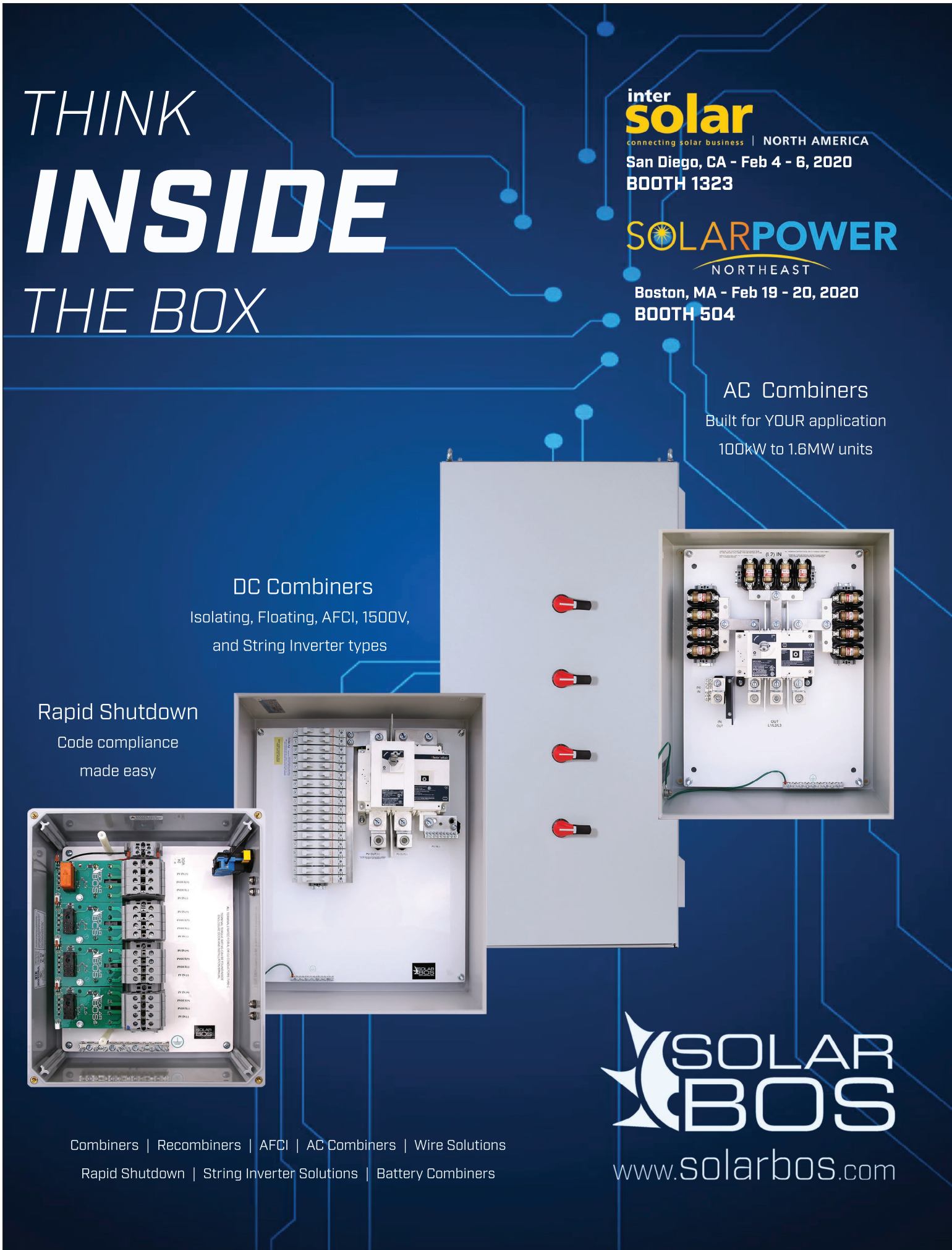
Fibox is a global manufacturer of UV resistant polycarbonate enclosures and cabinets for the alternative energy industry. Fibox enclosures are designed not only to protect and insulate components and controls in the harshest of environments, but also to provide a stylish, more robust alternative to metal and fiberglass boxes. Fibox polycarbonate enclosures offer a stronger, yet lighter and more flexible solution, which can easily be modified to exact needs and specifications. Fibox can also customize enclosures in advance, providing customers with a ready-to-use product right out of the packaging. Sized up to 32" x 24" x 12", Fibox offers large UL Listed NEMA 4x polycarbonate enclosures.

http://fiboxusa.com

Span

Span is introducing a new electrical panel designed for solar and storage. The Span panel serves as the center for connected power in the home. It provides all the safety features of a standard panel and adds real-time load monitoring and controls, customizable backup power prioritization, and embedded intelligence to optimize home energy. Span pairs with battery storage to provide customizable home backup, meaning customers have the power to choose or change their backup priorities any time through the Span App, whether they are at home or remote. Span's panel is a 200A main breaker that includes metering and an autotransformer.

www.span.io



HEYCO®
Wire Management Solutions for Solar Installers & Integrators...

Heyco® Solar Products Warranty
Visit **www.heyco.com** for information about Heyco's **20 Year Limited Warranty** on our solar products.

Heyco Edge Clips
Heyco Edge Clips provide high panel retention forces while requiring low insertion forces. Ideal solution for applications where holes are not available or temperatures are too extreme for adhesive solutions.

Helios UVX Clip
The Helios UVX clip installs into a .260″ (6,6 mm) mounting hole and holds up to 2 cables between .230-.315″ (5,8-8,0 mm) each.

Heyco®-Tite Cordgrips for Enphase Q Cable
Heyco now offers 1/2″ NPT and 3/4″ NPT cordgrips compatible with the Enphase Q Cable. Use the 1/2″ NPT for just 1 Enphase Q Cable or the 3/4″ NPT for 2 Enphase Q Cables PLUS a #8 solid Grounding cable.

Heyco® HEYClip™ SunRunner® 4-2 & 4-2U
SunRunner 4-2 & 4-2U clips are the ideal wire management solution for top racking manufacturers such as Unirac, IronRidge, Everest, SnapNRack, and similar rack profiles.

Heyco® HEYClip™ SunRunner®
Double-compression design holds from (1) 12 gauge USE-2 to (2) 8 AWG cables up to 8,3 mm OD.

Heyco® SunBundler® Stainless Steel Wire Cable Ties
Aircraft grade 302/304 stainless wire w/UV protected vinyl jacket and stainless steel crimp sleeve, 8″ (203 mm) to 20″ (508 mm) lengths.

For FREE samples or product literature, call toll free 1-800-526-4182, or visit heyco.com

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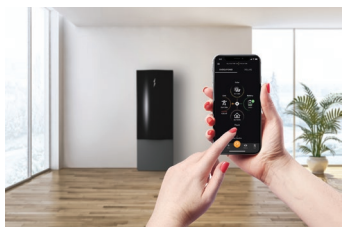
DYNAPOWER COMPANY
Trusted Worldwide Since 1963

Dynapower
The MPS-i125 EHV is a 125kW behind the meter Energy Storage System that combines Dynapower's efficient UL 1741 SA certified MPS-125 EHV with Li-Ion batteries in a temperature controlled NEMA 3R-rated battery enclosure. The compact integrated system is easily deployed on a concrete pad, crushed stone, or on the ground with a forklift and minimal labor, reducing system installation costs for integrators and system owners. MPS-i125 EHV systems can be paralleled together to meet the sizing needs of any behind the meter installation.

www.dynapower.com

ELECTRIQ POWER



Electriq Power
The smart home battery backup system designed to help customers save on electricity costs and protect against blackouts. The PowerPod is an all-in-one energy storage system with 5.5kW and 13.5kWh that is stackable up to 16.5kW and 100kWh.

www.electriqpower.com

H/Cell Energy Corporation
The company designs, deploys, and maintains advanced off grid clean energy systems utilizing solar, battery, fuel cell, and hydrogen generation technology.

www.hcellenergy.com

Hybrid Energy Storage Solutions, Ltd.
HESStec has developed advanced enabling technology in the field of ESS and Smart grids based on power electronics, control electronics, energy storage technologies, software, and energy management systems. All these pieces comprise the SHAD technology, which is the Hybrid Energy Storage System of HESStec. SHAD constitutes a hardware/software platform that integrates the operation of different storage technologies leveraging their synergies thanks to developed behavioral models. The technology offers a continuous range of energy storage solutions from energy to power BESS walking through multiple combinations of storage technologies.

www.hesstec.net

Icarus RT, Inc.
Icarus RT is a PV/thermal technology that converts traditional PV arrays into hybrid systems by collecting the heat from solar panels, storing the heat in a thermal battery, and converting heat to power on demand. The technology is designed for commercial and utility scale applications and increases power availability 25% in real time and provides additional power output from storage for peak demand use. Icarus charges the thermal battery while improving PV array output, resulting in a low cost and a 2.7 year payback.

www.icarusrt.com

KOREPOWER

KORE Power
KORE Power designs and manufactures the 1500V Mark 1 Energy Storage System. Developed to lower installation and operation costs with higher efficiency, the Mark 1 includes proprietary NMC cells and modules, with innovative safety features, managed and optimized by the Mark 1 BMS. Their Mark 1 energy storage system delivers 110.7kWh in a standard rack. KORE Power has 6GWh of production capacity in 2020 with deliveries available as early as Q2 2020.

www.korepower.com

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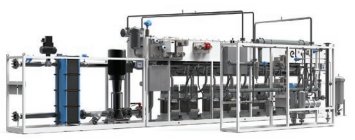

Nel Hydrogen, Inc.
Nel Hydrogen manufacturers Alkaline and Proton Exchange Membrane (PEM) water electrolysers, producing from 0.27 NM3 to 4,000 Nm3 of H2 per hour. Units can be grouped together into electrolyser plants for even larger production rates. Electrolysers are used to store excess electricity from renewable resources in the H2 bond. The H2 can then be sold to industry (converting curtailed power to cash), or burned in a turbine or run through a fuel cell to put the stored energy onto the grid during periods of low generation or peak demand. Due to their fast response times the PEM electrolysers are also used by renewable energy plants to balance the power the plant puts onto the grid.

www.nelhydrogen.com

NextGen NRG

The Multi-Input Power System (MPS) is a renewable energy generation and storage system, which enables users to generate and store their own energy. It can take electricity needs entirely off grid. This system permits up to three natural inputs simultaneously (solar, hydro, and wind) with a single inverter. A generator can be included for installations completely off grid. The MPS is able to power residential, commercial, or industrial buildings. Standard sizes range from 5KW to 500KW, each system can come as a kit, complete with solar panels, batteries, wind turbines, and generators of choice. Customization of the system can be granted to allow up to 1MW.

www.nextgennrg.com

Nuvation Energy

Nuvation Energy's Stack Switchgear (SSG) provides an integrated battery stack management solution that includes all the hardware and software required to integrate a battery stack into an energy storage system (ESS). Each SSG unit contains Nuvation Energy battery management system modules and is designed to be used with other products in the Nuvation Energy battery management system family. SSG configurations can vary depending on system requirements, providing more or less functionality as needed to match the customers' needs.

www.nuvationenergy.com

Sinexcel

Sinexcel, Inc.

The pre-engineered containerized battery energy storage solution, driven by Sinexcel, is not limited to battery technologies, and can support most batteries including lead-acid, lithium-ion, flow battery, and super capacitor. The standard electric room benefit from modular and ETL/CPUC/HECO listed PCS offers maximum space for battery and flexible configuration in AC power and voltage. The built-in transformer, switches, fire suppression, and local controls reduce many complications and cost of installation. There are NEMA 3R rating cabinets and 10/20/40ft containers for different power and energy requirements in community, commercial, and industrial applications.

www.sinexcel.us

SolarEdge

SolarEdge is expanding its StorEdge inverter by transitioning to HD-Wave technology and providing a new backup interface, pre-fitted with an energy meter and an auto-transformer for easier installations. The backup interface can connect to an external power source and ≤3 StorEdge inverters, each DC coupled to ≤2 batteries. The backup interface can provide automatic backup power to the entire home (≤200A) during grid interruptions, or give the homeowner the flexibility to pre-define critical loads. Service-side connection eliminates the need for an additional load board and wiring.

www.solaredge.com/us

Bring It On Mother Nature!

Meet PowerGrip Universal 7

One of the strongest solar anchors in the industry!

All solar mounts work well on calm sunny days when there's no wind, rain or snow blowing around. But for commercial solar arrays, you need a solar anchor that's designed to handle the worst that Mother Nature can dish out!

The new PowerGrip Universal 7 from OMG Roofing Products is designed to handle nature's worst!

It provides up to 2,000 lbf of shear strength, 1,500 lbf of tensile strength as well as the ability to withstand compressive loads of up to 2200 lbf*. In addition, it's compatible with every type of commercial roofing system, easy-to-install, and helps reduce ballast while providing a secure watertight connection directly to the roof deck or structural members.

So next time you're looking for superior performance in a commercial solar anchor, look beyond those sunny day mounts, and consider the PowerGrip Universal 7 instead. When the next storms blow in, you'll be glad you did!

Please visit us at InterSolar, booth 1238, to see the latest PowerGrip anchor technology or contact Kevin Kervick at kkervick@omginc.com for information.

**Third party test report is available from OMG Roofing Products.*

OMG ROOFING PRODUCTS

Superior productivity.
Superior performance.

800·633·3800
www.OMGRoofing.com

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Trimark Associates, Inc.

Trimark develops, installs, and maintains performance management systems for utility-scale power sites. These systems measure, control, and enable users to manage power production, energy storage, and utility interconnections. Trimark's Energy Storage Controller manages and controls Battery Management Systems and PV load and information to ensure power quality, reduce delays, and eliminate grid expansion costs by managing power flow. Trimark's integrated products – SCADA, revenue meters, MET stations, battery energy storage, and microgrid management systems – optimize site performance.

www.trimarkassoc.com

Engineering | Operations & Maintenance (O&M)

EDF Renewables

EDF Renewables offers a full range of services for all phases of renewable energy projects – operations, management, procurement, routine and emergency maintenance, retrofits, and upgrades.

www.edf-re.com

Exactus Energy

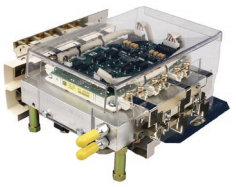
Exactus Energy provides new age engineering and permit plan solutions for solar PV projects of all sizes. Harnessing the power of drone technology, Exactus offers site surveys that are fast, safe, and accurate. Coupled with structural and electrical engineering expertise, Exactus offers a full turn-key solution for PV permit plan sets and designs.

www.exactusenergy.com

Heliolytics

Heliolytics provides aerial inspection, analytics, and consulting services to solve site DC health and performance issues. Their services enable clients to increase energy yields, decrease operational costs, and reduce portfolio risks through advanced analytics and actionable reporting. They have serviced over 32GW of solar projects from 10kW to 800MW internationally. Their proprietary aircraft sensor systems and in-house Artificial Intelligence software have been designed specifically for the PV industry. Their services can turn DC performance from a cost center to a profit opportunity. Based on energy payback alone, their preventative maintenance scans can achieve a positive ROI through a 0.1% improvement in system capacity and on average they find 1.2% of recoverable DC faults offline.

www.heliolytics.com



Ludlum Wind

Ludlum IGBT assemblies are built to last. Assemblies utilize IGBTs with high ratings and enhanced internal construction, new buses, new insulators, new stand-offs, new mounting brackets, new fasteners, and an upgraded new AEBM driver board with surface mount parts. Parts are kept in stock so customers can quickly get the parts they need. All assemblies are shipped with custom steel shipping plates and custom reusable packaging so the parts always arrive safely. Ludlum IGBT assemblies are manufactured and assembled in the USA.

www.ludlumwind.com

POWER Engineers, Inc.

From U.S. urban centers to remote African villages, POWER Engineers delivers solar PV systems that meet complex on-the-ground needs across the globe. Their experienced staff provides owner's engineering, environmental, and engineering design services for medium voltage collection systems, site civil, communications, SCADA, substations, and transmission interconnect lines. They perform upfront interconnection support and complete electrical system studies, as well as construction management, inspection services, and testing and commissioning. Their team lays the foundation to help make the most of an investment by designing reliable and cost-effective plant systems which also minimize O&M costs.

www.powereng.com

Sargent & Lundy

Helping clients evaluate and implement solar technologies is an integral part of Sargent & Lundy's leadership mandate. The firm supports developers, owners, investors, contractors, manufacturers, and research organizations with diverse projects. Experience includes solar resource assessments; owner's engineer; due diligence and conceptual/detailed facility design; as well as grid interconnection for PV, trough, tower, and dish technology. Sargent & Lundy offers complete engineering, project services, and consulting for power generation and transmission projects.

www.sargentlundy.com

SNC-Lavalin

SNC-Lavalin is a global player in the design and engineering of solar projects, including in development support, feasibility studies, and analyses.

www.snclavalin.com

Solar Support

Solar Support is an independent engineering company specialized in inverters and power electronics. Online, on-call, and on-site, Solar Support helps O&M providers and utility asset managers diagnose and resolve PV equipment failures to keep plants running at their max. Solar Support equipment reliability and performance experts bring 22 years of technical experience in corrective and preventive maintenance with more than 800 fault codes on nearly 50 different inverters. Committed to the solar community, Solar Support's online portal is a comprehensive equipment knowledge database for the PV industry, completely open and free to all.

www.solar-support.com

Spark Power

Established in 2004, Northwind, a Spark Power Company since 2013, has been providing wind and solar operations and maintenance (O&M) services. Across Canada and the United States, they've partnered with original equipment manufacturers (OEMs), developers, owners, and O&M Managers to minimize downtime, maximize asset performance, and deliver solutions that keep customer's operations up and running today and better equipped for tomorrow.

www.sparkpowercorp.com

Stellar Energy GP, Inc.

Stellar Energy GP Inc. Is headquartered is California and is a full service solar O&M company. They offer preventative maintenance, repairs, all the way up to complete re-powering. They specialize in systems that are under performing as well as trackers and utilize a high quality module cleaning process.

www.stellarenergy.com

Tropenas Company

Offering engineering services for utility-scale solar and storage, Tropenas Company provides turnkey electrical and civil permit packages. With 4+GW of interconnection applications and designs, their multi-state local engineers will lead any portion of a solar project. Designed blending contractor field experience with value engineering, Tropenas' designs incorporate and clearly communicate lean solutions, enabling fast installation and long durability, improving profitability. Example offerings: stamped electrical and civil permit drawings, independent engineering, medium voltage, and substation design.

www.tropenas.com

Ulteig Engineers

Ulteig supports the development, performance, and design of medium to large, grid-connected, solar electric projects including the C&I Distributed Generation and Utility-scale markets. In addition to medium voltage collection systems, substation, SCADA, transmission, civil, and GIS services, they also specialize in performance evaluation and plant design including DC collections and pile design. Their turnkey solar offering includes services that address all stages of a project's lifecycle, including project development, pre-construction engineering and support, construction support, and O&M.

www.ulteig.com

WANZEK

a MasTec company

Wanzek Construction

Wanzek's solar team specializes in designing, procuring, and constructing complex commercial, community, and utility-scale solar power projects. They approach projects systematically, providing innovative solutions to each project from initial development and design through construction and operations. Their engineering team has the expertise to provide a high level of industry value to their clients by ensuring an accurate feasibility process. Their solar designs are developed with a focus on maximizing investment returns through performance analysis, delivery of bankable designs, high quality equipment, and maximizing project output with minimal life-cycle cost. Wanzek's capabilities include: civil/road/earthwork construction, substation and switchyard construction, transmission line construction, piling and racking installation, panel/module installation, electrical trenching and cabling installation (AC&DC), electrical terminations (AC&DC), equipment placement, commissioning and turnover, and operations and maintenance services.

www.wanzek.com

Westlake Consultants, Inc.

Westlake Consultants supports the solar industry with civil engineering, surveying, and land use planning consulting for site development and installation of solar arrays, high-tech manufacturing sites, and battery storage facilities. Their energy team works in the Pacific NW and select other states offering due diligence/feasibility studies, drainage studies, transportation planning assistance, civil site design, and permitting assistance. They offer a full array of land survey services including field survey, ALTA surveys, and construction surveying. Their experience with difficult sites and knowledge of construction economics enables them to support clients at every stage of project development.

www.westlakeconsultants.com

CURTAILED POWER TO CASH

Nel Hydrogen electrolysers will help monetize excess energy, balance renewable generation, produce high purity hydrogen and provide high value grid services.

- Alkaline and Proton® PEM Technologies
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- Green Hydrogen for Commodity Sale and Marketable Credits
- Ideal for Energy Storage and Grid Management
- 90 Years of Field Experience
- Scale to Match Any Application

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Environmental Consultants | Business Services

Clean Energy Associates

The CEA Commercial and Engineering teams work in parallel with customers to provide on-the-ground support in Asian, US factories, and system job sites, as well as a greater understanding of local business and manufacturing processes to ensure that products ordered are the same as products delivered with Supply Chain Management, Quality Assurance, Engineering Services, and Market Intelligence.

www.cea3.com

Model MA1000
SOLAR PILE DRIVER

International Attachments is the leading supplier of Demolition Equipment for the USA and Canada. With Free Delivery in USA and a 3 Year Warranty on all our products you will be sure we can help improve your job.

INTERNATIONAL ATTACHMENTS

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info@iai-usa.com

Equipment Manufacturer

GRT Utilicorp, Inc.

GRT Utilicorp is a manufacturer of post driving and pressure digging machines. They also provide sales of new and used machines, truck and track mounted machines (for highway median or solar panel post driving), repair and replacement parts, pneumatic rock drills, augers, and equipment for smaller post driving jobs.

www.grtutilicorp.com

Financial Services

BlueFlame Energy Finance

BlueFlame Energy Finance is a specialty B2B energy finance company offering flexible, low friction, non-recourse financing solutions tailored to the specific needs of their customers. They are committed to making renewable energy and energy efficiency improvements accessible and affordable to a wide range of commercial customers nationwide. Their financial offerings include capital leases, operating leases, and PPAs with terms up to 25 years. These flexible financing solutions do not require any corporate or personal guarantees, even for non-investment grade properties, and is a smart alternative to traditional financing.

www.blueflameenergyfinance.com

CleanView Capital
Financing a clean energy future™

CleanView Capital, LLC

CleanView Capital is an equipment finance company specializing in making ownership of solar affordable and profitable for commercial and industrial companies nationwide. The Clean Energy Ownership Program uses a traditional equipment operating lease with attractive purchase options to create an affordable path to ownership at a reduced price. The program appeals to S Corps and LLCs that cannot directly benefit from a federal income tax credit as well as private and public companies seeking to optimize value and avoid budget constraints. Transactions from $100,000 to $10 Million. The program's lessor is a federally regulated bank with more than $80 billion of assets.

www.cleanviewcapital.com

Floating Solar Platform

Ciel & Terre USA, Inc.

The floating solar platform, Hydrelio, enables PV panels to be installed on large water bodies such as drinking water reservoirs, quarry lakes, irrigation ponds, or even tailing ponds. It is a simple and affordable alternative to ground-mounted solar systems. Hydrelio is particularly suitable for energy and water-intensive industries which can't afford to lose either land or water. Wineries, dairy or fish farms, mining companies, wastewater treatment plants, irrigation districts, and water agencies are examples of organizations benefiting from the synergy this technology creates between sun and water.

www.cieletterre.us

Foundations

Concast, Inc.

Concast provides product solutions and supplies their clients with precast concrete materials in a timely manner, while still upholding high quality standards. They have specialized in precast concrete products for the electrical industry since 1969. Their product line includes trench, pull boxes, handholes, vaults, box pads, flat pads, and modular ground sleeves.

www.concastinc.com

Ground Cover Seed

ROUNDSTONE
Native Seed
LLC

Roundstone Native Seed

Roundstone's native seed mixes are designed for a wide variety of land uses and project objectives including erosion control, water quality, native landscaping, and pollinator habitat. They have mixes specially designed for solar applications that will build the soil, increase infiltration, and provide pollinator habitat while improving public acceptance. These mixes are designed to provide wildflower blooms starting in the spring and continuing through the fall. Roundstone Native Seed has a large selection of native seeds, seed mixes, naturalized seeds, and plant materials to meet project objectives.

www.roundstoneseed.com

Ground Screws | Anchors

American Earth Anchors

American Earth Anchors introduces the PE46-Hex8 to their line of penetrator earth anchors. The Hex8 has been field tested to 9,000lbs. of downward pressure and up to 14,000lbs. of pullout strength, and was designed to fit a 2" schedule 40 pipe, making it an option for solar panel ground mount racking. The Hex8 can save time and money by replacing concrete footings providing the advantage of no digging, no forms, no pouring, no waiting, and easy leveling by screwing up or down. American Earth Anchors can also make custom brackets for any pipe size.

www.americanea.com

WORD Rock Drills

WORD Rock Drills' Skid Steer Attachment is a solution for ground screw and helical anchor installation. Their Rock Drill attaches to an existing skid steer, providing enhanced maneuverability and efficiency on the job site. Additionally, the WORD Skid Steer Attachment can easily tackle resistance holes and keep a project on track. With quick delivery times, this attachment can be on the job site in as little as three weeks.

www.wordrockdrills.com

Industrial Networking

Antaira Technologies

Antaira Technologies' LMP-1802G-SFP-T is an 18-port industrial Gigabit PoE+ managed Ethernet switch embedded with 16*10/100/1000Tx Ethernet ports that support IEEE 802.3at/af for a maximum of 30W/port and 2*100/1000 SFP ports. It is IP30 rated, DIN-rail mountable, and supports an extended operating temperature range of -40°F to 167°F (-40°C to 75°C). The switch supports the ring network redundancy function using the market's open standard ITU-T G.8032 ERPS protocol that has a <50ms network recovery time. The advanced network filtering and security functions, such as IGMP, VLAN, QoS, SNMP, RMON, and 802.1X/HTTPS/SSH/SSL increase determinism and improve network management for remote SCADA systems.

www.antaira.com

Inverters

COTEK

COTEK offers five series of pure, sine-wave inverter and inverter chargers for off-grid and backup applications designed to meet the needs of the solar industry. COTEK inverter models range from 200W-4000W with a DC input of 12V, 24V, or 48V. The new SC and SL series of bi-directional inverter chargers come equipped with 5 operating modes and advanced features such as power sharing and current limiting. COTEK also offers standalone inverter and battery charger options through the SP, SD and CX series.

www.cotek.ca

CyboEnergy

The AC assisted off-grid CyboInverter can run AC loads 24/7 with solar power, grid power, or combined power. Taking major loads off the grid and avoiding the headaches of on-grid solar, this is a low-cost system with easy installation, no batteries, and no grid connection fees. Each CyboInverter is 1.25KW and multiple units can daisy-chain. CyboInverters are patented, UL1741 certified, NEMA 6 rated, and made in the USA.

www.cyboenergy.com

Ginlong Solis USA

Designed for high energy yield, Solis 125kW three phase string inverter combines high power density and a maximum efficiency of 99.1% to deliver better LCOE for utility-scale systems. Advantages include 33% higher DC string voltage than 1000V systems, resulting in higher energy density and lower installation costs. DC to AC ratios up to 150% via 20 DC inputs allow for greater generation during lower irradiance conditions, and the option to connect two 125kW units into a 250K system substantially reduces AC cable costs. Offering an integrated utility solution, Ginlong's dedicated U.S. service team guarantees hassle-free commissioning and O&M.

www.ginlong.com

Growatt New Energy

Growatt 8-10kMTLP-US is a solar PV solution for residential systems. It comes with wide input voltage range and maximum efficiency of 97.8%. It's of compact design and is easy to install. With its three MPPTs, the system configuration is easy and flexible enough to fit different roofs. It is compliant with UI1741 SA and CA Rule 21. Furthermore, with Growatt OSS (Online Smart Service) it is convenient for customers to monitor and maintain the PV system from their smart devices.

www.growatt-america.com

Idenergy

Idenergy's residential energy management platform consists in highly efficient solar PV inverter modules as well as battery charger modules (0-200V), compatible with a range of battery chemistries. Lightweight, fanless, and engineered with electricians, homeowners, and smart-grid requirements in mind, it makes systems flexible and scalable. The platform targets the soft costs of solar projects, simplifying design and installation, while also featuring remote control and monitoring capabilities. Exceeding the latest standards, it can also offer grid-edge services by correcting voltage fluctuations due to the advent of DERs and EVs through reactive power injection.

www.id.energy

Ingeteam

Ingeteam's Medium Voltage Inverter Station is a compact, customizable, and versatile plug & play solution that can be configured to suit each customer's requirements. This medium voltage solution integrates all the devices required for a multi-megawatt system, customized up to 5.4MVA. With high adaptability and power density of 5.2W/in³, not only does Ingeteam's Inverter Station offer low CAPEX, but also low OPEX, thanks to its long-lasting design, ease of access and serviceability, and maximum protection. The high-performance design uses electronic conversion topologies capable of achieving efficiency values of up to 98.9%. Its dual channel air cooling system makes it possible to increase the ambient operating temperature for enhanced functionality, thus maximizing return on investment. The INGECON SUN Power B Series is certified in compliance with UL 1741 SA and pairs well with INGECON SUN STORAGE Power three-phase bidirectional battery inverters.

www.ingeteam.com

Northern Electric and Power, Inc.

NEP USA is headquartered in San Jose California. NEP Module Level Rapid Shutdown (RSD) device uses NEP developed algorithms and ICs. In addition to module level Shutdown, it supports module level monitoring for trouble shooting and provides module level monitoring of voltage/current/power/temperature for string inverters with no additional cost. The RSD device has panel and system level ove temperature protection and automatic shutdown as well as configurable panel level protection functions and a robust signaling design with no system cross talking and a very wide panel and system PV input voltage range. The RSD device is SunSpec signal compliant.

www.northernep.com

Rhombus Energy Solutions

Rhombus DC-Series, Multi-Port, Bi-Directional Universal Power Converter (UPC) is a one-size-does-more concept, and the latest addition to their Power Conversion System products. The UL Approved DC-Series provides reliability and flexibility with two power stages that can be configured in multiple ways and an integrated transformer lowers installation costs while providing grid isolation. The DC-Series includes a user interface software test suite for battery development and validation, while the compact footprint provides easy single point DC and AC installation.

www.rhombusenergy.com

Schneider Electric

Schneider Electric provides mature residential solar and storage solutions. Conext XW Pro storage inverter is certified to Rule 21 and offers high surge power, integrated transfer switch, and optional backup generator integration. Conext MPPT 80 600 charge controller offers high performance, accompanied by an easy-to-install and cost-effective rapid shutdown for NEC 2017 compliance, MPPT Disconnect RS. Their monitoring software, Conext Insight 2, provides cloud-based energy management. Schneider Electric products are compatible with multiple batteries, making it easy for installers to design solar + storage systems.

www.solar.schneider-electric.com

Sol-Ark

Sol-Ark 12K makes solar storage affordable due to efficiency and integration. Installers appreciate Sol-Ark's easy-to-install plug and play, all-in-one design. Key features include: standard 10-year warranty, dual 500V MPPTs generate up to 12kW of PV power to Grid/UPS loads/batteries simultaneously, TOU applications, automatic On/Off Grid, parallel stacking up to 4 systems for 48kW of production using up to 66kW of PV and up to 352kWh of batteries for small commercial, 120/240/208 with one or more systems, rapid shutdown NEC2014/17 compliance, DC couple 1.5kW to 16.5kW and separate AC coupling up to 7.6kW of solar in one system.

www.sol-ark.com

SOLAR FLEXRACK™
A Division of Northern States Metals

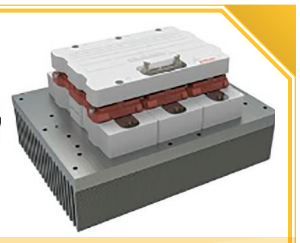
Whether it's a full turnkey solar tracker project, fixed tilt racking or almost any kind of ground-mount foundation you can imagine, Solar FlexRack offers utility-scale and commercial solutions engineered for fast installation and reliable performance at cost competitive pricing, but don't just listen to us, listen to what customers say about us.

solarflexrack.com 1.888.380.8138 info@solarflexrack.com 3207 Innovation Place, Youngstown, Ohio 44509

TMEIC Corporation

TMEIC introduces the Solar Ware Ninja, a photovoltaic inverter and energy storage system. The advanced PV inverter is modular and stackable for multiple PCS power blocks. The system is configurable into multiple solutions, including PV only, stand-alone energy storage, or as a PV+ESS independent solution. Application flexibility is built-in, with multiple ratings allowing customization for small, 2MW projects up to large-scale projects.

www.tmeic.com



WECS Renewables

Since 1982, WECS Renewables has supported the growing marketplace needs for North American solar components and Substation interconnection along with wind energy and storage. WECS inventories electrical, mechanical, and hydraulic O&M and new construction components from substation to MC4, IGBT to circuit breaker, transformer to motor. WECS can provide inventory to repair or solutions to redesign. WECS solutions include MV, LCDC, and LVAC parts from Semikron, TE, ABB, Schneider, Burndy, 3M, Siemens, and includes DC cable connectors, inverter internal components , DC bus and connections, combiners and internal parts, and new construction MV T-bodies and splices to link the solar array.

www.wecsrenewables.com

IPP

Switch Power

As an Independent Power Producer (IPP), Switch focuses on capital deployment in long-term infrastructure assets through creative projects, creative financing, and creative commercial structures. Switch provides innovative and sustainable power generation solutions by meeting load customers needs by lowering electricity costs through physical supply with multiple technologies and filling grid capacity with low-cost electricity supply from sustainable sources. They provide resiliency and ancillary services to both physical customers and the grid with energy storage, as well as utilize energy management and predictive market algorithm-based software systems.

www.switchpower.ca

Legal Services

McCauley Lyman, LLC

McCauley Lyman is a renewable energy law firm. They advise and represent business people in their transactions and have particular expertise in the renewable energy industry, including developing and financing energy projects. They help people negotiate contracts, obtain permits, acquire real estate, arrange financings, and buy and sell energy related businesses and their assets. They understand the need for timeliness, cost control, and practicality. McCauley Lyman is in an alliance with Barclay Damon, LLP, a National Law Journal Top 250 Firm, which provides their clients with access to Barclay Damon's 33 practice areas.

www.mccauleylyman.com

Sherin and Lodgen LLP

Sherin and Lodgen's national renewable energy practice group represents lenders, developers, municipalities, and companies committed to sustainability through solar, wind, hydro, and energy storage initiatives. Clients rely on their experience in financing, development, acquisition, leasing, environmental, and permitting to navigate this ever-changing market and accomplish their business goals.

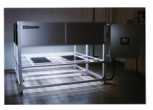
www.sherin.com

Troutman Sanders, LLP

Troutman Sanders Renewable Energy attorneys offer innovative legal solutions to help clients succeed in the solar energy industry. Their understanding of the ever-changing legal landscape is built on over a century of service to the electric power industry. They provide legal advice to independent power producers, developers, financial, utility, industrial, and government clients in energy-related businesses in the U.S. and internationally.

www.troutman.com

Light Spectrum Systems



EYE Iwasaki- Applied Optix

EYE Applied Optix / Iwasaki Electric is developing light-applied system solutions that provide uniformity, performance, and energy efficiency. They design and manufacture an integrated approach including the lighting source (lamp) along with the solar simulation equipment. Their systems are designed from inception around the proper lighting source for the particular application. This ensures efficient system performance. UV and Full Spectrum lighting for accelerated UV environmental chambers, soaking/UV preconditioning applications, module qualification/testing/durability.

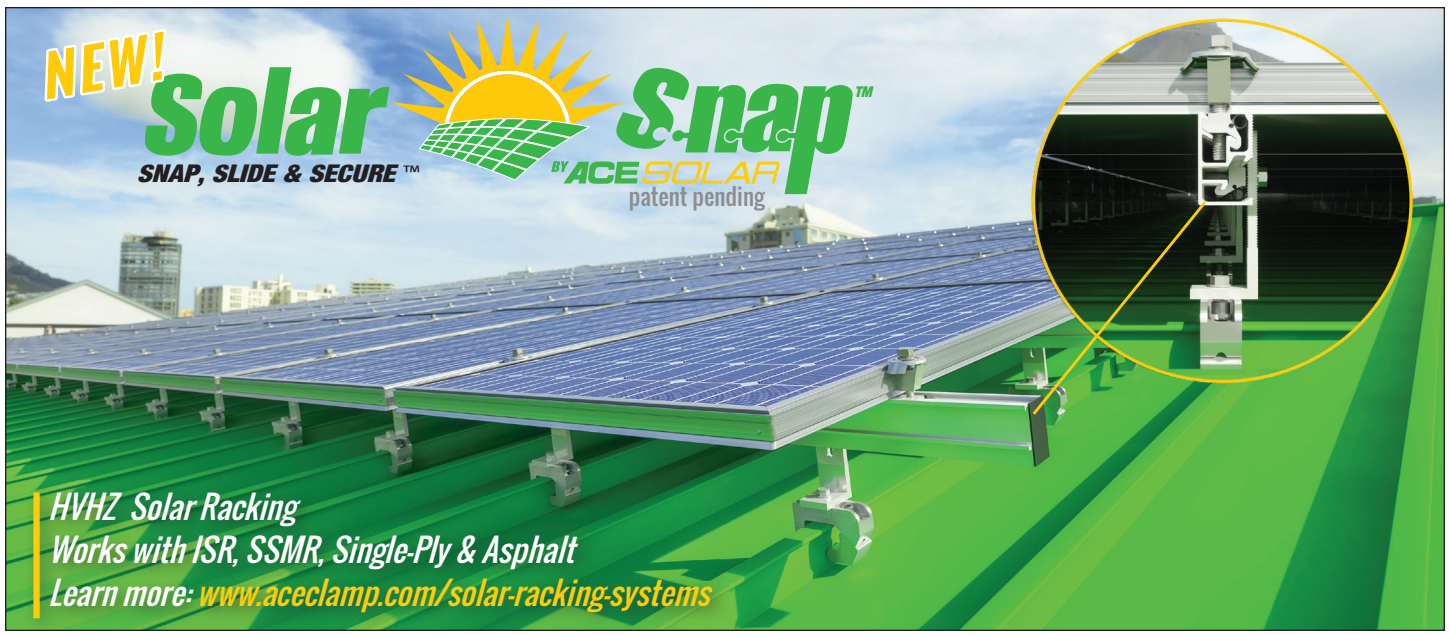
www.eyeappliedoptix.com

Microgrids

Sustainable Power Systems, Inc.

Sustainable Power Systems' Universal Microgrid Controller (UMC) is a drop-in control system designed to reduce the cost and complexity of microgrid deployment. It is engineered to meet the needs of a wide spectrum of microgrid configurations, grid-tied or off-grid, eliminating the need for solar project developers to do controls integration and custom programming. The UMC incorporates a real time optimization engine, including load and renewable forecasting, to ensure the lowest cost of energy. In Simulation Mode, the UMC monitors and controls a virtual version of each microgrid component, allowing for system validation and training prior to deployment.

www.sustainablepowersystems.com



Microinverters

APsystems

The QS1 from APsystems is a four-module, high-power microinverter for residential applications. A new design for APsystems, the QS1 offers 300% faster installation time, while offering high peak output power and up to 3X faster transmission speed. A wide MPPT voltage range will result in a greater energy harvest for homeowners. The first of its kind, the QS1 is designed to accommodate today's high output PV panels, offer enhanced capability, and significantly reduce installation time and costs while providing a high level of power with four independent MPPT per channel.

www.usa.apsystems.com

Enphase Energy

Enphase Energy is a global energy technology company that delivers smart, easy-to-use solutions that connect solar generation, storage, and management on one intelligent platform. The Company provides microinverter technology and produces an integrated solar+storage solution. Homeowners can pre-order storage systems based on Enphase Ensemble energy management technology for the Always-On capability that keeps homes powered when the grid goes down, and the ability to save money when the grid is up. Enphase delivers reliability through a distributed architecture with no single point of failure, resistance to extreme temperatures and humidity, upgradeability through semiconductor technology, and a cooling system with no moving parts.

www.enphase.com

NEF Power, Inc.

NEF Power is providing micronverter, rapid shutdown, and optimizer solutions to the U.S. market. Their dual-module microinverter is suitable for 60- or 72-cell PV modules up to 375W. 240V or 208V. Rule 21 compliant; provides the junction of the inverter's AC output side and grid connection (12AWG, drop length: 2.4m).

www.nefpower.com

Modules

www.axitecsolar.us

AXITEC®

high quality german solar brand

Axitec Solar

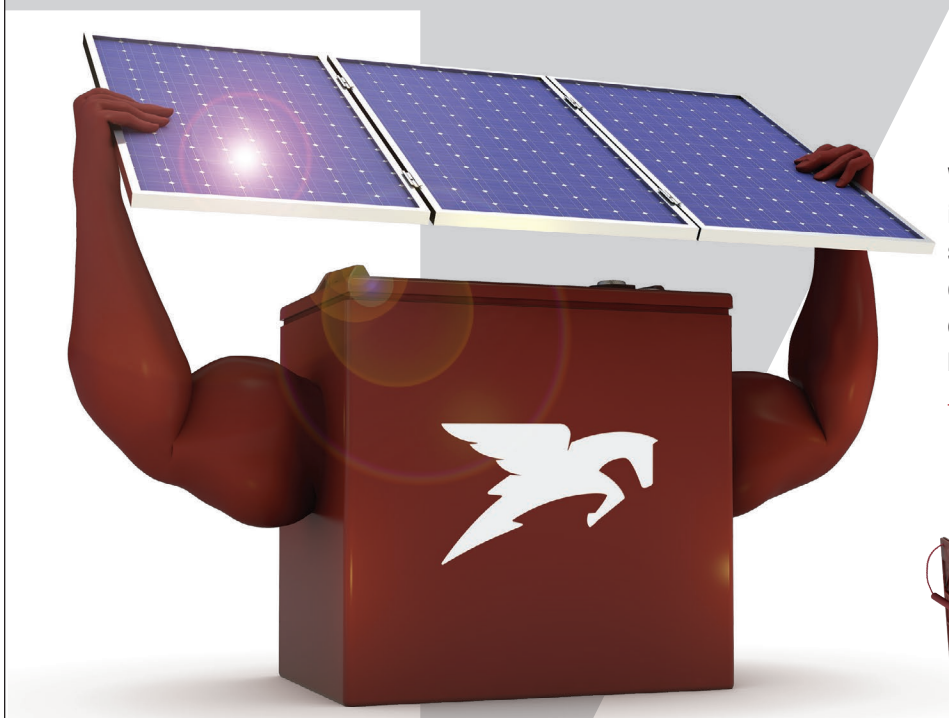
The monocrystalline solar module of the new AXIpremium HC series is an all-purpose choice among solar modules, for rooftop or ground-mount installations. The AXIpremium solar modules have an efficiency up to 20.38% providing a high energy yield and return of investment.

www.axitecsolar.com

TROJAN BATTERY COMPANY

ENERGIZING

THE SOLAR STORAGE NEEDS OF TOMORROW.



We don't just manufacture batteries - we innovate, engineer and develop energy solutions. We provide extraordinary life, quality, and performance for all your off-grid and mini-grid applications. At Trojan Battery Company, we're charging forward.

Learn more about all of Trojan's renewable energy batteries including our new Lithium Ion solutions.

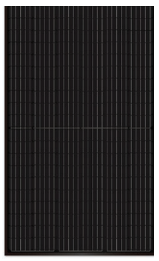
trojanbattery.com

Canadian Solar, Inc.

Canadian Solar HiDM (CS1H-MS) is a high-density, small-format, shingled, mono-PERC module providing up to 335W of electricity. Maximized light absorption area means this module's efficiency can reach over 20%. Sleek, all-black aesthetics blend into the roof and an innovative stringing design makes this a highly shade-tolerant module in both the horizontal and vertical directions. This module is suitable for residential rooftop installations, where homeowners want to inconspicuously maximize energy output in a limited space.

www.canadiansolar.com

CertainTeed SAINT-GOBAIN



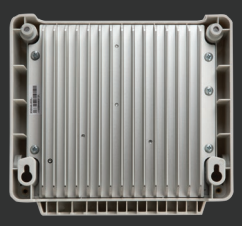
CertainTeed

CertainTeed's CT Series 120 half-cell and 144 half-cell modules utilize the next generation of mono PERC half-cut cells for high output, producing up to 330W and 400W, respectively. These high-efficiency panels are available individually or as part of CertainTeed's Solstice solar system, which features an all-in-one comprehensive warranty including installation workmanship when installed by a CertainTeed-credentialed installer.

www.certainteed.com/solar

MORNINGSTAR
PROFESSIONAL SERIES
World's Leading Solar Controllers & Inverters

QUALITY 25+ years 1993 | 2019 EXCELLENCE



We
DARE
TURN OUR
BACK ON YOU

At Morningstar, this is our best side.

Because we make the only complete line of full-powered solar controllers that doesn't need cooling fans. From our single-module SunGuard to our breakthrough 600V TriStar, Morningstar controllers keep their cool more intelligently, through advanced thermal engineering.

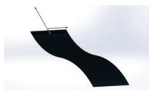
That means unlike our competition, our controllers have no moving parts to fail, no fans to suck in dust and depris, no fan motors to effect solar harvest. It's one reason why professionals in the oil & gas, telecommunications, security and other industries have put over four million Morningstars into their mission-critical installations since 1993—and why you should too, on your next project.
www.morningstarcorp.com

LG Life's Good

LG Solar USA

The LG NeON R ACe offers fast, easy installation with a small, built-in micro-inverter on the back of each high-efficiency 60-cell module replacing the junction box. The micro-inverter produces AC power with no external DC wiring or connectors. DC power is converted to AC at each module, and the power is then fed into the home. Individual modules can be monitored on a PC or mobile phone with LG's EnerVu software to help identify external shading and aid system troubleshooting, while also tracking module and system production. The NeON R ACe is guaranteed to produce 98% of nameplate power output in the first year and 90.80% at the 25th year. Modules and micro-inverters are covered by a 25-year limited product, performance, and labor warranty.

www.lg.com/us/solar



MiaSole

The FLEX-03W is a 500W CIGS flexible, lightweight, and shatterproof thin-film PV module that provides high power density for many types of applications, from roofing to transportation and beyond. The modules will not shatter when struck by rocks and hail, and they can conform to curved surfaces, expanding opportunities to add solar to a greater number of surfaces. The modules have >16.5% cell efficiency. The FLEX-03W module bonds to the roof surface with a simple peel-and-stick adhesive. This adhesive approach eliminates the need for racking and surface penetrations and provides strong resistance to wind and seismic events.

www.miasole.com

PowerFilm Solar

PowerFilm specializes in remote, portable solar solutions designed and built to meet customer requirements for performance and form factor. Controlling each step in engineering, design, and production, PowerFilm delivers high-quality systems with guaranteed performance. Their amorphous silicon functions at low light levels make it a solution for not only traditional outdoor IoT applications but also indoor use. Panels have been used for a wide range of applications including solar tents for the Army, powering electronics on a space exploration vehicle, custom asset tracking solutions, and indoor BLE sensors. PowerFilm has been developing and manufacturing its flexible solar technology for over thirty years in the United States.

www.powerfilmsolar.com

Q CELLS

The Q.PEAK DUO BLK-G6+ is manufactured with larger cells for 6% more power, equivalent to up to 345Wp. It is assembled at Q CELLS' Georgia facility, and offers long-term reliability with a 25-year product warranty and a low degradation rate, guaranteeing 85% initial performance in the 25th year.

www.q-cells.us

REC Americas, LLC

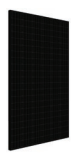
REC's Alpha delivers high power density on a 60-cell module, reaching 380Wp at 21.7% efficiency. The Alpha produces 20% more power, thereby reducing balance of system costs. Emerging from REC's half-cut cell technology, Alpha combines the benefits of crystalline silicon solar cells, thin film technologies, and 120 half-cut heterojunction cells with advanced connection technology to deliver high efficiency and energy yield, even at higher temperatures. Additionally, its 'Twin Panel' design delivers high performance in shaded conditions. Available in a black frame with black or white back sheet.

www.recgroup.com/alpha

Shinsung E&G Co., Ltd.

Shinsung E&G was established in 1977 and has been working in the PV business since 2007. Currently, they manufacture solar cells and solar modules at their factory in Korea under continuous R&D and with strict quality control. Their newly developed high-efficiency PowerXT PERC solar cell has achieved a 21.7% efficiency rate.

www.shinsungeng.com



Silfab Solar

Silfab Solar is a North American automated solar manufacturer with over 35 years of experience within the PV industry. Their fully automated facilities ensure precision engineering and reliability to produce high quality modules with low defect rates. (48.18 PPM Dec 2018). Lightweight and durable, their modules are engineered to weather low load-bearing structures up to 5400Pa. Silfab's BC Series-SIL-330 BL PV module utilizes 126 high-efficiency, half-cut cells combined with a conductive backsheet resulting in improved quality, reliability, and a sleek, black-on-black aesthetic. Made in Washington State, the SIL-330 BL is backed by their 25- and 30-year product and performance warranty.

www.silfabsolar.com

Sky Energy

SKY Energy markets new Lightray Solar photovoltaic (PV) modules and systems to commercial and residential customers and offers consulting services. Lightray Solar modules convert light from the sun into electricity that can be used to power buildings, homes, and electric vehicles through thin solid state silicon solar cells.

www.sky-energy.com

SOLARIA®

Solaria Corporation

Solaria's high-output solar panels deliver maximum energy production in a streamlined, all-black design that complements a home's architectural style. Solaria's advanced PowerXT 370W panels pack maximum power into minimum space for high efficiency. PowerXT 365W AC panel provides a pre-engineered system to maximize performance and optimize cost-effectiveness. Solaria's solar panels are backed by a 25-year warranty.

www.solaria.com

Sonali Energees USA LLC

Sonali Solar Energees USA now has a warehouse in New Jersey and offers 60- and 72-cell monocrystalline modules at competitive pricing. Sonali Solar also specializes in 3W to 250W 12V products for off-grid applications.

www.sonalisolar.com

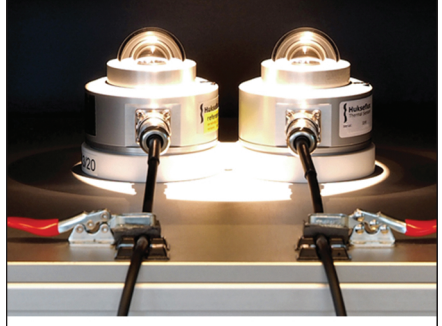
SUNTEGRA®

SunTegra

SunTegra's solar roof systems integrate solar with any new roof or reroof project. They offer homeowners a low-profile, roof-like appearance, and replace roofing materials, enabling added savings. A SunTegra Shingle or Tile solar roof system is a solution for builders, roofers and, solar integrators. SunTegra products are designed with proven materials, are easy to install, and feature a patented design which promotes cooling through ventilation.

www.suntegrasolar.com

iso-cal™ north america



Calibrating to a higher standard

Solar Radiometer Calibration Services

ISO-CAL provides fast, reliable, ISO/IEC 17025 and ANSI/NCSL Z540 accredited solar radiometer calibration services: WRR, WISG and/or NIST traceable.

Equipped to calibrate any pyranometer or pyrheliometer model type, ISO-CAL offers both indoor and outdoor Primary or Secondary reference calibration services in accordance with all ISO and ASTM calibration standards.

Supported sensor types:

- Pyranometers
- Pyrheliometers
- Pyrgeometers
- UV Sensors
- Net Radiometers
- PAR Sensors
- LUX Sensors
- Spectroradiometers

ISO IEC ISO/IEC 17025 · ANSI | NCSL Z540 1-1994 / 3-2006 · ASTM INTERNATIONAL MEMBER

480-336-8133
info@isocalnorthamerica.com
www.isocalnorthamerica.com

SR30 | Digital Secondary Standard Pyranometer

Join the evolution...

ev·o·lu·tion
/ˌevəˈlo͞oSH(ə)n/

noun
The gradual development of something, especially from a simple to a more complex form.

When it comes to superior performance, even Darwin would agree the latest SR30 pyranometer from Hukseflux is the natural selection.

SR30 pyranometer employs an internal, low power, maintenance-free ventilation system with heating, rendering larger higher power/ high-maintenance external ventilators obsolete. The SR30 is locally supported in the U.S. and backed by a 5-year warranty.

- Superior measurement accuracy
- Highest data availability
- Low cost of ownership
- Most value added features standard
- Performance validated (test data included)
- Compliant with latest ASTM & IEC standards

New

Low-power internal ventilation with heating via digital control over RS485 / Modbus (patent pending)

Internal ventilation port
Easy-view bubble level

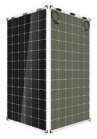
HuksefluxUSA™

631-251-6963
info@HuksefluxUSA.com | www.Hukseflux.com

SunWize Power & Battery

SunWize Power & Battery solar modules come in 5W to 320W designs and are suitable for all industrial and battery charging applications. Available in nominal 12V or 24V configurations, these modules feature Class 1, Division 2 certification (Groups A, B, C & D) for use in hazardous locations and are also UL 1703 listed. Impact resistant glass and 50mm thick anodized aluminum frames provide durability in even the harshest environments. Each module contains up to (2) bypass diodes to protect against hot-spot damage during partial shading. Durable junction box design has (4)-1/2" conduit knockouts for design flexibility. With a -0/+3% power output tolerance, a 5-year warranty on material workmanship, and a 20-year pro-rated warranty for performance, SunWize solar modules are a solution for off-grid sectors like oil & gas, industrial controls, security, wireless communication, transportation, and environmental monitoring.

www.sunwize.com



Trina Solar

Trina Solar DUOMAX TWIN family with a 30-year power warranty is a PID resistant, reliable, and durable dual glass bifacial module. Certified against weather phenomena beyond industry standards, the DUOMAX is engineered for extreme climates with higher lifetime power. The 1500V system voltage allows more modules per string thus reducing BOS costs. With just a 2% LID and 0.5% annual degradation rate, these modules deliver up to 40% more lifetime energy than a conventional module when paired with a single-axis tracker and white reflective albedo. The 2mm AR coated glass layers and custom frame design enables ease-of-use and compatibility with standard installation methods.

www.trinasolar.com

Vikram Solar

Vikram Solar's upcoming Somera P-Duplex 144 half-cut cell framed bifacial module with transparent backsheet will provide up to 15% power gain from ground facing side. Vikram Solar modules have been successfully audited by Black & Veatch 2019.

www.vikramsolar.com

YINGLI SOLAR

Yingli Green Energy Americas

The Yingli solar panel family features differentiated product lines ideal for residential, commercial, and utility-scale projects. They offer in all formats the monocrystalline YLM Series, multicrystalline YGE Series, and both p- and n-type PANDA Bi-facial modules to meet project needs. The cell efficiency on the premium modules reaches up to 22.7%. Service on products is provided by a US based team, who assist in technical advice, project planning, and guarantee to maximize ROI.

www.yinglisolar.com/us

Online B2B Exchange

EnergyBin

EnergyBin is a wholesale solar B2B exchange, allowing users to buy and sell new, used, excess, refurbished, and hard-to-find solar panels, inverters, racking, batteries and more at 20% - 70% below cost. Customers can build new business relationships, search pricing on major brands, gain real-time market intelligence on pricing, supply, and demand, and send and respond to quotes for single parts and full systems. Over 1000 solar companies, including solar manufacturers, distributors and suppliers, developers, EPCs, and installers, are members of EnergyBin. Members oversee projects in the residential, commercial, agricultural, industrial, and small-scale utility markets.

www.energybin.com

Performance Monitoring

Accuenergy

AcuDC is a specialty energy meter suitable for distribution systems that involve DC power generation. It is used for monitoring solar PV energy generation, wind turbine power generation, power distribution, and other direct current applications.

www.accuenergy.com

Apogee Instruments

Designed to optimize performance and price, the upward-looking model combines a blackbody thermopile detector and acrylic diffuser, and keeps the price close to that of silicon-cell pyranometers. The downward-looking model combines a blackbody thermopile detector and flat glass window. It performs similarly to domed downward-looking thermopile pyranometers, but without the cost of the dome. Combine to give incoming and reflected solar radiation.

www.apogeeinstruments.com

Cachelan

Cachelan

Cachelan is a solar monitoring solutions company that provides SCADA and DAS systems to help with O&M and Asset Management of solar and storage portfolios via their SolarVu platform. Manage portfolios of residential, commercial/industrial, and utility sized projects in one place. Receive high fidelity alerts of equipment issues and connect weather sensors, meters, site cameras. Easily compare inverter and string level performance. Cachelan interfaces with all major inverter and equipment manufacturers, and design to minimize their customer's cost.

www.cachelan.com

Campbell Scientific, Inc.

The Meteo PV is a purpose-built, modbus data logger and aggregator, suitable for distributed PV monitoring or functioning as a secondary weather station on utility-scale solar farms. The MeteoPV offers easy-to-create field commissioning reports, sensor metadata and management, and a communications troubleshooter. This PV platform can be easily integrated into existing PV monitoring systems and is compatible with a variety of pyranometers, module temperature sensors, and compact weather stations. With no data logger programming necessary, the MeteoPV is a simple solution for increased sensor densification and management in PV SCADA networks. That's because the MeteoPV includes an embedded web server that simplifies basic data analysis and automatic commissioning report generation. The interface also records and stores historical data, protecting it from network and power outages. Designed to deliver key PV resource data, the MeteoPV is made with Campbell Scientific reliability and quality, guaranteeing simplified data-collection.

www.campbellsci.com

eGauge Systems

The eGauge combines an energy meter, data logger, and a web server. This powerful combination lets users measure, store, and retrieve data directly from the device or from a remote location. Not only does it calculate power (V, A, VAr, kWh, etc), but also data from optional sensors that assess flow rate, temperature, wind speed, and more. Users can view historical and live data for up to 30 years with the unit's convenient user interface (UI). The UI can be accessed on a local network or via the internet from a computer, tablet, or smartphone. Once connected, users have access to real-time values, long-term reports, an interactive graphical interface, and many other tools.

www.egauge.net

EKO

EKO Instruments

With revisions to the ISO 9060:2018 Solar energy, specification and classification of instruments for measuring hemispherical solar and direct solar radiation, the MS-80 is Class A (previously referred to as Secondary Standard) with the additional specification of being a spectrally flat and fast response (<0.5 sec) pyranometer. MS-80 utilizes advanced pyranometer technology while remaining cost-effective for all applications. Combined performance gains have occurred in response time (<1sec) and reduction in thermal offsets. These improvements provide low field measurement uncertainty at an affordable price. When combined with the MV-01 heated ventilator, the MS-80 meets high requirements (Class A) for PV monitoring based on IEC 61724-1:2017. Users will also benefit from reduced maintenance costs by not needing to recalibrate or exchange desiccant for a minimum of 5 years. Every MS-80 comes standard with an ISO 17025 calibration including individual instrument directional and temperature response reports.

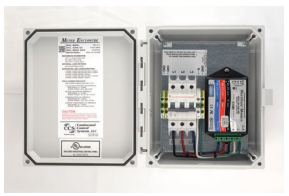
www.eko-usa.com

HukseFluxUSA

HukseFluxUSA, Inc.

The new digital SR30 Secondary Standard pyranometer features an internal maintenance-free heated ventilation system. The circulation of heated air flow between the inner and outer domes suppresses the formation of dew and frost on the pyranometer optic. With < 2.1 Watts max power consumption, SR30 delivers a high level of performance and data availability. Critical sensor data, including irradiance, sensor serial number, and calibration data, are all available via RS485 RTU / Modbus connection. The sealed desiccant cartridge free design with internal ventilation translates into reduced sensor maintenance and cost of ownership.

www.hukseflux.com



CCS Continental Control Systems, LLC
Socomec Group

Continental Control Systems

Continental Control Systems is now offering fully assembled WattNode Energy Meters in UL 508A NEMA metal and poly enclosures. Enclosures are available with a three-phase circuit breaker, a fuse block, or without circuit protection. Any model of the WattNode; the revenue-grade meter or standard accuracy meter comes preinstalled when ordered with the enclosure. Designed for indoor and outdoor installations, the enclosure complies to UL 508A Type 3R, 4, 12 and 13. Fully assembled meter enclosures can be ordered through their e-commerce site.

www.ctlsys.com

COTEK SC Series
Pure Sine Inverters Chargers

KEY FEATURES:

Available in 1200W and 2000W
Bi-directional with 5 in 1 operating modes
Built-in 3 stage battery charger and AC transfer switch
Temperature compensated charging option
-5o~105oF full load operation with derating up to 140oF
UL458 and UL1741 certified for mobile and residential
Lightweight high frequency design
Adjustable power saving options

The new SC bi-directional inverter charger takes advantage of the most recent technology to provide features such as Power Sharing, Power Generation and Current Limiting. Unique multi input capability allows for seamless switching and control of both AC and DC. Multiple inputs can be combined to satisfy larger power requirements or limited to match your unique application. The SC provides an array of advanced features in a light weight and cost effective package.

COTEK

COTEK *The Americas* - now serving Latin America!
For complete product specifications visit: www.cotek.ca

OTT HydroMet

Kipp and Zonen's DustIQ can be easily added to new or existing solar arrays and integrated into plant management systems. The unit is mounted to the frame of a PV panel and does not need sunlight to operate. It continuously measures the transmission loss through glass caused by soiling, so that the reduction in light reaching the solar cells can be calculated.

www.otthydromet.com

Seaward

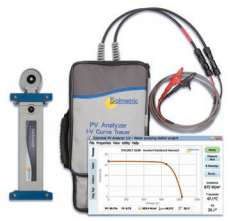
Seaward manufactures a range of electrical safety and performance measurement equipment for solar PV applications. The PV210 Solar PV Tester and I-V Curve Tracker is a compact and cost-effective multi-function tester. It offers a comprehensive range of tests to quickly prove the safety and performance of PV modules and strings. With simple push button operation, it is an efficient and versatile tester for measuring ground (earth) continuity, open circuit voltage, short circuit current, maximum power point voltage, current, and power (with AC/DC clamp).

seawardsolar.com

Solar-Log by Solar Data Systems

The Solar-Log Base combines detailed performance monitoring with advanced energy management. Components from over 100 manufacturers can be connected to the Solar-Log Base, reducing fleet management down to one single portal and one single login. New highlights include 4GB of internal storage, integrated communication test feature, modular design for flexibility, compact design, and communication ports for controlling consumers.

www.solar-log-america.com



Solmetric

The Solmetric PV Analyzer I-V Curve Tracer measures the performance of modules and strings up to 1500V and 30A. The wireless irradiance and temperature sensor captures environmental conditions at the time of the I-V sweep. Sophisticated software instantly determines the performance factor, fill factor, Isc, Voc, Imp, Vmp, Pmax, current ratio, and voltage ratio. Careful thermal management inside the tool ensures high measurement throughput enabling large systems to be commissioned quickly.

www.solmetric.com

Spectrafy Solar Sensors

Spectrafy Solar Sensors supplies spectrally enhanced ISO9080:2018 Class A rated irradiance sensors. Remove spectral noise from plant metrics, reduce performance uncertainty, track degradation, and quantify benefits of competing technologies.

www.spectrafy.com

Storage Battery Systems, LLC

EqualLink Battery Management System actively manages batteries to increase reliability and extend life. EqualLink can monitor current, ambient/room temperature, humidity, hydrogen gas, and electrolyte levels. Through available Form C contacts/relays, EqualLink can also monitor electrical equipment such as UPSs, inverters, transfer switches, generators, and air conditioning systems.

www.sbsbattery.com

SunSniffer GmbH & Co., KG

SunSniffer is condition-based plant analysis with artificial intelligence for all PV plant levels - panel, string, inverter - with high precision measurements and Digital Twin technology. SunSniffer delivers the exact amount of losses of each panel in dollars, together with sound service advice. In addition, the SunSniffer's virtual flasher is able to present STC values of each panel during operation in the field for real comparability. Automated diagnostics provide cost/profit analysis. Each level can be served separately, providing deep insights to minimize losses and maximize profit.

www.sunsniffer.de

EPPLEY

The Eppley Laboratory, Inc.

Eppley Lab is a US manufacturer of Class A Pyranometers used for site selection, prediction, and performance testing of PV power plants. Eppley's GPP Pyranometer is now available in analog or digital output to provide customers with reliable, bankable data of global, plane of array, and aldebo/bifacial measurements of solar irradiance.

www.eppleylab.com

Trimark Associates, Inc.

Trimark Vantage User Interface is a scalable and flexible visualization tool that provides real-time SCADA information and data from inverters, trackers, meters, weather stations, and substation equipment to determine if equipment at PV sites is operating and performing at expected levels. Operators can monitor and control performance for individual devices, a site, or an entire portfolio – all in a single, intuitive dashboard. Users can customize thresholds, alarms, dashboards, and reports to quickly assess PV performance and power generation. Performance management confirms that all site equipment is performing at expected levels, enabling data-driven decisions based on asset performance.

www.trimarkassoc.com

Portable Solar

California Sunlight Corporation

California Sunlight Corporation offers cost-effective, high efficiency, and portable solar energy systems such as solar generator, solar security light, solar table lamp, solar-powered BBQs, solar water heaters, and solar balloon cookers. The latest product line is a solar powered portable AC generator from 100W to 3,000W with integrated solar panels, battery, inverter, and controller. It's suitable for use in everything from camping, emergency responses, sustainable living, to lighting, charging, cooking, and cooling in developing countries.

www.california-sunlight.com

Position Sensors

POSITAL-FRABA

POSITAL's rugged and reliable TILTIX inclinometers and IXARC rotary encoders are suitable for monitoring and controlling the position of solar power systems, including photovoltaic arrays and CSP systems based on parabolic trough collectors or tower/heliostat arrangements. POSITAL position sensors are designed for harsh conditions and are available with environmental protection up to IP69K. Communications interface options include analog, SSI, CANopen, Modbus, and Industrial Ethernet. With a wide variety of mechanical configurations available, POSITAL sensors are a good fit for projects of any size or budget.

www.posital.com

Power Engineering and Consulting

Electric Power Engineers, Inc.

EPE Consulting provides the following services; transmission and distribution planning and design, energy market analysis, project/system design, interconnection testing and commissioning, NERC compliance services, integrated resource planning, smart grid modeling, and power system studies.

www.epeconsulting.com

PV Distributors

Atlantic Clean Energy Supply (ACES)

ACES offers no-tariff solar panels, top tier solar panels, inverters, Battery Energy Storage Systems (BESS), EV chargers, solar mounting systems, trackers, PV lab testing equipment, international RECs transaction, community solar project co-development, and is a financing provider.

www.atlanticces.com

PV Installers

Baker Electric

The Baker Renewables C&I Group is an experienced and reputable electrical contractor serving Southern California for the last 80 years. With over 130 installations completed, Baker's team of professionals analyze building data and present best fit solutions. Baker Electric's resume includes projects for commercial buildings, non-profits, education facilities, and government/military installations. Baker provides in-house design and installation services for solar, storage, and microgrid systems. Baker has a large team to support their projects with an in-house staff which includes engineers, designers, estimators, project managers, electricians, and LEED and NACEP Certified employees.

www.baker-electric.com

Baker Electric Home Energy

San Diego-based Baker Electric Home Energy has designed, engineered, and installed solar and solar + home battery systems for 13,000 homes in Southern California. Baker gives people control of the way they generate, store, manage, and use energy. This offers homeowners the benefit of significant cost-savings and energy independence.

www.bakerhomeenergy.com

PREFORMED LINE PRODUCTS

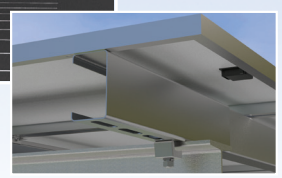
SOLAR CARPORT

Ready-Made Shade Structure

- Modular design – common components
- Shared PV module clamps – up to 50% fewer clamps
- 0, 5, and 10-degree tilt options – positive or negative
- Purlin extensions adjust to any width module

800.260.3792

preformed.com



Purlin Extension

Shared Module Clamp

Hannah Solar Government Services, LLC

Hannah Solar Government Services, LLC (HSGS) is a service-disabled veteran-owned renewable energy company with core expertise in providing solar energy solutions for government, utility, industrial, and commercial clients across the continental United States as well as overseas. HSGS is a solar PV project developer and an engineering, procurement, and construction (EPC) firm specializing in the development, design, installation, and maintenance of solar PV energy systems and microgrids.

www.hsgs.solar

Solar Negotiators

Solar Negotiators provides solar installation, sales, consultation services, project management, maintenance and repair, system additions and upgrades. panel cleaning services, critter guard, installation, trouble-shooting, and active solar monitoring.

www.solarnegotiators.com

Sullivan Solar Power

Sullivan Solar Power is a turnkey solar system and energy storage provider that delivers solar electric projects from concept to completion in Southern California. The company has installed 9000 commercial and residential installations regionally and also develops energy storage in the state of California, using the LG Chem Residential Energy Storage Unit (RESU) home battery. As a C-10 licensed electrical contractor, in-house electrician crews are held to state and industry standards for all projects.

www.sullivansolarpower.com

PV Manufacturers & Equipment

Alencon Systems, LLC

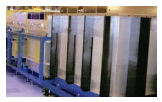
Alencon Systems' Version 6 String Power Optimizer and Transmitters (SPOTs) are the latest version of its galvanically isolated DC-DC optimizers. The newly released SPOT Version 6 includes a high power rating, improved wireless communications, as well as features including optional UL listed ARC and Ground fault detection. The SPOT is suited for use in DC-Coupled Solar + Storage, Microgrid and PV repowering applications, and are compatible with virtually any third party inverter.

www.alenconsystems.com

Aplus Energy Co., Ltd.

Aplus' corrugated metal solar panels infuse the solar directly with the metal.These corrugated metal solar panels are lightweight and provide roof strength and can easily be installed on existing farm buildings, solar carports for electric vehicle charging, new commercial warehouses, and homes. This corrugated metal solar panel has been tested and certified for residential and commercial use. They are lightweight - 33lbs, impact resistant to handle most hail storms, low glare so does not blind pilots or drivers, and are easily installed.

www.apluspvt.com



Kurdex Corporation

Kurdex is a supplier of large area vacuum deposition and etch equipment for R&D, pilot, and high volume manufacturing (HVM). Products include sputtering, evaporation, PECVD, spatial ALD, ARC-CVD and plasma etch tools. Standard and custom systems configured for in-line, cluster, and R2R with full automation. Substrate sizes up to 2300MM rigid or flex, wafers, glass sheets, or roll of flexible materials. They also offer an applications lab for contract coating services, DOE, and technology development.

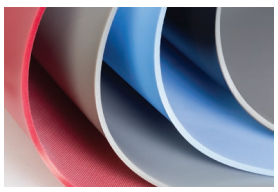
www.kurdex.com

Panasonic

Panasonic

Panasonic HIT high efficiency solar panels provide homeowners with decades of reliable sustainable power. Add EverVolt, their intelligent battery storage solutions and deliver a complete solar + storage system. Homeowners can improve grid independence and save money with a fully integrated energy ecosystem that keeps their family powered up during outages and peak rate periods. With full support from Panasonic, installers stand by their work and product with confidence.

na.panasonic.com



SMARTECH

Smartech International

Smartech supplies North American PV module manufacturers with Steinbach Laminator Diaphragms and PTFE Sheets. Steinbach materials are consistent and durable. Steinbach's patented EVA-resistant Lamibran Diaphragm provides extensive cycle-life and low per-cycle cost. Steinbach's solid silicone diaphragms come in range of durometers, in seamless widths of 3 meters or more. PTFE release sheet and transport belt materials are available in a wide variety of thicknesses and surface treatments, including anti-static coatings.

www.smartechonline.com

Sunflare

A solar system has been created to be able to install solar modules on any metal roof type in the world. Sunflare introduces LiteMount, a ultra lightweight module that seamlessly integrates with every existing metal roof attachment system. This solar system is less than 1lb/sq ft installed. LiteMount panels have a wind load of 42lbs/sq ft and a snow load up to 33lbs/sq ft. It also has no glass covering, so it's shatterproof.

www.sunflaresolar.com

VSUN Solar

VSUN is providing customers with EPC services and customized solar modules solutions such as: full black, double glass, smart, half-cell, bifacial DG, low weight, standard mono and polycrystalline modules.

www.vsun-solar.com

PV Washing System

Bitimec International, Inc.

Bitimec's RoboKlin is a solar panel washing machine designed for utility size ground-mount PV power plants. The RoboKlin runs smoothly on an M&S Track Buggy rubber-track dumper undercarriage. With twin joy-stick controls, a telescoping boom, ultrasonic sensors, and a hybrid foam brush, feather-light and mechanized panel washing is done simply and gently. A new Snow Brush option will allow fast snow removal to restart the production of power shortly after a snowfall.

www.wash-bots.com

Buffalo Turbine

Buffalo Turbine can easily and affordably clear solar panels and get them working efficiently again. Their powerful double stacked and single hydraulic machines remove snow, increasing the efficiency of solar panels all year long. This touch-less system never puts panels at risk of damage or scratching.

www.buffaloturbine.com

Premier Water Cleaning Systems

PWCS provides Sola-Tecs brushes, an efficient and effective solar panel cleaning solution. All equipment required to utilize the brushes effectively are available as well. Some examples include spot free water generation, pressure washers, and remote controls.

www.premsc.com

ProSolarClean, LLC / SOLA-TECS

The SOLA-TECS F brush, specially designed for ground mounted systems, features a horizontal oriented brush movement with a cleaning range from 80" up to 13ft with a high rate of speed not achieved by other manual methods; between 3300 to 6600sq. ft. p/hr. The F brush is rugged and uncomplicated, with no batteries or electrical system, and is made entirely of mechanical components which can be adjusted on-site. High pressurized water powers the rollers spinning action which gently, but effectively, cleans the panels with little effort. Water is distributed throughout the entire width of the brush ensuring even cleaning from frame to frame and it can jump 12" gaps.

www.sola-tecs.com

RST Cleantech USA

RST Cleantech is an automated solar panel cleaning technology. When deployed, RST technology can virtually eliminate soiling losses, increasing solar production up to 30%. The system preserves panels warranties, it cleans at night when panel glass is cooler and without pressure or chemicals. The technology has been field tested over 8 years and has virtually no moving parts. RST has over 1.5GW installed and cleans over 7.5 million panels weekly.

www.rst-cleantech.com

SolarCleano

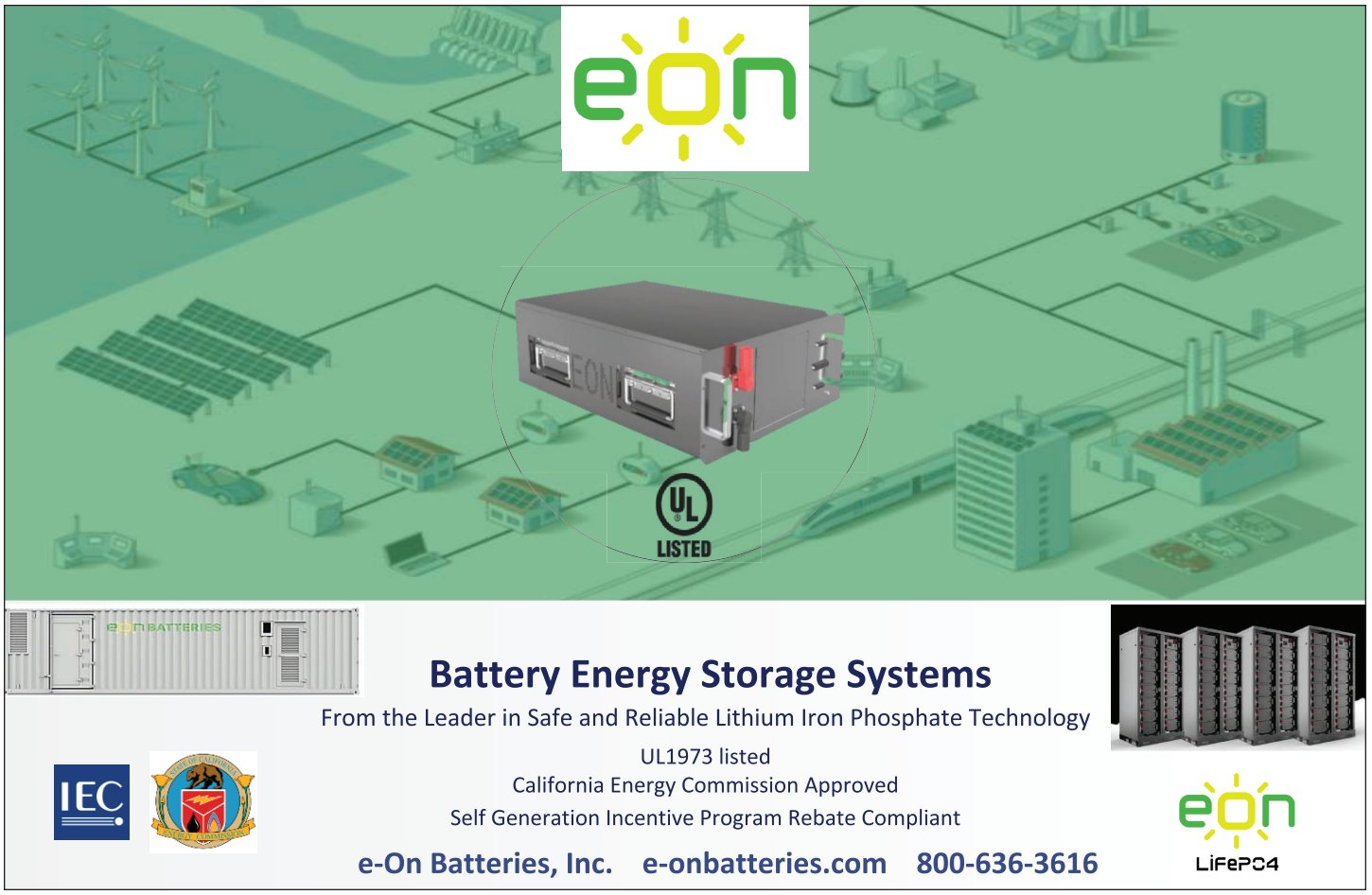
SoalrCleano is a solution for wet and dry cleaning of all solar installations in a quick, efficient way: floating, carports, rooftops, ground-mount. Developed by cleaners, can dismantle into 4 parts, and has been engineered for use by a single person. Thanks to its 5 interchangeable brush types, each of which made of 2 different fiber sorts, SolarCleano reaches quality results in just one go. With its accessories and a smaller version, the Mini, SolarCleano can respond to all solar cleaning needs.

www.solarcleano.com

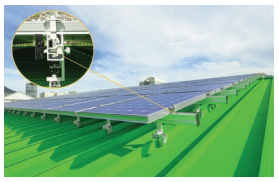
Washpanel Srl

Washpanel is an Italian company that has designed and produced PV plants washing technologies since 2010. It provides a range of 10 different robots for plants such as solar parks, roofs, carports, greenhouses, and agriculture farms.The key product offered by the company is SERIE "EVO" machine which is a portable semi-automatic robot. It represents a solution for the tracker market and can be used both in wet and dry modes, depending on the needs. Two operators are needed to clean 1MW/day per robot. This machine helps keep the panels efficient and reduces maintenance costs (NPV impact). Washpanel robots are awarded with a TUV certification which ensures the machines cause no damages to the panels.

www.washpanel.com



Racking & Mounting Systems



AceSolar by PMC Industries, Inc.

AceClamp, the manufacturer of precision-engineered snow retention and solar mounting systems, has released its most recent product called Solar Snap. Solar Snap is an Adaptive Solar Racking System designed to work with any of their SSMR clamps, corrugated brackets, and MCP (Membrane Coated Plate), making it a solution for almost any roof type. Their fully-assembled, non-penetrating Ace clamps and component groups get installers off the roof faster, while their cross-platform system adapts to all roof types creating less inventory to have to maintain.

www.aceclamp.com

Advanced Racking

Xpress GM ground-mount is available with multiple foundations, including 15' long I-beams and helical. Designed to accommodate modules two (2) High in Portrait, with spans up to six (6) modules wide. The system is module agnostic, and features adjustable brackets which help deal with offsets in the NS and EW directions. Manufactured using steel from the US and Mexico

www.advancedracking.com

AllEarth Solar

The AllEarth Solar tracker is a complete grid-tied, dual-axis solar electric system that uses GPS and wireless technology to follow the sun throughout the day for optimal energy production. The tracker's 360° range allows it to produce up to 45% more electricity than fixed systems, resulting in more guaranteed savings from a solar installation. Made in America, the tracker comes with an industry-leading 10 year warranty, a 120-mph wind rating, and superior snow shedding. Its simple, durable design and complete system pallet simplifies costly procurement and installation time.

www.allearthrenewables.com

Allied Tube & Conduit

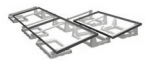
Allied Tube & Conduit provides in-line galvanized steel tube to assist with solar racking and tracking. Their Gatorshield is strong and has a reduced weight, with advanced corrosion protection and formability. Gatorshield also complies with UL2703. To ensure precision, they offer prototype and fabrication services. Allied is able to provide small and large O.D. sizes with heavy gauge, meet and exceed tube strength requirements, tool up for new profiles to meet customer specific needs, swage tube to help build a solar array, and various types of tube fabrication.

www.atc-mechanical.com

APA Solar Racking

Designed by installers for installers, the TITAN is a 3-rail asymmetrical design that comes standard with a single driven pile or dual ground screw. The TITAN is universal to all 72-cell modules and has a low part count per MW. It allows for reduced installation time with features like telescoping posts, set and go purlin install, hole patterns for easy in the field adjustments, and just 2 fastener sizes with serrated flange nuts. APA's Gravity Clip increases the module install speed by more than 30%. It is a bifacial module friendly system with low back side shading.

www.apalternatives.com



DynoRaxx

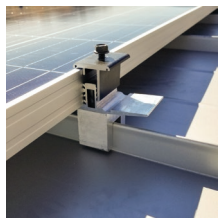
DynoRaxx offers solutions for pitched and flat roof ballasted solar racking and also provides the DynoBond UL2703 module to module grounding product. The flat roof racking is designed to work with all framed modules and does not require tools for assembly or installing which reduces install labor. The DynoBond grounding is used in carports, ground mounts, and other racking products which helps to reduce electrical grounding costs.

www.dynoraxx.com

EcoFasten, an ESDEC Company

The RockIt System 3.0 is rail-less, employs a streamlined design, utilizes North-South adjustability, and provides a fast, easy, no-hassle installation. Top-down leveling gives the installer the ability to level the array during or after the install. EcoFasten products are protected by U.S. Patents and are UL 2703 and UL 1703 Class A certified.

www.ecofastensolar.com



Ecolibrium Solar

MetalX and EcoX Universal Rail-less Solutions deliver speed and simplicity for pitched roofs. With no costly, cumbersome rails and fast, simple installation, both systems reduce labor and logistics. MetalX is a fast solution for r-panel, corrugated, or standing seam metal roofs. With 73% less aluminum to transport and install, and maximized spans, MetalX provides a low cost per watt for metal roofs. EcoX Universal is an aesthetic solution for composite roofs, requiring 33% fewer attachments. Experienced project managers select the correct metal roof mount, prepare project-specific calculations, layout, and bill of materials, and details needed for permitting and inspection.

www.ecolibriumsolar.com

Ecolibrium Solar

EcoFoot Ballasted Racking delivers 5° and 10° solutions for low-slope roofs. EcoFoot2+ 10-Degree Racking provides speed and simplicity with small pre-assembled components, roof-friendly Base, 13.5 modules per installer-hour, 5-minute learning curve, one-tool installation, and dense packing. For high density, EcoFoot5D 5-Degree Racking delivers 18.4% more power with a small modular base and dense inter-row spacing of 9.9". EcoFoot systems provide ease of installation, transport, and loading on the roof. Experienced project managers prepare project-specific calculations, layout, and bill of materials, and details needed for permitting and inspection.

www.ecolibriumsolar.com

EJOT Fastening Systems L.P.

With simple and easy installation, the EJOT flashing is designed to be used on three tab asphalt shingle roofs. With triple layer sealing, it provides watertight seals on top of the flashing, top of the shingle, and bottom of the shingle. The kit includes a flashing and an EJOT Solar Fastener JA3-SB-8.0 x 80/70 E22 for wood substructures. The fastener has a 5/16" lag screw on the bottom and can be used with L-feet or other Hanger Bolt Clamps to support the rails. For the installation preparation in the shingle and wood substructure use the EJOT Click&Drill Hole Saw.

www.ejot-usa.com

IronRidge

IronRidge, an Esdec company, designs and manufactures structural hardware for residential and commercial solar systems. For over 20 years, they have worked closely with solar professionals to build strong, simple, and cost-effective products. IronRidge is NSF Certified to ISO 9001, maintaining high quality management standards. They design and test every product in extreme conditions, then certify them for compliance with the latest engineering and building codes. Their products are also supported with powerful online tools and experienced sales and service teams, who are dedicated to making solar easy to design, procure, and install.

www.ironridge.com

Jurchen Technology GmbH

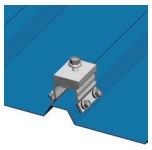
Jurchen Technology, daughter company of BELECTRIC, offers solar PV racking which provides install simplicity and high land utilization of 0.74MW per acre. No foundations, trenching, or heavy machinery required with the substructure made of 3 lightweight items.

www.jurchen-technology.com

KB Racking

KB Racking specializes in providing commercial solar mounting solutions for rooftops in North America. They manufacture ballasted and anchored solar racking systems for flat roof projects, as well as customized solutions for metal roofs. The EkonoRack 2.0, is a simple, non-penetrating solar mounting solution, that is light-weight and easy to install. The system's ETL Certification attests to its high standard of safety and robust design. 25-year standard product warranty.

www.kbracking.com



Magerack Corporation

MageBracket and Standing Seam Metal Roof Mounting Kit are Magerack's newest products for solar installation on metal roofs. MageBracket is angle-adjustable rib mounting bracket for R-panel trapezoidal or corrugated metal roofs. The bracket has two adjustable parts that can rotate to fit rib with different angles. Installers just need one MageBracket R for all R-panel trapezoidal metal roofs and one MageBracket CH for all corrugated metal roofs. Standing Seam Metal Roof Mounting Kit is rail-less solar mounting system that can be used to install solar modules on standing seam metal roof. It has only two components, mid clamp kit and universal end clamp kit. They are UL certified with built-in bonding and universal end clamp fits all framed solar modules.

www.magerack.com

Olympic Energy Systems, Inc.

Olympic Energy Systems produces simple, deployable, low impact solar panel mounting systems using tensioned cables, available in kits, including the R1X non-penetrating roof mount, which are a solution for commercial roofs, metal and other specialty roofs, as well as residential rooftops. They also offer the G1M ground-mount with no in-ground foundations, suitable for capped landfills, parking lots, brownfields, farms, or residential yards. These systems advance mounting solar panels with low embodied energy, achieving true sustainability. Installed systems, which use less labor, are re-deployable, with lower cost replacement or end of life retirement, with no lasting impact to roofs or ground surfaces.

www.olympicenergysystems.com

OMCO Solar

OMCO Solar has two fixed-tilt solutions, the Field-Fast Slide & Stay Mounting and the CHOICE Direct-Bolt Mounting System. These products benefit from a nationwide manufacturing footprint and OMCO Solar's steel procurement expertise. The Field-Fast system is designed to reduce installation time and increase safety by incorporating premium features as well as preassembled components which allow users to install the modules/racking with no overhead lifting equipment. The CHOICE system is a racking structure specifically designed for large Utility-Scale projects and also provides the added benefit of reducing total material needed which lowers freight costs.

www.omcosolar.com

OMG Roofing Products

OMG Roofing Products' new PowerGrip VRM (PG-VRM), is a strong rooftop attachment anchor for mounting solar racking systems and other products to virtually any commercial roof. PG-VRM units are designed to reduce or eliminate the need for ballast in solar racking systems, so there's less weight, material handling, and labor on the roof. Made of heavy-duty cast aluminum, PG-VRMs include a base ring that is secured through the roofing assembly and into the structural roof deck and waterproof cover plate to prevent water from infiltrating the system.

www.outofthestoneage.com

Kinetic Solar

Kinetic Solar's new awning sets the standard for solar awnings. Made from a single piece of steel tubing, it attaches easily to the wall, allowing for the installation of a standard 60- or 72-cell module. It is a solution for an existing pitched roof system when the space on the roof is totally utilized and more power is desired. Additionally, the relatively steep 60° angle prevents heavy snow buildup, ensuring production on even the snowiest days. In the summer, additional production is made while providing shade to existing windows.

www.kineticsolar.com

Pegasus Solar

Pegasus Solar's Comp Mount is a cost effective, high-quality option for rail installations on composite shingle roofs. Designed to last decades, the one-piece black flashing uses a 0.9" tall single-formed cone. There are no fused parts or deck-level EPDM washers to fail. Everything needed is provided in one easy-to-carry 24-pack. Fewer boxes means fewer trips up the ladder and less trash to bring down from the roof. The EPDM sealing washer is pre-installed on the lag, so there are no little parts rolling down the roof into a customer's gutter.

www.pegasussolar.com

Power Structures, LLC

Power-Structures Solar Awning Brackets provide an easy and aesthetic way to construct a solar panel awning off the sides of buildings. Their certified TIG welded aluminum brackets are engineered and guaranteed for the life of the system. Awnings not only provide power, they shade windows from the intense summer sun, cutting heat gain and AC bills. Their awning system comes ready to mount on the wall. Use any solar racking product across their sturdy brackets.

www.power-structures.com

SolarVu®

Solar Site Monitoring Solutions

- Maximize site revenue, reduce costs by identifying issues quickly and clearly
- Bringing unparalleled support with specialized service plans available - 'We pick up the phone'
- Customized to your site needs – any size, any equipment
- Remotely manage your portfolio, download data with multiple inverter manufacturers all in a single view

Alerts of Issues | Identify Problems | Solve Quickly

We monitor it all!

LDC SCADA Systems | Fleets of small sites
Community Solar | C&I Rooftop | Solar Farms

cachelan.com | 905.470.8400 Cachelan

Preformed Line Products

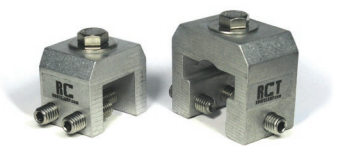
The BALLASTED POWER PEAK system is designed for project sites with unfavorable soil or ground conditions that prohibit pile driving. Each BALLASTED POWER PEAK system is engineered to site-specific environments and arrives on the project site ready to assemble on precast or poured-in-place concrete bases. PV modules are mounted in a two-row portrait configuration of modules in each row match the string size for easy and efficient wire management. The BALLASTED POWER PEAK system features bottom access PV module clamping which eliminates the need for ladders. The module clamps are preassembled with no loose parts for fast installation rates and code-compliant integrated electric bonding. The BALLASTED POWER PEAK system features C-Channel verticals with adjustable bases that allow for uneven ballast blocks and terrain changes.

www.preformed.com

QuickBOLT

QuickBOLT is excited to introduce their fast, simple, and efficient QuickBOLT design, the QB2. The QB2 is comprised of Microflashing, an L-Foot, and a Dual Drive Shoulder Screw. No more nuts are needed to tighten and secure the L-Foot. Not only does this simplify the installation process, it also cuts down the installation time. The new Dual Drive Shoulder Screw design can be driven using a standard 1/2" Hex Nut Setter or a 6mm Hex Driver. The QB2 doesn't leave any room for user error when it comes to Microflashing compression. Once the Dual Drive Shoulder Screw is secured, the Microflashing is compressed. Specs and test results are available online.

www.quickbolt.com



Roof Clamp

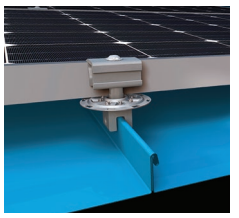
Roof Clamp's two models replace dozens of other clamps. Made of 6061-T6 aluminum with all stainless steel hardware, the 3-point attachment system guarantees strength for parallel and perpendicular loading. Their clamps feature anti-seizing, coarse thread set screws which allow for unlimited re-torqueing and re-attachment. Over 95% of today's standing seam profiles are compatible with the universal for Roof Clamp system.

www.roofclamp.com

Roof Tech Inc.

RT APEX is a self-flashing rail-less PV mounting system for rooftops. Certified by the International Code Council (ICC ESR-3575), PE stamped letters available for direct to deck attachments (1/2" plywood, 7/16" OSB, 1 x 6 planks) and rafter attachment. Roof Tech's self-flashing helps to preserve the integrity of the roof.

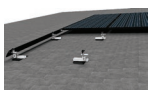
www.roof-tech.com



S-5!

Solar installation is quick and convenient with direct-attach. PVKIT 2.0 utilizes clamps or brackets and a grab system to marry the module to the built-in rails. Lower the weight of the entire system, reduce logistics and shipping hassles, off and on the roof, while saving significantly in install time and labor. The S-5! PVKIT 2.0 comes pre-assembled, requiring only a single tool to install the S-5! clamp and PVKIT. Featuring aggressive bonding teeth for better grounding, this UL 2703 listed solar module mounting solution requires fewer lugs/ground wires, helping customers save time and money when flush mounting.

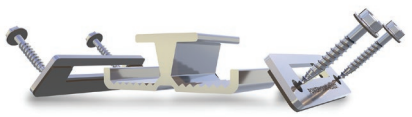
www.s-5.com



SnapNrack Solar Mounting Solutions

SnapNrack RL Universal is designed to provide a fast and intuitive install experience on the roof. The direct mount system features four basic components, with nothing larger than the size of a module, resulting in easy material management. Features include an integrated Skirt for a secure installation with sleek aesthetics, Universal Mounts used at all locations on array and Links that can accommodate 2-4 modules. Mount & Link interference is eliminated with the unrivaled 2 1/2" Mount offset and 5 1/4" Link adjustability. The RL-U System offers incredible spans for a railless system, with a labor saving installation process.

www.snapnrack.com



Solar Connections International

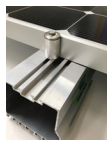
s International introduces their latest product which solves the complicated issues that arise when attaching solar panels to an R-Panel metal roof. The new PowerMount Adjust for R-Panel metal roof profiles makes installation hassle-free. Featuring the ability to adapt to ribbed panels that range in widths of .75" to 3.00" and PowerWings with pre-applied EPDM, the PowerMount Adjust takes the guess work out of R-Panel installations.

www.solarconnections.com

Solar Slate Solutions

Solar Slate Solutions has created the Solar Slate Plate, a mounting/flashing product specifically designed for installation of solar on slate roofs. Each mount can be installed in under 4 minutes and no slates need to be removed.

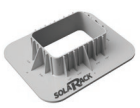
www.solarslatesolutions.com



Solar STACK

Solar Stack is a mounting system designed to eliminate racking and rails by using a code approved foam adhesive instead of roof penetrations, keeping the roof warranties intact. This method of solar mounting is cost effective and reduces labor costs and installation time by 50%. Patented and meeting stringent wind codes, Solar Stack is designed to meet 185mph winds. Certified Florida Product Approval including HVHZ (High Velocity Hurricane Zone). Solar Stack eliminates drilling holes, inserting screws, and locating structural connection points on the roof for positioning of the solar panel.

www.solarstack.com



SolaRack

SolaRack's SolaSeal is a standoff waterproofing base built specifically for the solar industry. Use when installing standoffs on flat roof applications such as torch-down, rolled asphalt shingles, and TPO. It's one piece, rectangular-shaped like a standoff base, and uses 18% less pourable sealant, which is a significant savings opportunity.

www.solarackusa.com

Sollega

Sollega specializes in commercial ballasted/hybrid flat roof racking. The FastRack (FR510) is injection molded, utilizing glass-reinforced nylon, and engineered to outlast the useful life of the array in extreme weather conditions (25-year warranty). The one-piece hybrid mounting system arrives ready to install. Quick to ship, stage, and install, the U.S. manufactured FR510 includes integrated features such as: wire management, grounding, optimizer/micro-inverter mounts, and all top down one size tool attachment which means less extra hardware and cost. FR510 supports all framed modules at 5° or 10° tilt angles. Inter-row spacing is 10" and 13". FR510 has a Class A Fire rating (Type I & II). Sollega provides full PE Engineering and design services.

www.sollega.com

SunModo Corp.

SunTurf, SunModo's easy, affordable solar racking innovation for ground-mounted and elevated roof-mounted systems, helps installers with the challenges of having to navigate obstacles on the roof or ground. The SunTurf system works on flat roofs where solar panels are elevated above obstacles to maximize system size while allowing space underneath for easy maintenance and repairs. SunTurf features standard leading-edge heights of up to 7ft on flat roofs, ground mounts that integrate rails with Schedule 40 steel pipes to span up to 10ft and innovative swivel pipe caps to accommodate up to 27% slope east-west and 120% slope north-south.

www.sunmodo.com

TerraGen Solar

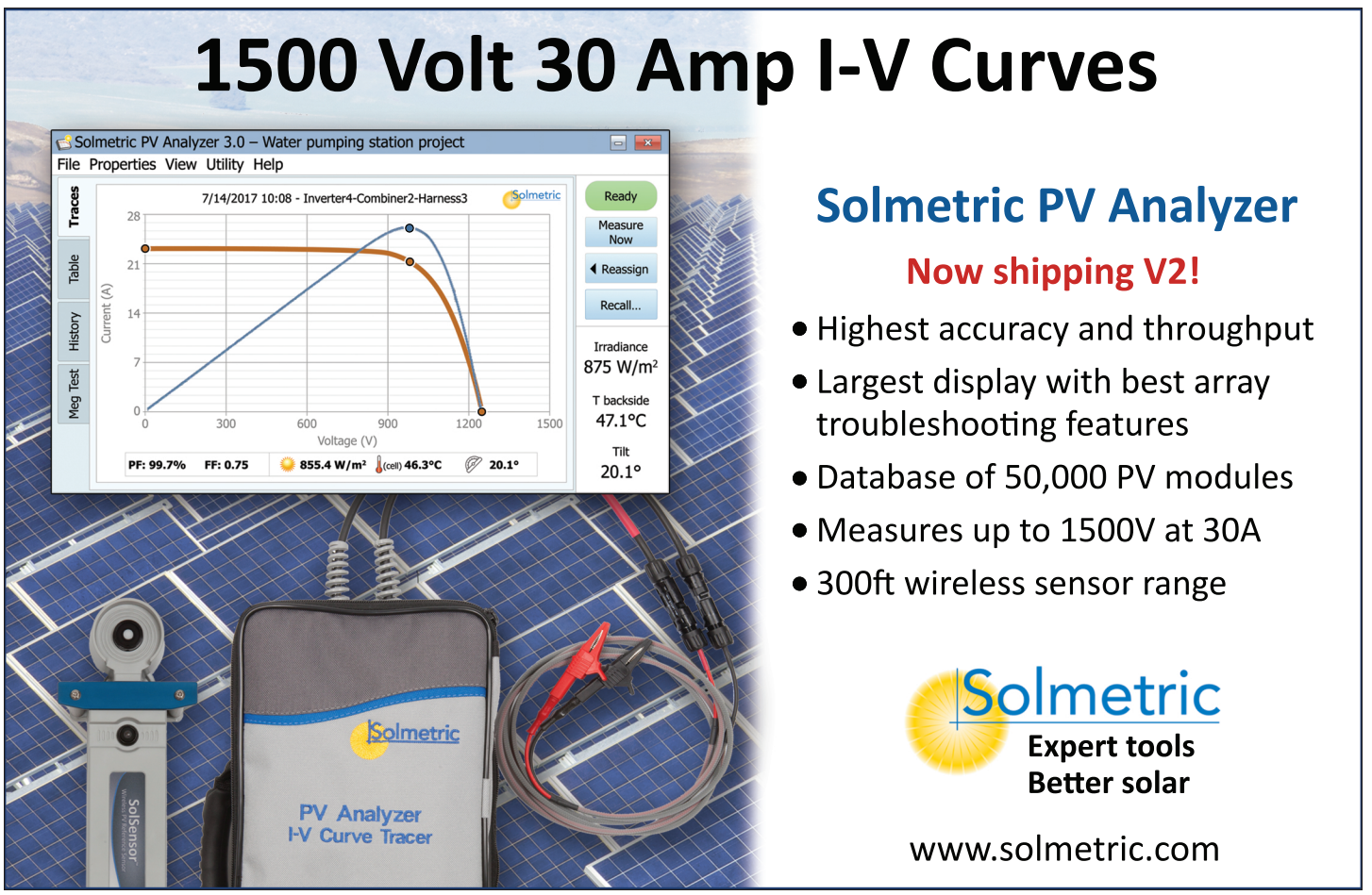
TerraGen Solar is a solar PV mounting system engineering and manufacturing supplier focused on client relationships and continuous improvement to develop PV racking designs and solutions. To date, TerraGen has supplied racking solutions including their standard TGR flat roof ballasted system, their TGT tilted pitched roof system, their TGP flush mount system, carport and ground mount systems, and custom designs for various customers. TerraGen is able to overcome site-specific challenges and offer solutions to the market with their experience in manufacturing, engineering, construction, project management, and solar power plant design.

www.terragensolar.ca

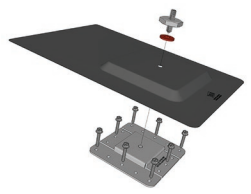
TerraSmart

GLIDE is a ground screw-based racking system designed to work in any soil condition for utility-scale solar projects. Infused with bifacial module compatibility, GLIDE's landscape mounting orientation offers a shadow free backside and integrated electrical bonding. Structurally, GLIDE consists of minimal hardware and is a stiff, yet agile racking system that increases the speed of install, resulting in maximum field efficiency. GLIDE's simplified connections and lightweight parts result in reduced labor hours in the field, which aid in a significant reduction in price per watt.

www.terrasmart.com



ZILLA
SOLAR MOUNTING UNLEASHED



Zilla Corporation

Zilla's patented Double Stud XL Flashing Assembly attaches directly to sheathing while also providing the option for structural members if necessary. Without having to locate structure, the Zilla Double Stud XL eliminates the need for installation prep work, standardizes design and installation processes, achieves speed and flexibility in the field, and makes it possible to complete more projects in less time at less cost. Zilla Double Stud XL is compatible with Zilla flush mount systems or any solar mounting system to help drive better bottom line results.

www.zillarac.com

Radiant Heating

Electro Plastics, Inc./STEP Warmfloor

Electro Plastics manufacturers STEP Warmfloor heating elements based on self-regulating PTC Nano Poly Carbon Technology. The system operates on low-voltage and is extremely energy efficient. The elements can be connected to AC power supplies or directly to DC solar panels. Because the elements are self-regulating, they cannot overheat. The elements are cut to length on site, making the system suitable for both new construction and remodeling, for primary heating and floor warming. Other applications include snowmelt and deicing for roofs, decks, pipes, containers, and ships. All products are made in the USA with environmentally friendly and recyclable materials.

www.warmfloor.com

Research & Development | Testing

DEWESoft, LLC

DEWESoft has developed data-acquisition instruments to perform measurements both accurately and efficiently with an all-in-one solution. DEWESoft has an array of products and specifically developed software that caters to all power measurement requirements, such as; power quality, direct and diffuse solar radiation data, converter, and overall efficiency. All their equipment and testing criteria follow international norms such as the IEC-61000-4-30 Class A.

www.dewesoft.com

Roll Forming

JOHNSON BROS.
Roll Forming Co.

Johnson Bros. Roll Forming Co.

Johnson Bros. Roll Forming is a manufacturer of panel frames and other solar energy components, such as the supports and structural components for panels, as well as reflector troughs for solar concentrators. They offer a wide variety of custom shapes for various different solar panel frames and structures.

www.johnsonrollforming.com

RPM
ROLLFORMED METAL PRODUCTS

RPM Rollformed Metal Products

RPM Rollformed Metal Products is a New Era Group company with 2 fabrication facilities located in Ontario Canada. Plant 2 is the heavy steel division dedicated to roll forming complex steel profiles; thickness between 0.108" to 0.179" in a variety of finishes and material yield strength. Plant 1 is dedicated to thinner steel and lighter metals which are laser welded and unique configuration. Both divisions use USA or Canadian steel mills as their prime source for raw material. RPM has roll formed millions of pounds of custom steel for the global solar racking industry.

www.rpmroll.com

Samson Roll Formed Products Co.

Samson Roll Formed Products Co produces channels used by the solar industry as brackets, photovoltaic array supports and solar panel framing/trim, including a parabolic shaped channel, the main component in compound parabolic collectors, as well as custom shapes. Samson was founded in 1946 and is located in the Chicago metro area in a 200,000sq/ft facility housing approximately forty roll form lines and an array of ancillary equipment to provide stamping, bending, assembly, parting, in-house design, and production of pre-notch, pre-punch tooling, as value-added services. Samson holds ISO9001:2015 Certification.

www.samsonrollform.com

Safety

BLÅKLÄDER
WORKWEAR

Blaklader

Blaklader, a Swedish Company, manufactures functional workwear for all workers' needs. Within the clean energy segment, their FR styles 1636, and now 1676, are tested and compliant with NFPA 70E. 1636 and 1676 work pants are HRC compliant, with an 11 calories/cm² arc rating.

www.blaklader.com

IMO Automation

The FireRaptor safety shutdown solution has been designed with fire safety in mind, and offers a reliable way to remotely shut down a solar PV array in the event of fire or other emergency. It offers a manual shutdown operated at ground level, and two forms of automatic shutdown based on temperature and external power loss. FireRaptor can be fitted to new and existing installations, is FCC and UL approved, and is fully compliant with NEC2017. Plus, the FireRaptor can be used with any solar inverter, on virtually any PV installation. There is also an option for hardwire or mobile communication alarm signaling.

www.imoautomation.com

Kee Safety, Inc.

Kee Safety manufactures OSHA-compliant safety railings for commerical, institutional, and industrial facilites. KeeGuard rooftop guardrail systems provide fall protection around the perimeter. Kee Klamp steel and Kee Lite aluminum railings are designed for in-plant applications including handrails, machine barriers, mezzanines, and loading docks. Other products include Kee Gate self-closing safety gates, KeeLine horizontal lifelines, Kee Hatch roof egress railings, plus Kee Dome and KeeGuard Skylight Screens for skylight fall protection. In addition Kee Walk anti-slip rooftop walkways are available with guardrails and can be custom-configured as rooftop or in-plant crossover platforms.

www.keesafety.com

Kong USA, LLC

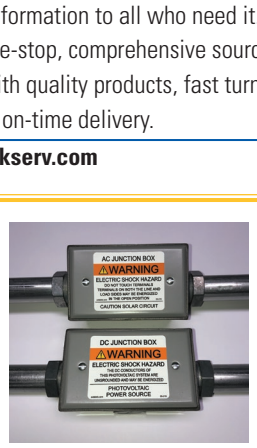
Made in Italy, the KONG BACK-UP ANSI/ASSE Z359.15-2014 is an ANSI certified version Back-Up fall arrester. Safe and simple to use with only one hand. The KONG BACK-UP is a fall arrester that follows the operator in both directions. Shifting the special button to lock mode, the BACK-UP can be used as a positioning device. The KONG BACK-UP supports the strongest stress in a semi dynamic way, avoiding the shock effects on the rope caused by the traditional self-locking devices with toothed cams. Connector/lanyard included.

www.kongusa.com

Marking Services, Inc.

Marking Services, Inc. (MSI) improves and standardizes solar identification to promote safer work environments and minimize downtime due to errors or accidents. They enhance the overall efficiency of solar energy plants by providing photovoltaic solar labeling products and identification services which effectively communicate valuable information to all who need it. MSI offers a one-stop, comprehensive source for solar labeling with quality products, fast turnaround times, and on-time delivery.

www.markserv.com

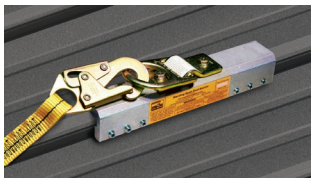


PV LABELS

PV Labels

PV Labels has created two new items to help installers comply with code and finish off the install with a professional look. The new 05-218 and 05-219 labels have been designed to communicate the multiple messages required on DC and AC junction boxes. Based on the need to satisfy ANSI standards, these unique labels fulfill multiple code requirements while still fitting on these smaller components that have such limited space for labeling.

www.pvlabels.com



Standing Seam Roof Anchor

The Standing Seam Roof Anchor is a light and universal fit anchor point and fits 95% of today's profiles. Made from non-corrosive 6061-T6 aluminum with stainless set screws, temporary or permanent attachment. Lab tested to 14,500lbs ultimate breaking strength. Optional adapter plates expand functionality. They also offer a complete line of fall protection equipment.

www.fallpd.com

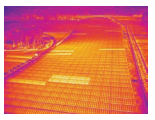
Semiconductors

Nor-Cal Products, Inc.

Nor-Cal Products is a source for prototype and production quantity custom vacuum chambers and weldments. Spherical, cylindrical, or rectangular bodies can have single-wall, double-wall, or channeled construction and are value-engineered to reduce cost, and increase reliability and performance. All welds are reviewed for vacuum integrity, structural strength, heat resistance, and flange distortion to minimize or eliminate secondary machining. In-house fabrication capabilities allow exhaust weldments to be fabricated from a single piece of tubing, eliminating welds and manufacturing steps while improving cleanliness and fit.

www.n-c.com

Site Assessment & Forecasting



Raptor Maps, Inc.

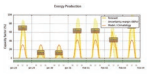
Aerial thermography and Raptor Maps' AI-enabled data post-processing platform offers valuable insights into a system's performance. They accurately and efficiently identify, localize, and prioritize site anomalies. Their technology enables O&Ms, EPCs, and engineering firms to reduce risk, improve resource allocation, and decrease costs. Raptor Maps has analyzed over 14GW of solar PV through turnkey inspections and in-house drone support.

www.raptormaps.com

Solargis

Prospect app is all-in-one pre-feasibility tool that will help users find the right location for their solar power plant. It combines 24 map and data layers with Solargis' latest PV simulator. Users can compare multiple sites or use the project economy calculator. After the plant configuration is set up, users can download a bankable PDF report. They can also create a free account and generate report for planned or existing sites.

www.solargis.com



WPred, Inc.

WPred offers solar and weather forecasting services for up to 14 days ahead for the specific location of a solar park. Multiple meteorological parameters tailored to their client's operations are available, such as precipitations and accumulation by type, temperature, solar flux, etc. They offer expert tools that help plan and optimize maintenance operations, identify underperformances due to dirt and snow, and allow their customers to base financial decisions on historical and forecasted data.

www.wpred.com

Software Supplier

Aurora Solar Inc.

Aurora is an end-to-end cloud-based PV system design and sales platform. With Aurora, users can precisely calculate how many solar panels will fit on a property, forecast how much energy they will produce, estimate how much money the system will save the property owner, and generate sales proposals without ever having to visit the property itself. Aurora Solar has developed new tools, improving accuracy, streamlining the industry's workflow, and supporting time-saving integrations. A process that used to require multiple software applications, hours of design work, and site visits, can now be completed remotely and more accurately in under 10 minutes with Aurora.

www.aurorasolar.com

BURNHAM EYE™ Inspection and Documentation

Burnham Nationwide, Inc.

The BurnhamEYE is an inspection and documentation app that covers all aspects of a solar installation. The app directs the installer to gather information through a series of geo-tagged and time-stamped questions and photos. This information can be used to make an accurate assessment without having a 3rd party inspector physically at the site. As an additional service, their qualified team of inspectors will review the data and provide an unbiased and comprehensive report. These structured and consistent reports can be used as proof of workmanship for potential new clients or retained as record should future issues arise. The BurnhamEYE documentation can be done as soon as the installation is complete and before the installer leaves the site thus eliminating unnecessary and costly truck rolls.

www.burnhameye.com

Extensible Energy

Extensible Energy promotes the expansion of the commercial solar market through developing intelligent software that is always adapting with energy, technology, data, and the grid. DemandEx, their new demand charge reduction software, is easily and inexpensively installed with commercial solar projects in less than a day. It works by analyzing flexible loads, utility rates, weather data, and solar production, then intelligently manages the building's flexible loads, reducing peak demand charges by 30% with no batteries required.

www.extensibleenergy.com

Green IT Energy Applications

Green IT Energy Applications gives owners and operators perspective on their portfolios. Green IT's 'Renewable Energy OS' is a comprehensive software suite that spans the complete asset lifecycle. Green IT's 'Ownership IT' program combines cybersecurity, NERC CIP, and systems/network engineering into a single optimized package. With 15+ years of experience, 100+GW of projects in development and 20+GW operating projects, Green IT optimizes how the renewable energy industry does business.

www.greenitea.com

JobNimbus

JobNimbus offers a fully mobile sales and production management software with features including interactive boards, customizable workflows, and photo uploads. Enter new leads and move them through the sales pipeline. Everything in JobNimbus is organized into job folders, including notes, emails, tasks, contracts, photos, estimates, and more. The entire pipeline can be viewed and interacted with in a digital whiteboard to see where everything is and what's up next. With a mobile app (iOS, Android), JobNimbus provides tools in the field to capture lead information, take and upload pictures to a job folder, and create estimates on the spot. The app works in offline mode to provide uninterrupted productivity anywhere. Featuring integrations for canvassing, QuickBooks, and EagleView, JobNimbus is a one-stop solution for managing business from the field or in the office.

www.jobnimbus.com

kevala+

Kevala Analytics

Kevala's Grid Assessor application for solar developers and land agents provides these customers the information critical for identifying parcels of land, owner and mailing address, their proximity to distribution circuits, substations, and transmission infrastructure. Their SaaS solution will speed users entry into new states, and increase the top of the development funnel opportunities. This solution will also reduce the risk of late stage fallout, saving time and money.

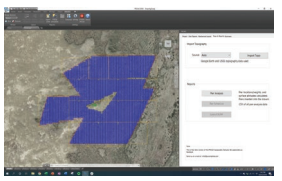
www.kevalaanalytics.com

Nearmap on OpenSolar

Installers can now find everything under one roof to effectively plan, sell, and design their next solar project with Nearmap on OpenSolar. The end-to-end sales toolkit combines Nearmap high-resolution aerial imagery with OpenSolar's design tools, customer relations management, proposals, custom branded templates, equipment catalog with full specs, energy estimators, pricing tools, and financial modeling. It's a one-stop shop for everything solar to help companies see clearly, plan easily, and sell simply.

www.nearmap.com

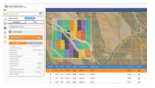
PVCOMPLETE



PVComplete

PVComplete offers design software for residential, commercial, and now utility scale solar. PVCAD Utility simplifies and streamlines multi-megawatt and single-axis tracker layout design, even on complex terrain. With click-and-drag control, quickly complete site layouts for utility-scale projects of any size. Define trackers, import topography, and get top of pier schedules. Built on Autodesk technology. The full suite of PVComplete products, PVSketch, PVCAD, and PVCAD Utility and Design Services can be used together to design any PV system.

www.pvcomplete.com



Terabase Energy

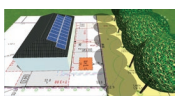
The Terabase Platform is a powerful web-based tool to accelerate large scale solar project development decision-making from siting through to design optimization. Find a suitable site, then design and optimize the project, all via a simple and intuitive GIS-based interface. The Terabase Platform is powered by a predictive engine for energy output, including bifacial performance. The platform is free to use and Terabase also offers engineering services for a fee to platform users.

www.terabase.energy

Vaisala

Vaisala's Solar Energy Due Diligence Services deliver the net energy estimates needed to make critical project investment and financing decisions. Vaisala's forecast system is based on advanced numerical weather prediction modeling techniques. It statistically integrates on-site data to calibrate forecast predictions to a project site's distinct geography and climate. When long-term ground observations are unavailable, they use nearly 20 years of hourly site data from their global solar dataset to provide a reliable and accurate solar production forecast. Their methodology accounts for localized characteristics such as clouds influenced by complex terrain, coastal effects, and monsoons.

www.vaisala.com



Valentin Software

PV*SOL premium is a professional software for the design, simulation, and yield calculation of solar electric systems. PV*SOL premium includes features for electric vehicles and the calculation of bifacial modules. The detailed circuit diagram simplifies construction work. 3D models can be imported via an interface, for example using photos from drone flights, and the energy flow diagram represents the overall system, including the battery system and consumers. A trial version is available on the Valentin Software website, as well as video tutorials and introductory online webinars.

www.valentin-software.com

Solar Coatings

GfE Metalle und Materialien GmbH / GfE Fremat GmbH

GfE offers a wide range of planar and rotatable sputtering targets for thin film photovoltaics such as CIGS, a-Si, CdTe, and Si wafer based cells as well as for thin film thermal solar collectors. Standard materials include ZnO/Al2O3, i-ZnO, high purity Si, Mo, TiOx, and Cr in different qualities as well as numerous other materials as per specific customer requests. GfE's unique rotatable bonding technology enables them to offer a variety of materials to be bonded stress-free onto stainless steel carrier tubes for achieving high sputter performance and optimal target output.

www.gfe.com

Solar Fasteners

Arconic

Huck fasteners have been engineered to provide high installation speed and vibration resistance, making them a joining system solution for a wide range of solar applications. These fasteners are engineered to be installed in 1 - 2 seconds, and self-grounding Huck fasteners are now being used to replace conventional multi-part, grounding assemblies. To add even more flexibility and speed to installations Huck offers battery powered tooling. Huck fasteners also have the strength to support the connection of the solar panels to their frames, providing a level of vibration resistance which allows them to withstand winds exceeding 100mph. Finally, these fasteners are designed to be tamper proof, providing an additional measure of security for valuable PV panels.

afshuck.net/us

Solar Home Energy Monitor

Sense

The Sense home energy monitor works like a fitness tracker for the home, telling homeowners what's on, what's off, and how much energy it uses, so they can save money and make their homes more sustainable. The Sense Solar app tracks solar production and energy consumption simultaneously, showing the homeowner in real time how much energy is used in the home and returned to the grid.

www.sense.com

Solar Integration

Southern States, LLC

Southern States LLC is committed to increasing utility systems reliability by delivering next generation switching, automation, and protection solutions. The TranSwitcher vacuum switching device, is a cost effective and reliable switching device that will reduce or eliminate rapid voltage change events by minimizing inrush currents when connecting solar generation to the grid.

www.southernstatesllc.com

Solar Lighting

Beghelli

LUCE SOLARE solar LED lighting by Beghelli is an "All-in-One" solution that integrates the solar panel, battery, and LED module in a compact, ecological package. Easy to specify, install, and maintain, LUCE SOLARE includes an on-board sensor that monitors ambient light and automatically controls the luminaire, turning it on and off to maximize performance and run time. Designed to be a solution to light up pathways, parking areas, playgrounds, parks, general urban environments, and even be used for temporary lighting.

www.beghelliusa.com

Solar Pile Driver

International Attachments, Inc.

Mazaka Solar Pile machine MA-1000 and MA1200 features and benefits include: wireless remote control including pile accuracy with an auto plumb system, engagement of the hammer and being driven from the ground, reduction in surveying time and costs with compatibility of GPS systems. Rework is reduced with piles installed in the correct location, depth, and angle, and less time is spent installing piles and resetting for the next pile. Piles are kept plumb with an auto -plumb system reducing cycle time and out-of-plum piles.

www.iai-usa.com

Solar Radiometer Calibration

ISO-CAL North America, LLC

ISO-CAL North America is an ISO/IEC 17025:2005 accredited calibration laboratory specialized in the calibration of solar radiometers: including UV, visible light, solar, and far infrared sensors. Services include indoor and outdoor WRR, WISG, or NIST traceable primary and secondary reference calibration, depending on calibration method and sensor model type.

www.isocalnorthamerica.com

Solar Ribbon

Luvata

Luvata manufactures PV ribbon branded Sunwire. Sunwire is compatible with both thin film technology and crystalline silicon and is used as both an interconnecting ribbon and a cross-connecting ribbon. Sunwire is rolled from round wire, annealed for extra softness, plated all-over via a hot-dip-tinning process, and precision level-wound on returnable spools. With a high-purity oxygen-free copper core base, Sunwire offers high electrical conductivity combined with guaranteed elongation and yield strength. These enhanced mechanical properties reduce cell breakage rates and improve the productivity. All standard dimensions, plating alloys, and spool sizes are available.

www.luvata.com/sunwire

Solar Support Structures & Carport Systems

Baja Carports (Baja Construction Co., Inc.)

Baja Carports' solar Double Post Back-to-Back bolted connection framing system is pre-engineered in-house by Baja's design/engineers. It's a cost-effective solution for covering large spans of parking areas. Designed to maximizes solar panel production in either portrait or landscape layout. Pre-fabricated light-gauge high-tensile steel, it's engineered to meet live loads up to 90psf, and wind speeds up to 170mph [per local jurisdiction building codes]. Roof tilt slope/angle of 5° to 15° with a clearance height of 8' to 14'. Configured with two posts every bay "four car spaces." Covers two rows of 90° parking spaces. Can be custom configured to meet the customer's site-specifications.

www.bajacarports.com

KERN SOLAR STRUCTURES

Kern Solar Structures

Kern Solar Structures' Solar CarPort is built with strong structural steel to endure any wind conditions an installation site may deal with. It accepts all major solar panels, which means there won't be fitting problems regardless of the panel specifications. Their Solar SpeedRax shared rail system ensures a sturdy solar carport system and permits a solid build with limited fasteners and few repairs. A clean design with grounded cable management allows for an aesthetically pleasing carport combined with a powerful frame made from long-lasting material.

www.kernsolarstructures.com

Kinetic
SOLAR RACKING AND MOUNTING

Kinetic Solar

Kinetic Solar's new seasonally adjustable ground mount brings versatility and strength while being economical and fast to install. Each module section is balanced in order to make seasonal adjustments with 60- or 72-cell modules simple and easy, no heavy lifting required. Seasonal adjustment can offer a yearly increase of in production of up to 14%, without the added cost of a tracking system. Standard tilt angles include 20°, 45°, and 60°. It is engineered to withstand 1kPa of wind and 2.5kPa of snow, making it suitable for use in nearly any location in North America. It's innovative design tilts flat for fast and easy construction. Available with optional string inverter mount, micro inverter mount, and rear cable shielding panels. The structures sturdy steel construction and hot dip galvanized coating stands up to even the most hostile environmental conditions.

www.kineticsolar.com

Quest Renewables

The QuadPod double cantilever is erected on three foundations per 100kW, and its trusses are capable of 60' spans between foundations. Its proprietary geometry reduces foundation size in high load environments. The canopy enables more kilowatts per acre under high snow and wind where high power density is needed. 90% of QuadPod's construction takes place on the ground, inclusive of module placement, inverter mounting, and wiring. After ground assembly, canopies are lifted by crane for final attachment, minimizing overhead work and optimizing site safety. Fewer days on-site time means reduced construction management costs, increased throughput, and limited disruption to parking lot operations.

www.questrenewables.com

SCARLET Solar

SCARLET's TiltPort is a large commercial-sized sun-tracking carport. Its solar roof tilts automatically, facing East in the morning, and West at night. TiltPort is customizable, from hundreds of units for corporations to waterproof sheds powering agriculture. Each 10-car-size, 36KW, Plug-n-Play unit is installed in minutes. Successfully tested for 2 years in windy Rio-Vista, TiltPort provided 2032KWH/KW in 2018.

www.scarlet.red

POLY-TEX SOLAR

Poly-Tex Solar

Poly-Tex Solar designs and manufacturers solar canopy systems for parking lot and parking ramp applications. Using their Tri-Plane Truss design, they focus on bringing structural solutions and financial feasibility to their customers. Their modular truss design provides strength, low weight, and allows for large span distances up to 70' without the need for expensive cranes. This system ships efficiently, is easily installed, and requires no onsite welding. They serve all 50 states and have knowledge of high snow load/ high wind load building code requirements.

www.poly-texsolar.com

Structural Solar LLC

Structural Solar LLC designs, manufactures, and installs solar carports on surface lots or parking decks, and solar pavilions or architectural solar structures for commercial, institutional, and government projects across the US including Hawaii and Caribbean nations. The cost-effective structural designs with integrated aluminum racking systems are engineered for 40 - 60 year durability and can be value engineered to accommodate a wide range of challenging conditions and applications. Structures are typically cantilevered up to 45' wide or long span moment frames. Services include engineering for foundations and structures, steel fabrication, coating, steel erecting, and mounting of modules.

www.structuralsolarllc.com

Solar Thermal Manufacturing & Equipment

FAFCO, Inc.

CoolPV combines solar electric and solar thermal into one panel to enhance electricity output and heat a swimming pool. CoolPV delivers up to four times the energy of standard solar modules in the form of both electricity and thermal energy. It is often referred to as hybrid or photovoltaic/thermal (PVT) technology. Water within the CoolPV thermal tubes cools the solar module, which increases its efficiency and produces more electricity. Heat pulled from the modules and absorbed from the sun is then used to heat the pool. CoolPV optimizes roof space by combining two energy-producing systems into one while maintaining rooftop aesthetics.

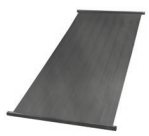
www.fafco.com

Sunda Solar Energy Technology Co., Ltd.

SUNDA has solar thermal experience for over 30 years. With Germany technology and standard, SUNDA patent products are Metal Absorber Evacuated Tube Solar Collector series: SEIDO1 series heat pipe vacuum tube and collector, SEIDO2 series direct flow vacuum tube and collector, SEIDO3 storage type vacuum tube and solar shower, SEIDO8 horizontal heat pipe vacuum tube and collector, SEIDO6 receiver tube and parabolic trough concentrating collector, which are extensively applied on domestic hot water, industry process, pools and spas, space heating and solar air-conditioning, sea water desalination, CSP etc. fields. SUNDA owns over 10 international certificates, Solar Keymark, SRCC, etc. With their sales network all over the world, their products have been exported to more than 80 countries and regions.

www.sundasolar.com

Solar Thermal Systems



Aquatherm Industries, Inc.

Aquatherm Industries offers unglazed polymer solar thermal collectors, primarily used in residential and commercial pool heating applications, solar heat for industrial processes (SHIP), and low-cost thermosiphon systems. Their products are manufactured in the USA to ISO 9001 quality standards, NSF-50 listed, and IAPMO performance certified.

www.aquathermsolar.com

Baknor Thermal Management

Baknor provides solutions for heat dissipation with liquid cold plates, heat sinks, heat pipes, fans, and more. Their extensive knowledge of cooling weighs various tradeoffs and factors such as functionality, manufacturability, volume, mass, cost, packaging, efficiency, and the reliability and safety of heat dissipation components. Baknor's thermal designs ensures the optimum temperature to keep a device running efficiently while improving performance essential for today's electronic designs.

www.baknor.com

Chromagen Hot Water Solutions

Chromagen develops, manufactures, and sells advanced hot-water, energy-saving solutions. Founded in 1962, in Israel, Chromagen brings solutions to projects worldwide, including single-family homes, apartment buildings, hotels, hospitals, and industrial plants. Chromagen has two subsidiaries in Australia and Spain, as well as a network of distributors who serve customers in over 40 countries, including the USA. Chromagen's scheme complies with ISO 9001; and its systems conform with European EN12975, EN 12976, SRCC USA, ISO 9806, ISO 14001, 18001, and Australian standards.

www.chromagen.com

Digital Solar Corp.

DSH provides a patented solar heating system with inter-seasonal storage. Primarily this system is for new homes and commercial buildings, or for hydronic retrofitting. The heating system is capable of offsetting up to 70% (100% in Net Zero homes) of heating costs and 100% of the offset GHG carbon emissions. Each system is designed to suit the application and is capable of storing MW of thermal energy in summer for later use. New 2019 developments include snow melt, spa, pool, and process heat for industry, commercial applications such as car washes, hotels, and motels for heat and laundry. A new version suited for Canadian winters has been developed with Wifi access and data storage.

www.digitalsolarheat.com

Stiebel Eltron, Inc.

Stiebel Eltron SOLKITS thermal solar systems have SRCC OG100 system certification. Each solar closed loop system includes SOL 27 PREMIUM flat plate collector panel(s) and mounting hardware, SB/SBB storage tank with heat exchanger(s), pump station with expansion tank, temperature/pressure gauges, pressure relief and check valves, and controller unit with corresponding sensors. There is a 10-year warranty on Stiebel Eltron solar panels and tanks.

www.stiebel-eltron-usa.com

SunEarth

SunEarth Inc. makes ten primary products. These are the Empire, ThermoRay, and SunBelt medium temperature liquid flat plate collectors, the CopperHeart integral collector storage system, the SunSiphon packaged thermosiphon system, the Oasis low temperature pool and spa collector, standard SunBurst, and custom all copper roll-formed absorber plates, "Solar Strut", RexRack, and CompRail integrated mounting systems and hardware.

www.sunearthinc.com

Techno-Solis, Inc.

Techno-solis Solar Pool Heating Systems kits provide everything that is required for a quality installation of a solar pool heating system. The kit will raise the pool water temperature up to 16° and can be mounted on the roof or ground rack. Three panel sizes are available to meet area requirements. Techno-Solis offers a 10-year full replacement warranty for customer peace of mind.

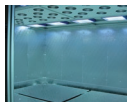
www.techno-solisusa.com

Viessmann Manufacturing

Viessmann Manufacturing provides solar thermal systems for DHW heating and central heating backup. All components of their solar systems have been carefully design-matched to ensure reliable performance and efficiency every step of the way.

www.viessmann-us.com

Testing & Certification | Testing Chambers



Honle UV America, Inc.

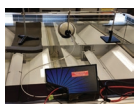
The Honle Group is an international supplier of industrial UV/LED, and Sun Simulation technology. Honle UV Technology develops, manufactures, and distributes UV systems, UV lamps, LED systems, and measurement instrumentation worldwide. The equipment is used in the curing of photo reactive substances as well as surface sterilization and sun simulation. At the heart of every UV system is the Honle Lamp. Honle manufactures its own high-performance UV discharge lamps and apart from standard spectra lamps, customer specific and process specific lamps are produced.

www.honleuv.com

Q-Lab Corporation

Q-Lab provides accelerated weathering and corrosion test equipment and test services. Comprehensive accelerated testing of materials and modules helps to develop higher durability solar solutions. In addition, Q-Lab offers contract test services, which include accelerated laboratory testing, at locations worldwide. Outdoor exposure testing for weathering, light-fastness, and corrosion is available in both Florida and Arizona locations.

www.q-lab.com



Spectral Evolution

Spectral Evolution spectroradiometers provide an accurate instrument for measuring both continuous and pulsed solar simulators. The SR-3501, SR-1901, and SR-1901PT use their DARWin SP Data Acquisition software for spectral match to AM0 and AM1.5, DARWin includes pull-down menus for easy access to spectral match report capabilities. The DARWin software captures and shows actual irradiance for respective spectral ranges. Built-in software routines provide class status as a function of wavelength and generate a spectral match report. The SR-3501 has a spectral range from 280-2500nm; the SR-1901 and SR-1901PT have spectral ranges from 280-1900nm.

www.spectralevolution.com

Tools

ITH Engineering

ITH Bolting Technology manufactures bolting tools and systems for thread sizes as small as M16 up to M510 and larger, including standard products and custom designs engineered based on customer needs. The full scope of tools includes battery torque multipliers up to 6,000Nm (4,425 ft-lbs), electric torque multipliers up to 13,000Nm (9,588 ft-lbs) and higher, hydraulic torque tools, and hydraulic tensioning tools. Torque-angle tightening and data recording with documentation are optional.

www.ith.com

McCann Equipment, Ltd.

McCann Equipment Ltd. is a multi-branch Canadian industrial tool distributor, specializing in the sale, service, and rental of torque and tensioning products. Their services include the repair, calibration, and certification of torque tools (manual, electric, pneumatic, hydraulic), transducers, and testers. Additionally, they certify air pressure gauges and hydraulic gauges as well as tension calibration testers (Skidmore). Each of the company's branch offices is ISO 17025 accredited. The scope and accreditation for each is available on their website.

www.torquetools.com

WEH

WEH designs and manufactures high-quality nozzles, breakaways, receptacles, filters, and check valves for hydrogen refueling and has become a partner to the automotive industry in this technology. Safety, ease of operation, and the well-executed design make WEH H2 products a solution for manufacturers for H2 filling stations and fuel cell vehicles worldwide.

www.weh.us

Tracking Systems

FTC Solar

FTC Solar's new Voyager single-axis tracker provides ease of installation, performance, and reliability, with a low total installed cost. The Voyager tracker requires no special tools and only two wrench socket sizes to be fully assembled. It features few foundations per module and employs a fast and intuitive clamping system. The balanced DC string architecture reduces the overall DC collection cost and is suitable for DC cable harness systems. And, the single row, 2-portrait module mounting architecture allows engineers to make the most of the available land while maintaining suitable accessibility in higher GCR designs.

www.ftcsolar.com

NEXTracker

NX Gemini two-module-in-portrait solar tracker optimizes lifetime value and performance on customer sites with challenging terrain and irregular project shapes. Designed for ultra-high winds, NX Gemini has the maximum modules per foundation and high power density. The GCR-configurable system supports up to 120 modules on four 1500V strings and requires only 7 foundation posts, delivering a low number of foundations per MW. The ruggedized 2P tracker incorporates a distributed drive system for maximum stability in all wind conditions, eliminating the need for dampers and producing virtually zero energy losses associated with stowing.

www.nextracker.com

OMCO Solar

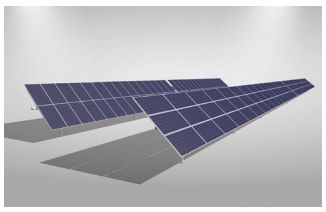
OMCO has recently launched its newest product offering the OMCO Origin Factory-Direct Tracker. This single-axis tracker can span up to 120 modules per row, has multiple preassembled components, proven auxiliary features (drive, motor, dampers, and controller), all with the added benefits of the structural components manufactured in the US by OMCO. Origin also has a universal module mount which allows it to use any module with frame heights between 25mm to 50mm and widths up to 1.3m. Origin has a unique bearing designed by their engineers to be able to adjust in 8 distinct ways to account for post misalignment.

www.omcosolar.com

PVH

PVH's latest PV tracker, Axone Duo, is a horizontal single-axis with central driveline architecture in dual row, capable of moving 128 modules with a 1 module in portrait configuration and ready for all market available modules, including thin film and bifacial. It can be easily installed on all types of sites as it adapts to uneven terrain and plot contours without requiring great precision to align rows and allowing access between them, facilitating maintenance. A waterless PV cleaning robot is also available, as well as a customized SCADA solution to maximize energy production. Axone Duo is CPP wind tunnel tested, resisting strong winds and adverse weather, UL3703, IEC 62817.

www.pvhardware.com



PVH

Monoline are PVH's single-axis PV trackers in two configurations: 3-landscape, supporting 90 panels per row and two-portrait supporting up to 60 and ready for bifacial. Specially designed for large scale PV plants with steep terrain and irregular plots, it minimizes the movement of land and civil works, taking better advantage of available space. Provides EPCs with a quicker and less expensive installation and the owner with a robust and durable 25-year design life. Waterless PV cleaning robots are also available for each configuration, as well as a customized SCADA solution to maximize energy production. CPP wind tunnel tested, UL508 ASCE 7-10, UL3703 includes UL2703 Europe: CE, IEC TS62727.

www.pvhardware.com

RBI Solar, Inc.

RBI announces the formal launch of their Sunflower single-axis tracker. This tracker system is designed to accommodate undulating topography and its tabled design allows for more site flexibility when laying out module locations on a given site. Tracker rows can be designed up to 120 modules in length.

www.rbisolar.com

Solar FlexRack

Solar FlexRack TDP 2.0 Solar Tracker with BalanceTrac is now available with a self-powered option for crystalline and thin film solar modules. Solar FlexRack's latest tracker technology bundles an advanced tracker design with full project support services. Features include: up to 90 modules per row, rotational range of 110° (± 55°), optimized for 1000V and 1500V modules, and low per-unit fixed costs for BOS savings and more.

www.solarflexrack.com

Valmont Utility

Valmont Utility offers a single axis tracker, the Convert TRJ. Convert TRJ features a robust structure with high tolerances for construction and topography, standard construction tooling, and only eight primary components. The wireless controls and string-powered motors provide a battery-free low-maintenance solution.

www.valmontutility.com

Transformers

Niagara Transformer Corp.

Since 1933 Niagara Transformer Corporation has been designing and manufacturing transformers in Buffalo, New York. Their products comply with IEEE Standards and government standards practiced throughout the world. Their customers include OEM and engineering, procuring and construction (EPC) firms, as well as end-users in private industry, government, utilities, universities, and others. Their diverse product line includes inverter duty transformers, substation collector transformers, step-up collector transformers, grounding transformers, and load tap changing transformers. Base ratings up to 50MVA, 138kV, and 650kV BIL.

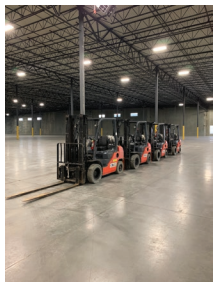
www.niagaratransformer.com

SPX Transformer Solutions

SPX Transformer Solutions provides medium and large power transformers up to 1200MVA, 345kV as well as power transformer, LTC, and circuit breaker components, including a line of Transformer Health Products. SPX Transformer Solutions also offers a variety of substation-applicable training classes for all skill levels and provides complete transformer service solutions for almost any manufacturer's units, including installation, maintenance, relocation, testing and engineering assessments, oil processing, dryouts and retrofits, corrective and preventative maintenance, load tap changer field retrofits, and repairs.

www.spxwaukesha.com

Transportation | Logistics



Logisticus Group

Logisticus Group offers a full suite of turn-key transportation, project management, and technology-related services. Service specialties for ongoing and/or planned commercial solar and wind projects include standard/industrial warehousing, lay-downs, and warehouse management technologies with a multitude of options tailor-made to the needs of each customer and project. Currently with 5 such warehouses across the U.S., Logisticus secures, up-fits, or modifies facilities as needed; runs all aspects of operations; staffs and manages personnel; offloads/reloads; transports to project sites; tracks transport vehicles and inventory through the proprietary technology system (LTS); and much more.

www.logisticusgroup.com

Utility Scale Solar | PV

7X Energy

7X Energy provides utility-scale solar and solar + storage project development.

www.7x.energy

AquaSoli, LLC

AquaSoli Engineering offers loadtesting (Pull Tests) of ramming piles and helicals acc. to valid standards; ground surveys for mounting structures, roads, and transformer stations with design of the basement; chemical corrosion analysis; GPS field measurements of the site surface; 3D-model-generation; module array and layout planning; shadow optimized layout planning for solar fields based on AutoCad (Civil 3D) files as deliverables; electric string predesign of solar parks, including the forecast of power generation; and dewatering and erosion protection.

www.aquasoli.com

Inovateus Solar, LLC

Since 2003, Inovateus Solar has been creating energy solutions for their clients. With the ability to offer customers a wide variety of solar energy products and services, Inovateus Solar has built a strong portfolio of customers ranging from fortune 500 companies to utilities, universities, municipalities, and the federal government. Inovateus has completed over 364MW of solar installations in the USA and the Caribbean, and has delivered services in over 15 countries.

www.inovateus.com

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Make plans now to attend our Continuing Education Conference at The St. Charles Convention Center in St. Charles, MO (a suburb of St. Louis) from March 16-19, 2020. This is the ideal opportunity for NABCEP Board Certified Professionals to obtain up to 21 continuing education credits needed for recertification. Non-certified professionals can also earn up to 18 hours toward their NABCEP Board Certification.

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- All meals and entertainment included in the price of registration

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NAI Capital

NAI Capital provides services including site locations, creative financing, contract negotiations, escrow and title insurance coordination, and marketing, acquisition, and liquidation services.

www.naicapital.com

OYA Solar

OYA Solar develops utility-scale solar projects on land, rooftops, and parking lots, and connects communities to clean energy. Their solar projects provide property owners with a passive stream of long-term income. They work closely with landowners to select land or rooftops for a large solar project, take care of the permitting, and get the project to construction. The solar projects generate cost-effective, clean energy for the surrounding community. Businesses, community organizations, and individual households sign up to receive power at a low price.

www.oyasolar.com

SunEnergy1

SunEnergy1 is a U.S. solar developer, owner, and operator of utility-scale solar projects with over 1GW installed. The company has developed large-scale solar power on the East Coast for nearly a decade. SunEnergy1 is vertically integrated and controls all stages of development in-house, creating affordable, low risk, quality solar power facilities for corporate, institutional, and utility partners.

www.sunenergy1.com

Trimark Associates, Inc.

From Trimark's SCADA system and revenue metering, to their meteorological stations (METs) and data reporting solutions, Trimark has all the experience, equipment, and expertise needed to ensure utility-scale solar sites are operating as efficiently as possible. Trimark's solutions take the interests of various parties into account, maximizing productivity and revenue for site operators, while adhering to ISO requirements specific to different regions of the country, and thereby enhancing grid stability. Moreover, the scope of their services extends far beyond project completion through their Trimark Operations Center (TOC) service agreements.

www.trimarkassoc.com

Valves

GEMÜ Valves

A wide range of solutions are offered for the area of valves, measurement, and control systems. This is due to the different quality, purity, and flow rate requirements. The materials range from polypropylene (PP), polyvinylidenefluoride (PVDF), to ultra-pure and resistant perfluoroalkoxy (PFA). The GEMÜ CleanStar "solar valve" diaphragm valve, also features the GEMÜ seal system, provides high quality and performance capability. Thanks to its weir shape design and the various connections and body materials available, it is suitable for a variety of processes in the solar energy industry.

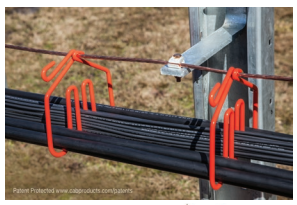
www.gemu.com

Wire Management

AerosUSA

AerosUSA flexible conduits show high resistance to weather, UV (sunlight), and excellent low-temperature properties. Designed for use in exterior applications and those involving movements in extreme weather conditions. The conduit is highly flexible and manufactured from high grade specially formulated polyamide materials. These conduits are widely resistant to acids and solvents, free of silicone, cadmium, halogen, and have robust flame retardant and self-extinguishing properties. These conduits are designed especially for heavy outdoor applications with high mechanical stresses. The features and benefits of these products make them suitable for solar installations.

www.aerosusa.com



Cambria County Association for the Blind and Handicapped

The patented Integrated Grounding Solar Cable Management System is the newest solution from CAB Products. Listed by Intertek to UL 2703, the new system uses a proprietary copper composite messenger wire and special hardware to allow it to act as the EGC and GEC, while also providing for cable management in CAB's patented solar hangers. The hangers are available in numerous configurations to support a variety of cabling. CAB can help identify which of the hangers will work best for a project.

www.cabproducts.com

HellermannTyton

HellermannTyton's PVDF Solar Tie is a commercial-scale, plastic solar tie designed to last more than 25 years. The cable tie's unique material and pawl design are responsible for its extended lifespan and performance. Manufactured from polyvinylidene fluoride, or PVDF, this outdoor tie exhibits high UV, chemical, and thermal resistance for a plastic resin, with a maximum operating temperature of 284°F. It was designed to replace metal ties, known to sometimes slice through electrified solar cables and lead to catastrophic faults. Some metal ties require a hand tool to crimp them closed, a time-consuming inconvenience.

www.hellermann.tyton.com

HellermannTyton

HellermannTyton's Solar Locking Clamp is an easy-to-install solar wire management fastener. Engineered to fit the predrilled holes on most solar modules, the integrated fir tree can be inserted effortlessly. This fastener's high extraction resistance makes it suitable for use on single-axis trackers. The solar locking clamp was inspired by installers who run standard cable ties directly through sharp module holes, a solution that fails prematurely. A molded-in saddle allows users to add a Solar Tie to extend the bundle capacity. Manufactured of high impact modified, heat-resistant, UV stabilized material, the locking clamp is a solution for long-term performance in any climate.

www.hellermann.tyton.com

Heyco Products

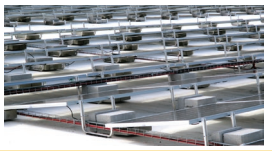
Heyco recently added a variety of Edge Clips to aid in wire management for solar installations. Edge clips adhere either on panels from 1-3mm thick or 3-6mm thick. Bi-directional mounting platform for 1-3mm version allows for universal applications. Can ship assembled or un-assembled with a cable tie depending on the requirements.

www.heyco.com

Nine Fasteners, Inc.

The NFI-Hanger is the newest addition to Nine Fasteners line of UL Listed solar wire management devices. The NFI-Hanger can be used in any ground mount installation. Made of hard drawn galvanized steel, the NFI-Hanger will withstand any severe weather it may encounter. The most attractive feature of the NFI-Hanger is the opening/closing function that it offers, resulting in the ability to add or remove wires from during maintenance without removing and replacing the Hanger itself. The NFI-Hanger is UL Listed to scope 1565 and is currently available for samples or purchase.

www.ninefasteners.com



OBO Bettermann of North America, Inc.

OBO Bettermann of North America provides specially designed wire management products for solar installations. Their hot dip galvanized wire basket trays are self connecting. The 10ft section connects in a single snap, making installing tray on rooftops fast and easy. Their tray systems are UL classified and feature a lightweight aluminum cover to protect cables from direct sunlight and extend cable life. Most sizes and finishes are in stock and ready to ship. They can also help select the right size tray and mounting options for custom applications.

www.obous.com

Solar Power Events

2020 EVENTS

Solar Power Events is presented by the Solar Energy Industries Association (SEIA) and the Smart Electric Power Alliance (SEPA). The flagship event, Solar Power International (SPI), is North America's largest solar trade show. All Solar Power Events feature a robust education program vetted by industry experts, ample networking opportunities with executives that have buying power, and a packed exhibit floor.

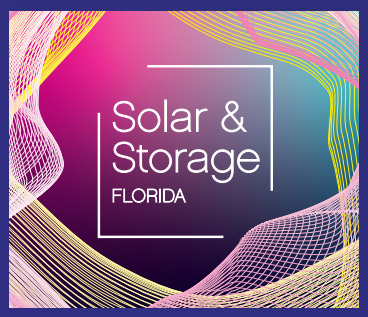
January 16-17
San Francisco, CA

February 19-20
Boston, MA

February 24-26
Denver, CO

March 24-26
Mexico City, Mexico

April 20-21
Atlanta, GA



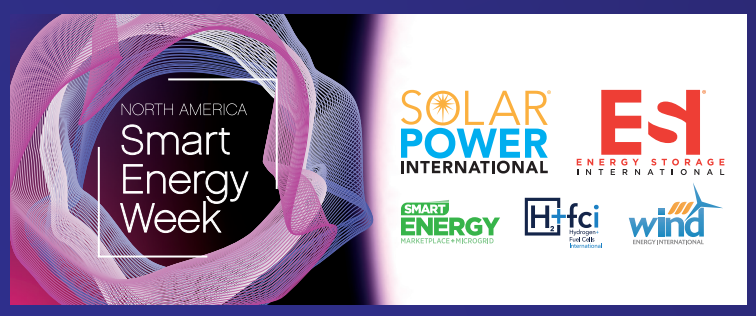
Spring 2020
Florida

May 14-15
San Diego, CA

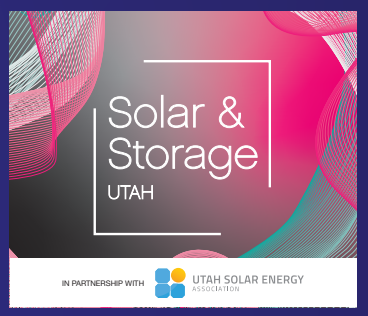
June 4-5
Houston, TX

June 2020
San Juan, Puerto Rico

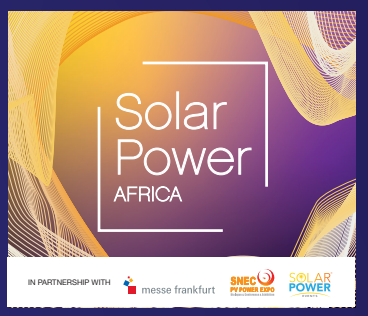
July 9-10
Philadelphia, PA



September 14-17 | Anaheim, CA



October 20-21
Salt Lake City, UT



November 4-6
Cape Town, South Africa

November 5-6
Chicago, IL

December 2020
New York

SOLARPOWER® EVENTS

POWERED BY SEIA Solar Energy Industries Association®

Smart Electric Power Alliance

inter solar | NORTH AMERICA
connecting solar business

INTERSOLAR NORTH AMERICA

February 4th-6th, 2020
San Diego Convention Center
San Diego, CA

www.intersolar.us

Intersolar North America is a solar event that connects innovators and decision makers in the solar + energy storage industry. With a dynamic exhibition floor and robust conference program, Intersolar North America provides business-to-business professionals a platform to advance business, expand education, and drive networking.

show in print

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

Reliable PV connectors

Stäubli Electrical Connectors, Inc.'s MC4 connector system is rated up to 1500V UL, 1500V TÜV safety class 0, and is available for 14 through 8 AWG cable configurations. Also available is their in-line fuse PV-K/ILF connector for very low energy loss and heat generation featuring a robust IP68 enclosure. Stäubli Electrical Connectors, Inc. offer custom solutions tailored to their customers' needs.

Stäubli Electrical Connectors, Inc.
www.staubli-alternative-energies.com
Booth 1316

North/south wire management

Nine Fasteners' NFI-1307-V90 wire management clip is a 90° oriented clip that mounts directly onto a solar panel's frame (or onto a racking structure in some cases). It is capable of securing 1 or 2 PV wires and is suitable for North/South wire management due to its orientation. As with all of Nine Fasteners' clips, this clip is manufactured in the U.S. with a rolled outer edge for maximum wire safety and is UL Listed for use within solar installations.

Nine Fasteners
www.ninefasteners.com
Booth 1128

Heavy-duty hybrid batteries

Rolls 4500 Series 6 volt S6 L16-EX model offers heavy-duty thick plate construction with Advanced NAM carbon for more efficient charging and extended cycle life and durability. Designed to deliver long-term energy storage, this hybrid model pairs Rolls Series 5000 industrial-grade plate construction with the popular L16 case design, offering high Amp-Hour capacity (371 AH @ 20 Hr) and reliability, backed by a 4-year full replacement warranty.

Rolls Battery Engineering
www.rollsbattery.com
Booth 847

Advanced residential solar solution

Take home solar to a new level with the Solaria PowerXT AC panel, a pre-engineered system to maximize performance and optimize cost-effectiveness. Pure Black high performance solar panels combine the latest microinverter technology to significantly boost power and module efficiency and enhance a home's architectural beauty. Using the latest smart grid-ready Enphase IQ7+ platform, the Solaria PowerXT-AC module combines aesthetics and performance into an elegant product that reduces installation time and costs by combining the inverter, module, and monitoring.

Solaria Corporation
www.solaria.com
Booth 1514

Tier 1 Commercial Carport

Kern Solar Structures' Solar CarPorT™ System is a premium grade commercial carport manufactured using structural steel, and can be installed in 3-5 days.

Contact Us

627 Williams Street
Bakersfield, CA 93305
kernsolarstructures.com

P: 661.912.0560
F: 661.869.1269
E: solar@kernsteel.com

Commercial solar racking anchor

OMG Roofing Products has introduced PowerGrip VRM (PG-VRM), a rooftop attachment anchor for mounting solar racking systems and other products to virtually any commercial roof. PG-VRM units are designed to reduce or eliminate the need for ballast in solar racking systems, so there's less weight, material handling, and labor on the roof. Made of heavy-duty cast aluminum, PG-VRM units include a base ring that is secured through the roofing assembly and into the structural roof deck, as well as a waterproof cover plate to prevent water from infiltrating the system. PG-VRM units transfer wind up-lift loads to the structural roof deck for maximum strength and effectiveness. The system does not require any membrane welding, and PG-VRM units are typically installed in less than five minutes, saving both time and labor when compared to alternative options.

OMG Roofing Products
www.omgroofing.com
Booth 1238

Plug & play, wireless balance of systems

Shoals' combiner-less BLA harness has helped streamline installation while creating between 20 and 60% material savings. The newest addition to this is the introduction of BLM which adds current and voltage monitoring along with autonomous I/V curve measurement. I-V curve measurement provides more information about the performance of a PV module or array than any other measurement method and is coupled with the fastest possible measurement tools. The entire system is plug and play and completely wireless - allowing for maximum functionality.

Shoals Technologies Group
www.shoals.com
Booth 1010

Safe alternative to AC breaker panels

SolarBOS AC Combiners provide a safe and cost effective alternative to AC breaker panels. Individual fused inputs facilitate string inverter output aggregation. SolarBOS AC Combiners support all string inverters and they are highly configurable to fit any application. Key benefits include low installation cost, reduced PPE requirements, reduced maintenance, 100% operation and reliability upon fuse replacement (as opposed to breaker degradation), and better performance at elevated ambient temperatures. Optional custom output bussing allows for direct connection to a transformer. Other available options include integrated input or output disconnects, auxiliary breakers, integrated SCADA monitoring components, convenience receptacles, pre-terminated custom length input conductors, and surge protection.

SolarBOS
www.solarbos.com
Booth 1323

Hybrid lead-acid battery

MK Battery's Deka Solar line includes sealed lead acid GEL and AGM batteries and select flooded products. The new UltraBattery is a hybrid device – a chemical combination of a lead-acid battery and an ultracapacitor, achieving higher-rate, partial-state-of-charge operation with extended longevity and high efficiency. Its unique chemistry not only increases power handling but vastly reduces hard sulfation, facilitating excellent longevity, and allowing it to run for long durations between refresh charges. The UltraBattery is a solution for low voltage home and commercial use, as well as high-voltage grid applications. It's extremely efficient; up to 90–95% of every unit of energy stored is available for re-use when used in partial-state-of-charge. Like all batteries in the lead-acid family, UltraBattery is fully sustainable with its closed loop recycling.

MK Battery - Deka Solar
www.mkbattery.com
Booth 834

Solar cable management

CAB Solar Cable Management has a new, patented Integrated Grounding system. It utilizes copper composite messenger wire in place of the standard system's galvanized, and can act as the EGC and GEC. The new system uses grounding hardware on the L-brackets allowing them to bond the messenger wire to the pier and eliminate jumpers at each pier. This system saves both labor time and product cost. It is safety listed by Intertek to UL 2703 and the L-brackets are UL 467 compliant. Engineering reports on the system and installation best practices are available.

CAB Solar
www.cabproducts.com
Booth 1028

Utility-scale DC-to-DC converter

The UL 1741-listed DPS-500 is a 500kW DC-DC converter designed for utility-scale solar plus storage applications and has received the IEC 62109 certification from TUV. Up to 8 DPS units can be paralleled together and it works with all central inverters. The DPS-500 is also available as part of a fully integrated energy storage system from Dynapower, complete with battery enclosure, thermal management, site controls, and batteries. Multiple integrated systems can be paralleled together.

Dynapower
www.dynapower.com
Booth 829

Microflashing technology

The patented Low Profile QuickBOLT with Microflashing is a solution for mounting solar on Asphalt Shingle Roofs. It can be installed without lifting shingles or removing nails and staples, saving installers time and money. The QuickBOLT with Microflashing has multiple layers of protection that create a watertight seal. The Microflashing has passed standing and pressurized water tests and has been installed over 1 million times with zero reported leaks.

QuickBOLT
www.quickbolt.com
Booth 1527

Adjustable solution for r-panel rib attachments

The PowerMount Adjust was designed and developed to eliminate the headache of the ordering process and simplify the installation experience – in turn, saving time and money. The adjustability takes the guess work out of R-Panel installations with its aptitude to adapt to ribbed panels that range in widths of 0.75"-3.00". This high-performance solution features four points of attachment and a watertight seal, while maintaining a competitive price. This system includes the PowerMount Adjust Bracket, two PowerWings with pre-applied EPDM, four fully gasketed stainless steel fasteners, and a M8 serrated bolt. The PowerMount Adjust is an appealing and efficient system for a streamlined installation experience on virtually any R-Panel metal roof.

Solar Connections Intl.
www.solarconnections.com
Booth 1129

Online platform to buy and sell solar equipment

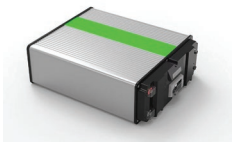
EnergyBin.com is a B2B, members-only online community and marketplace where solar providers gain access to competitively priced components, including panels, inverters, racking, and batteries. EnergyBin facilitates the brokering, movement, and commerce of new, excess, used, refurbished, and legacy solar equipment and provides critical supply-chain intelligence. As a U.S. Department of Energy SunShot Initiative awardee, EnergyBin has lowered residential and commercial project capital costs by 20-70% on equipment.

EnergyBin
www.energybin.com
Booth 723

Energy measurement instrument

Accuenergy AcuDC power meter provides facility managers a reliable way to accurately measure DC energy generated from solar PV panels. Whether the PV system is tied to the local grid or off-grid, the AcuDC can be easily integrated. Placed between the panel and inverter or battery, it displays real-time energy data applicable for submetering, energy efficiency benchmark improvements, and reduction in overhead cost.

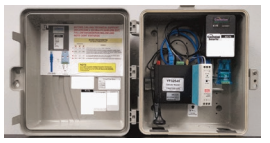
Accuenergy
www.accuenergy.com
Booth 436



Smart relay storage battery system

Fortress Power engineers announce their newest 5kWh storage battery solution. The unit uses a safe Lithium-Iron-Phosphate technology with a built-in SIM card and WiFi for remote monitoring and trouble shooting ability. The smart relay Battery Management System supports Close loop communication with various 48V inverters on the market. This unit has wall mounting functionality and fits well into standard server racks for large systems. Competitively priced, the battery also comes with a 10-year warranty and 6,000 guaranteed cycles.

Fortress Power
www.fortresspower.com
Booth 727



Low cost data logging solution

Cachelan presents a budget data logging solution called SolarVu Lite. Designed and priced for monitoring large numbers of geographically separated solar sites, from differing manufacturers all in one view. It is a plug-and-play solution provided within a weatherproof box with optional cellular internet. SolarVu Lite is compatible with any string inverter brand, and is applicable for residential, commercial, and industrial sized sites. From the SolarVu portal, the user sees a list of connected sites within a control center view. Stakeholders receive emails when any issues are detected.

Cachelan
www.cachelan.com
Booth 435

Flexible and simplified inverter installation

Ecolibrium Solar's EcoMount Inverter Kit simplifies and streamlines rooftop inverter deployment. Modular design minimizes the inverter rooftop footprint, allowing installers to meet NEC 690.12 rapid shutdown requirements without decreasing module density. For use with EcoFoot2+ and EcoFoot5D Low-Slope Racking, kits can be combined for one or two inverters to fit project configurations. EcoMount is compatible with major inverter brands. As with all Ecolibrium Solar products, EcoMount Inverter Kits provide flexibility and simplify logistics and installation.

Ecolibrium Solar
www.ecolibriumsolar.com
Booth 1438

Maximize every roof

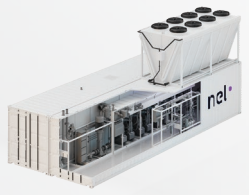
Panasonic's HIT AC Series combines the module efficiency of Panasonic solar panels with the intelligence of Enphase microinverters. Extract maximum power production from every roof size and shape. A built-in IQ 7X microinverter helps deliver an all-in-one module offering design flexibility, reduced installation time, and a higher homeowner ROI.

Panasonic
na.panasonic.com/us/solar
Booth 1616

Solar support structures

Kern Solar Structures manufactures and supplies a variety of premium solar support structures utilizing high-strength structural steel and proprietary technology to provide fast installation times while reducing costs for all involved parties by employing manufacturer-direct supply and management practices. Featuring products such as X-Piles and the Solar CarPorT System, Kern Solar Structures provides innovative, aesthetic, and cost-efficient solutions. The team at Kern Solar Structures brings along over 1.4GW of solar PV and CSP manufacturing expertise.

Kern Solar Structures
www.kernstructures.com
Booth 1329



Large scale hydrogen plants

Nel Hydrogen provides large scale electrolysers. The MC200 and MC400 containerized platforms enable flexible plant configurations and installations for medium to large scale hydrogen plants based on water electrolysis technology. The units provide fast response times and production flexibility making them suitable for hydrogen generation utilizing renewable power sources. The MC200 and MC400 with Proton PEM Technology make for reliable and turnkey solutions with minimal maintenance.

Nel Hydrogen
www.nelhydrogen.com
Booth 639

Long-lasting, safe, and lightweight batteries

Since 2010, Bioenno Power's BLF- lithium iron phosphate (LiFePO4) batteries have been providing a 10-year service life, built in circuitry that protects against overcharge, overdischarge, and overcurrent, and are 1/4 the weight of SLA batteries.

Bioenno Power
www.bioennopower.com
Booth 926

Versatile mounting system

SunModo introduces the Multi-Purpose System with SunTurf. The versatile system can be used as roof-mount, ground-mount, canopy, or multi-pole. The streamlined design combines the simplicity of a pipe-based system with next-level engineering. By spanning over roof obstructions, SunTurf Roof Mount takes full advantage of the available roof surface therefore maximizing the PV system size and increasing ROI. The system easily achieves 7ft leading edge height and provides convenient access to roof surface for maintenance and repair. Anchor SunTurf Ground Mount using one of SunModo's foundation types including ground-screw, auger, ballasted "Eco-block," or traditional post and concrete. The swivel pipe cap kit can accommodate terrains up to 27% slope east-west and 120% slope north-south. Optional bracing can provide additional structural rigidity for sites with high snow or wind load conditions. SunTurf is a solution for solar installers looking for a low-cost, high-performance system.

SunModo Corp.
www.sunmodo.com
Booth 1226

Solar racking systems

AceClamp manufactures precision-engineered solar mounting systems, like their fast-installing rackless Solar Mounting Kits or their L-Foot Kit for use with racking systems. Both kits utilize identical, non-penetrating roofing clamps for convenience. Their most recent invention is AceClamp's new "Solar Snap ISR" which provides solar mounting solutions for homes with island-style roofs. National Gypsum and Acrylabs have teamed up to create the first Bermuda-Style roof system that has been wind tested for winds over 157 miles per hour. The third and final component of this system is a rooftop solar solution by AceClamp. This solution provides a secure anchor point for photovoltaic solar panels. It is now possible to have a roof system that is up to the task of handling extreme winds and rain while creating a renewable energy source.

AceClamp
www.aceclamp.com
Booth 1337

PV wholesale distribution

On a global level, Krannich Solar is prepared to support and service installation partners through all phases of their project with a dedicated sales manager for every client. Krannich Solar strives to fulfill all of the installer's solar needs from a single source by offering a wide range of solutions for every project, from a small 4 panel system to multi-megawatt commercial projects. Their close cooperation with leading manufacturers around the world allows Krannich Solar the buying power needed to provide customers with competitive product pricing and exceptional availability. In efforts to provide 24/7 service, Krannich Solar launched their web shop offering users access to view their entire product range, along with current prices, delivery time, and comprehensive technical documentation.

Krannich Solar
www.usa.krannich-solar.com
Booth 1123

Military-grade EMP technology

Originally designed to protect niche government, security, and military applications against the threat of electromagnetic pulse from hostile enemies or natural solar flare activity, Sol-Ark EMP hardened hybrid storage systems are now available to consumers. Sol-Ark's team of Texas based defense engineers integrate six proprietary technologies custom order into the 12K hybrid inverter/charger and supply its own PCC-230 AGM batteries to provide homeowners and businesses protection against electromagnetic pulse on top of its flexible energy storage solutions and blazing 4 ms UPS transfer time.

Sol-Ark
www.sol-ark.com
Booth 722

Increasing the ground coverage ratio (GCR) on PV projects

The low tilt and clearance design of the Dahlia system is engineered to maximize PV coverage on a given; creating a high financial return for project owners and integrators. With the simplified engineering of a fixed-tilt system, Dahlia requires fewer connections to be made in the field, making installation easy.

RBI Solar
www.rbisolar.com
Booth 1323

SOLARPOWER EVENTS

SOLAR AND ENERGY STORAGE NORTHEAST

February 19th-20th, 2020
Westin Boston Waterfront Hotel
Boston, MA

www.events.solar/northeast

Solar and Energy Storage Northeast is a forum for professionals dedicated to the integration of solar, storage, and additional renewable energy assets like wind energy and electric vehicle infrastructure in the northeastern United States. This event provides the tools, experience, and expertise to enhance innovation, policy, regulation, and business opportunities in the region. Attendees will find a regionally focused trade show with highly rated networking events, an active show floor with leading companies, compelling education, and practical takeaways that can be applied upon return from the conference.

show in print

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

Disruptive all-in-one hybrid storage inverter

Sol-Ark 12K makes solar storage affordable due to efficiency and integration. Installers appreciate Sol-Ark's easy to install plug and play, all-in-one design. Key features include: Standard 10-year warranty, dual 500V MPPTs generate up to 12kW of PV power to Grid/UPS Loads/Batteries simultaneously TOU applications, automatic On/Off Grid, parallel stacking up to 4 systems for 48kW of production using up to 66kW of PV and up to 352 kWh of batteries for small commercial, 120/240/208 with one or more systems, rapid shutdown NEC2014/17 compliance, DC couple 1.5kW to 16.5kW and separate AC coupling up to 7.6kW of solar in one system.

Sol-Ark
www.sol-ark.com

Solar canopy systems

Poly-Tex Solar designs and manufacturers solar canopy systems for parking lot and parking ramp applications. The company has been in business for over 35 years providing innovative structural solutions. Poly-Tex Solar developed the Tri-Plane Truss architecture to lower the cost for solar canopy (carport) systems. The Tri-Plane Truss architecture uses less steel, ships efficiently, and brings financial feasibility to projects. The modular design requires no onsite welding and provides strength, low weight, and allows for large span distances up to 70' without the need for expensive cranes. Poly-Tex Solar serves all 50 states, specializing in high snow load/high wind load building code requirements.

Poly-Tex Solar
www.poly-texsolar.com

The standing seam attachment solution

The Standing Seam Power Clamp is an innovative mounting solution that provides strength and eliminates confusion by condensing the wide variety of standing seam profiles into just five SKUs.
The patented Silver Bullet Fastener offers ease of installation and includes a rounded bullet tip to maximize strength and won't damage the paint finish or pierce the seam, which safeguards the warranty of the roof. Achieve a clean and simple rail-less installation by pairing the Power Clamp with the Solar Connection Kit that is UL 1703 and UL 2703 listed and approved. The featured GroundBonding Technology creates a conductive bond from panel to panel and the PushLock Technology secures the cable management disc to the standing seam base clamp without needing extra tools or parts.

Solar Connections Intl.
www.solarconnections.com

High density, high voltage energy storage solutions

KORE Power is a developer of high-density, high-voltage energy storage solutions for utility, industrial, and mission-critical markets. Designed to lower energy storage installation and operation costs while optimizing performance, the 1500Vdc Mark 1 energy storage system includes their proprietary NMC cells with added safety features and innovative modules, fully integrated with the Mark 1 BMS. With support from manufacturing partner, Do-Fluoride Chemicals Co., KORE Power enhances the quality control and visibility across the entire supply chain. The company serves the growing demand for applications such as replacing fossil fuel peaker plants, wind and solar plus storage projects, microgrid optimization, behind-the-meter C&I, mining energy solutions, and the military. KORE Power has 6GWh of production capacity in 2020 with deliveries available as early as Q2 2020.

KORE Power
www.korepower.com

Black mono modules

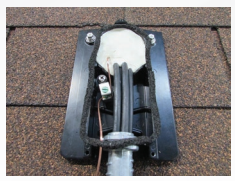
Axitec's AXIblackpremium HC solar modules are suited for installations where the black exterior design must match performance. These high performance monocrystalline solar modules reach efficiencies up to 19.26%, guarantee high power output, and a spinning meter.

Axitec Solar
www.axitecsolar.us

Solar wire management clip

Nine Fasteners' DCS-1306 is produced, as with all of Nine Fasteners' solar wire management products, right here in the U.S.A. Using 410 stainless steel, the DCS-1306 is produced with a rolled outer edge for maximum wire safety.

Nine Fasteners
www.ninefasteners.com



Wire management on the rooftop

Since the 2012 launch of Roof Tech, Inc.'s T-REB Roof Entry Bracket, 150,000 REB kits have been installed in Japan with zero leaks. The package includes: M5 x 60 stainless mounting screws, RT Butyl tape, putty, and plastic grommet. The ground lug is not included.

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

Helping installers capitalize on opportunities in solar energy

After 43 years of solar research and development, Panasonic continues to drive innovation in solar performance. Advances include a unique cell structure that minimizes carrier loss and a panel surface that reduces reflection. A low temperature coefficient of -0.258% /^{0}C provides impressive performance at high temperatures.

Panasonic
na.panasonic.com/us.solar

Modular solar carport structures

Preformed Line Products introduces Solar Carports. The Ready-Made Shade Structures are engineered and optimized to site-specific applications and PV solar installation. The modular structures feature a simplified design and integrated PV module mounting system designed to provide fast assembly rates and labor savings on every project. These solar support structures feature tilt angles that offer 0°, 5°, and 10° positions and an optional gasket sealing solution. PLP's unique module clamping system offers 50% fewer components than traditional systems and has built-in ¾" spacing. This system offers 4-high or 7-high in portrait module mounting for single row or double row car parking with built-in wire management channels.

Preformed Line Products
www.preformed.com

Custom site reports for solar developers

Kevala's Site Assessor application for solar developers and land agents brings the same power as Kevala's Grid Assessor, but with a focus on site-specific data including names and proximity of grid infrastructure. Site Assessor will save a customer's team time and money, avoiding driving to site locations and mapping the infrastructure. Simply plug in an address or digital coordinates in the search bar, Site Assessor will provide where data are available, owner and mailing address for the parcel location, surrounding parcel information and the parcel's proximity to distribution circuits, substations, and transmission infrastructure.

Kevala Analytics
www.kevalaanalytics.com

Rapid shutdown solutions

SolarBOS' Rapid Shutdown Solutions represent low-cost and space-saving solutions for commercial solar systems utilizing string inverters. Combiners and pass-through disconnecting units with integrated load break contactors provide string level rapid shutdown functionality when it isn't feasible for the string inverter to be within the array boundary (per NEC 690.12). Products can be configured for grounded or floating systems and can accommodate inverters with single or multiple MPPTs. Additional options include capacitor bleed down and Low Voltage Ride Through functionality. All use compact NEMA-4X polycarbonate enclosures.

SolarBOS
www.solarbos.com

Solar solutions manufactured in the USA

OMCO Solar's product line includes two fixed-tile solutions, the Field-Fast Slide & Stay Mounting System and the CHOICE Direct-Bolt Mounting System. CHOICE is a fixed-tilt racking structure designed for large Utility-Scale projects. OMCO's newest product offering is the OMCO Origin Factory-Direct Tracker. This single-axis tracker can span up to 120 modules per row, has multiple preassembled components, proven auxiliary features (drive, motor, dampers, and controller), all with the added benefits of the structural components manufactured in the US by OMCO.

OMCO Solar
www.omcosolar.com

Software to power solar projects

The ENACT digital platform uses data and services for distributed solar project management. The platform digitizes and automates the entire project development process: design, financing, installation management, and customer asset management. Sales teams can develop accurate proposals in minutes, fully customizable to their brand and content needs. Cost and financing analysis is also customized, along with layout designs for panels. ENACT can be used as a built-in CRM platform along with workflow management as well for complete project management.

ENACT Systems, Inc.
www.enact-systems.com

Pre-engineered racking and mounting kit

APA's pre-engineered kit is a concrete-free solution for projects under 200KW. Foundations, posts, racking, and module clips are included. Easy install with a skid steer and auger attachment, the kit is stamped for all 50 states. This racking works with APA's helical anchors, ground screws, or geoballast foundation. A 10KW system of the Ready Rack Kit has easily been installed in 4 hours. Since no outside material is used with this system APA is a one stop shop for residential or small commercial racking needs.

APA Solar Racking
www.apalternatives.com

Durable, high-capacity AGM batteries

Chosen for a wide range of off-grid and backup energy storage installations, Rolls AGM-S 6 volt S6-460AGM model offers the convenience of sealed VRLA technology in the popular L16 case design. This durable, high capacity (415 AH @ 20 Hr) model delivers exceptional cycle life and efficient charging, and is backed by a 3-year full replacement warranty when used in renewable energy applications.

Rolls Battery Engineering
www.rollsbattery.com

Mounting system for TPO roofs

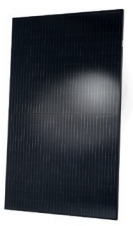
QuickBOLT has passed the ASTM E331 and ASTM E2124 water tests with no leakage, ensuring that the QuickBOLT can be installed on TPO Roofs. The test reports can be found in their updated AHJ Permit Packets. The Microflashing technology of the QuickBOLT has saved installers time and money for years on Asphalt Shingle roofs, now installers can have these same benefits on TPO roofs.

QuickBOLT
www.quickbolt.com

Going green with a solar canopy

RBI Solar designs, engineers, manufactures, and installs solar canopies on surface lots and parking garage structures. Their team of in-house experts has the capabilities to turn any unique parking area into a PV paradise.

RBI Solar
www.rbisolar.com



Reliable, powerful, and efficient residential modules

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Q CELLS North America
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Current Kills

Safety lessons from large scale energy storage deployments

by Hanan Fishman

What we can learn from ESS fires in South Korea, and how galvanically isolated, rack level DC-DC optimizers can improve safety and reduce the chance of fires and other mishaps.

It is well understood that large scale energy storage is the key to allowing us to achieve our clean energy utilization goals in the effort to fight climate change. Energy storage helps us overcome the biggest drawback to renewable sources of generation like solar – the issue of intermittency. Pairing renewables with storage creates the opportunity to turn clean sources of generation into truly dispatchable energy resources.

Large scale lithium ion batteries can store a huge amount of energy and make it available on demand. However, the revolutionary benefit these batteries provide comes with a major public safety drawback: large scale lithium ion batteries can catch fire, and even explode if not deployed safely. Such fires can be massive and particularly difficult to contain for first responders.

One less well-known fact is that, as of 2019, South Korea is the world leader in megawatt hours of large-scale lithium ion energy storage systems (ESS) deployed. That deployment experience has also meant South Korea has seen a number of fires and other mishaps of large-scale storage systems. In June of 2019, the Korean government issued a report on the conclusions its fire investigation committee drew regarding the root cause of the 23 energy storage system fires that have occurred there since August of 2017.

In their report, Korean officials stated:

"Systems were not able to properly protect against electrical hazards due to ground faults or short circuits... The short circuit current allowed the failures cascade to the bus bar which resulted in fires inside the ESS".

All the failed systems studied were charged/discharged by a monolithic power converter that required all of the battery racks in the ESS to be connected in parallel on the same DC-bus.

One Solution

Any proposed solution must address the exact safety shortcomings in large scale lithium ion ESS found by the Korean government in their investigations. A galvanically isolated DC-DC converter charges each rack in a large scale ESS separately. This eliminates the need for common bus bar, and prevents the catastrophic failures by detecting ground faults and short circuits before they happen.

Charging and Discharging the ESS – Container vs. Rack Level

Large scale ESS solve the intermittency problem of renewables by charging during times of oversupply (when a PV plant with a DC overbuild is overproducing) and discharging when the renewable resource is unavailable (at night, in the case of solar).

There are essentially two ways to charge or discharge the battery racks in an ESS. You can parallel all of the racks on the same DC-bus or handle, or one rack at a time. So- called "monolithic" chargers require all the racks to be placed in parallel, and look at the ESS as whole. An electrical schematic of this approach is shown in Figure 1 in the context of a DC coupled Solar + ESS. In such a topology, all racks are placed in parallel, which of course leads to much higher fault current contributions (in parallel, current adds up, and, as any electrician will tell you, current kills!)

In a rack level-based charging scheme, as shown in figure 2, each rack can be controlled individually; all the racks are not required to be placed in parallel, which significantly reduces the fault current contribution of the ESS.

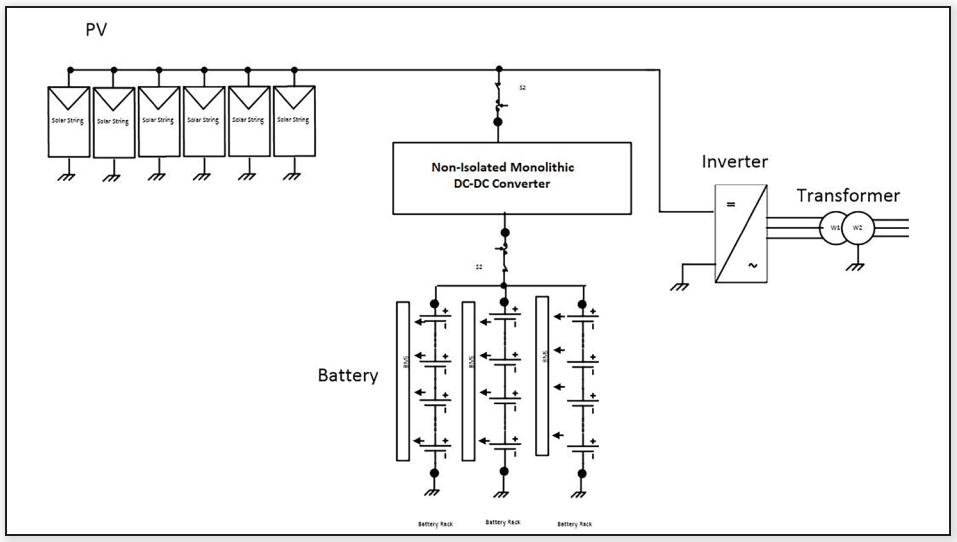

Figure 1: *An electrical schematic of a DC coupled PV with ESS Monolithic Charger. In such a configuration, all racks are placed in parallel, generating a very high level of fault current and inability to detect faults at the battery rack level.*

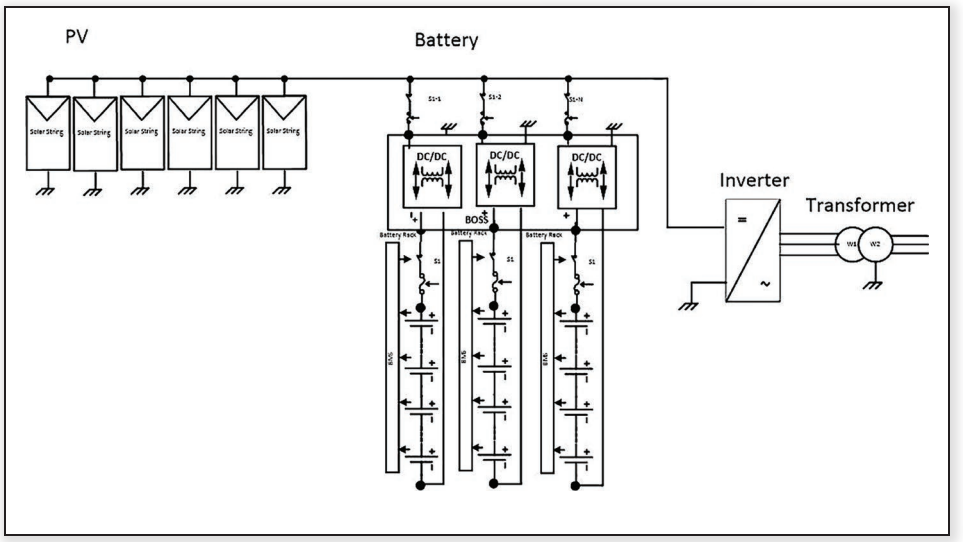

Figure 2: *Providing galvanic isolation to LI battery racks offers many safety benefits, including being able to detect harmful faults before they occur*

A large-scale lithium ion ESS fire in Korea being put out by first responders. Given the large amount of energy stored by these systems, fire created when they fail can be extremely dangerous and hard to contain.

How to Improve ESS's Safety

Charging and discharging each rack in the ESS individually reduces overall fault current potential. More importantly, isolating each rack can detect faults at the rack level before they occur.

Talk to any major lithium ion battery manufacturer and they will tell you that their racks should be floating, not grounded. This is for safety reasons: by allowing racks to float, two faults are needed to cause an issue. Should any cell get damaged and short to a grounded case, the loss of isolation can be immediately detected, and the entire battery rack safely removed from the battery container by the PMS. This allows for the kinds of dangerous faults found in the Korean system to be detected much earlier, before tragedy strikes.

Using a monolithic charger forces a reactionary approach. Additionally, the monolithic DC-DC converters typically deployed today are not isolated, which is an especially problematic approach when pairing batteries and PV on the same DC bus. As such, these units basically have to rely on very large fuses and for contactors to react when danger strikes. These are the exact devices that were found to have failed in the Koreans' investigations.

In short, a major takeaway from the ESS fires observed in Korea is this: A rack of prevention is better than a container of cure.

Hanan Fishman is the President of Alencon Systems. He has over 20 years' experience in technology development and commercialization. In his role at Alencon, he is responsible for managing all aspects of the company's operations, including business development, product sales, marketing, engineering, and production teams.

Alencon /// alenconsystems.com

Enhanced three-phase inverter

SolarEdge Technologies, Inc. is extending its commercial offering to improve the scalability of DC optimization in large PV installations. A new version of its 120kW three phase inverter with synergy technology is designed to enable quick and easy installation and inventory management. SolarEdge has also launched a new commercial power optimizer with two MPP trackers that connects to up to four modules. The new commercial inverter and power optimizer are expected to be available in the beginning of 2020.

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Integrating Onsite Energy Management

by Shashank Sane

CLEAN ENERGY TECHNOLOGY IS BECOMING INTEGRAL to today's business operations, but are businesses getting as much from their energy assets as they can? Intelligent design and operation of an energy system can ensure that, when it comes to your onsite energy infrastructure, 1 + 1 equals more than 2.

Onsite energy assets, or distributed energy resources like solar generation and battery storage, have become more affordable, contributing to their growing ubiquity among utilities and businesses. Continued cost declines, coupled with increasing pressure from consumers for businesses to be more sustainable, will only increase the pace of growth of distributed energy resource deployments. In fact, a recent Navigant report estimates that the amount of energy produced by distributed energy resources will more than double by 2028. For businesses to achieve the full potential of these soon-to-be-installed onsite energy assets, they have to stop treating them as individual components, and start recognizing them as building blocks of an integrated system.

In an integrated energy system, each component is designed based on both its own operating characteristics and how it will interact with everything else on the site. Once the system is fully operational, a real-time controller ensures that each asset works in coordination with all other assets, based on the best (then-current) information. The result is an energy system that is designed, built, and operated without unnecessary and costly duplication because it's selecting the right asset to meet demand at the right time. Energy decisions are made in real time through tracking site-specific information, combined with technical specifications and market inputs. When fully embraced, the energy system is assimilated into the overall site operation, which leads to more efficient business strategies. Not only are integrated energy systems helping businesses meet financial goals, they are key in responding to consumer demand for sustainability.

Consider the following examples:

1. Battery energy storage + backup generator system: Each technology offers individual value – a battery is typically used to reduce grid demand during peak load events, and a backup generator runs when the grid is not delivering power. In an integrated system, however, they work together to do more. Generators are great for long outages because they can operate as long as fuel supply is available, but they are very expensive to run, and emit significant GHGs. Battery storage responds to signals quickly but cannot operate continuously for more than a couple hours. If the grid cannot deliver power, an integrated system would first deploy the battery, resulting in no downtime for the facility. The generator would only be dispatched when the battery is depleted. If an outage is short, the generator may never be turned on, which reduces fuel cost, GHG emissions, and maintenance cost from less wear. For a longer outage, the system would seamlessly transition from battery storage to the generator.
2. Electric vehicle (EV) charging: Two of the biggest issues for EV fleet owners are the availability of power to charge their vehicles, and minimizing the cost of charging. An integrated system approach to both the vehicle selection and charging schedule can provide solutions to both. A fleet owner that needs their vehicles to run for two days, without grid power, may choose to size their vehicle batteries to twice the size required for an individual day. Alternatively, that same owner could utilize onsite solar, battery, and backup generation to ensure power is available during a grid outage. The result would be a lower upfront vehicle expense because of the smaller battery, and lower operating expense for the vehicles because they will not be carrying around an unnecessarily large battery. Minimizing EV charging costs is typically done by avoiding charging during the middle of the day when electricity from the grid is more expensive. Many businesses charge their EVs overnight to avoid peak costs. However, an integrated system can pair EV charging with expected generation from an onsite solar array - this avoids fully charging the EVs overnight because the sun will be bright enough the next day to finish charging the vehicles (before they go out on their routes at noon, for example). This ability to make real-time decisions provides for lower overall costs and lower GHG emissions.

Though an integrated system approach is the logical evolution of distributed energy resources and onsite energy generation, the methodology is a new way of thinking about energy procurement and operation. The good news is that integrated systems rely on readily available technology. It's also relatively painless to install; service providers are making these deployments much less daunting than may be expected. Indeed, as more and more businesses turn to integrated systems to streamline their existing power usage and improve their results, these systems will become as commonplace as those

Energy management system

Nikola Power's Intellect EMS is designed to optimize solar + storage system operations and maximize customer returns in multiple use cases. The software uses proprietary algorithms to forecast load and PV production data and then run an optimization for maximum economic benefit and asset health. Intellect can maximize savings both behind the meter and in front of the meter and it is capable of operating in a number of use cases such as peak shaving, time-of-use arbitrage, self-consumption, and non-export. Intellect is compatible with multiple incentivized markets such as the Massachusetts SMART and Clean Peak Energy Standard programs, the California SGIP program, and the Hawaii market. The combination of Intellect's control technology with Nikola Power's Ratio predictive capabilities brings the added benefit of increased accuracy between project analysis and real-world performance when projects are controlled by Intellect.

Nikola Power /// www.nikolapower.com

they are beginning to replace.

Service providers specializing in integrated systems can help businesses, facility, and fleet managers modernize and deploy their energy resources more effectively. These providers can leverage their energy intelligence to position their customers on the cutting edge of cost-effective, resilient, and sustainable energy technology deployment. The returns on this approach will be well worth it, simultaneously helping a business's bottom line and promoting stewardship of the world we all inhabit.

Shashank Sane is Senior Vice President and Head of Invenergy Edge. Invenergy Edge is a subsidiary of Invenergy, a leading privately held, global developer and operator of sustainable energy solutions.

Invenergy Edge
/// invenergyedge.com

Factory Finished

by Greg Tremelling

ENERGY GENERATION AND CONSUMPTION are changing rapidly around the globe. As renewable generation merges with energy storage technologies, new power architectures must be applied. Integrators face significant challenges and pitfalls while responding to the growing need for storage. Many of these pitfalls are rooted in not having the proper system architecture to support the goals of the project. Choosing a power architecture that best aligns with the energy needs, demands, and markets of the future, is critical to deploying successful clean energy projects.

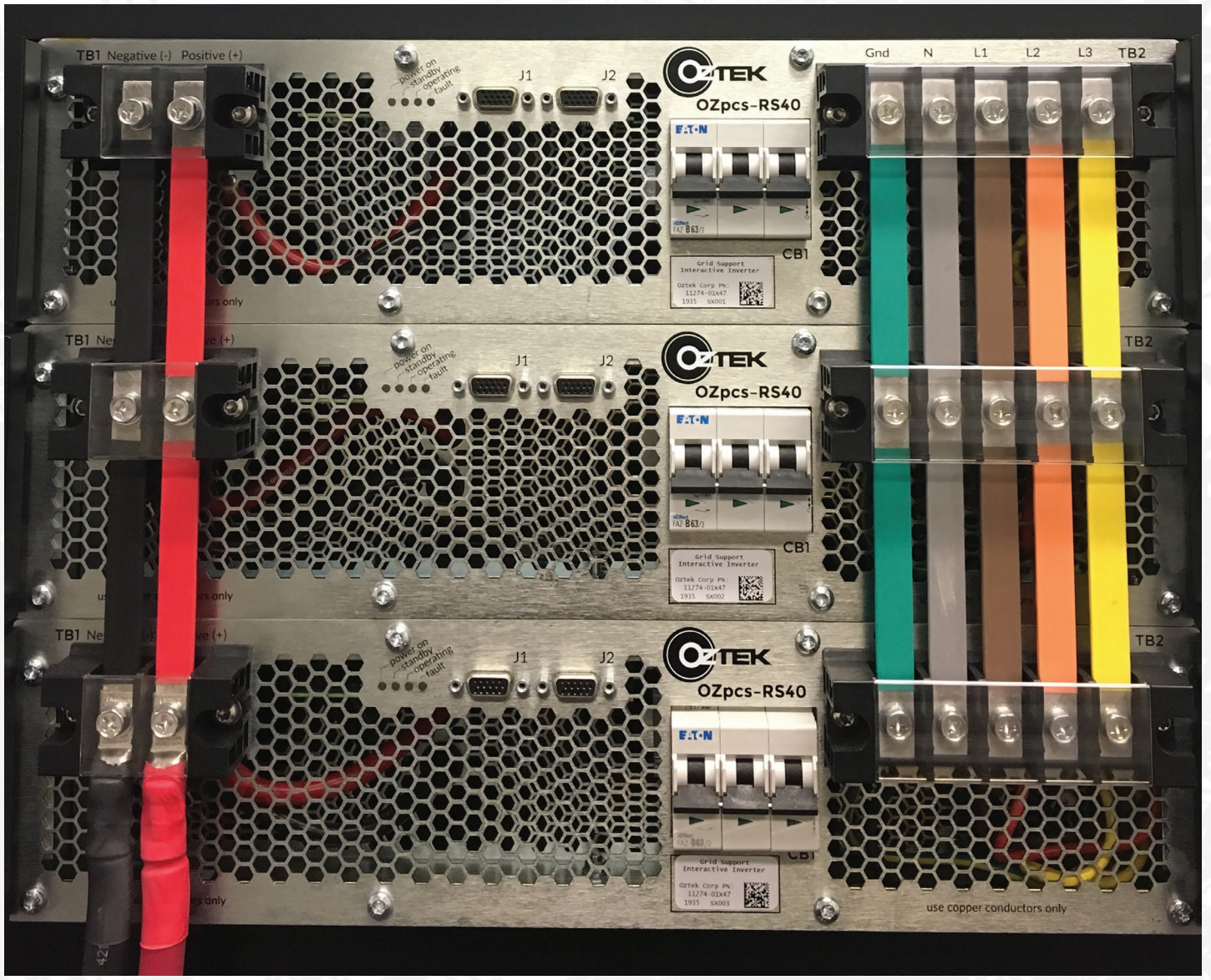
The architecture of the hardware behind any energy storage installation heavily impacts both the real and soft costs of how a business operates. It also affects the cost basis of the project, beyond the upfront purchase price. Integrators factor in these cost implications in the configuration and project sizing phase - before they are even awarded a contract - which can lead to substantial losses/customer acquisition costs if they fail to win the project. System sizing, warranty assumptions, availability guarantees, and service models all add to the cost basis, which the integrator passes on to the end user. Picking an architecture that lowers the cost of all these factors is critical to achieving the lowest possible installed system cost, at the highest reliability and performance levels.

Modular architectures allow manufactures to quote lower costs for warranty support, lower costs for capacity guarantees, lower costs for availability guarantees, and (above all) lower production costs, by creating a factory finished product. This is achieved not only by increasing the predictability of your cost basis, but also by shifting where labor is performed (factory vs field.). Smaller sized PCS products can be better aligned within the supply chain, and be tested as complete higher-level assemblies before they ship.

Lowering the cost of maintaining and augmenting a system allows for a lower up-front cost because less money needs to be reserved for future expenses. The result? Total cost of ownership is not limited to ongoing operational expenses, and DOES translate into the upfront cost of deploying an energy storage system.

When the time comes to add capacity, a storage system that has isolated its batteries (with either AC conversion or DC conversion at the string level) will be able to add energy with ease. Mismatched impedance, short circuit calculations, differences in capacity, and differences in technology, are all masked and managed by having this one degree of separation between the batteries. The control system can look at each string and maximize its contribution, such that each string reaches “empty” at the same point in time, maximizing run time. Smart integrators already take this approach.

It is interesting to note that data center computing, telco power systems, and even solar industries have chosen to use modular solutions as the industry standard. How can they all afford modularity? As it turns out, it’s more cost effective to manage a limited number of building blocks, from which a variety of systems can be built. It also offers the flexibility, availability, expandability (~augmentation), and manageability of the “Internet of Things” (IoT) hardware you expect in today’s technology environment. If a product fails, just put it in a box and send it back; and yes, it can be that easy. How would a data center function if it had to wait for a qualified technician to fly half way around the world to look at a server failure? That kind of inefficiency just wouldn’t work. Equipment on the grid should be expected to be as reliable as data center equipment, with the same level of availability, uptime, serviceability, and low MTTR.



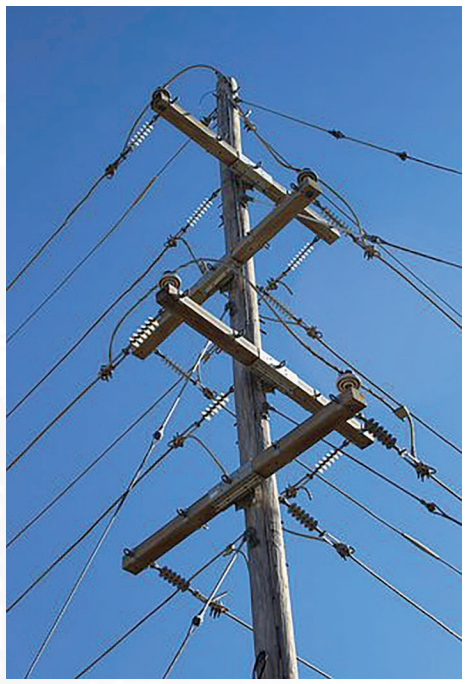
120KW of bi-directional grid connected UL1741SA approved power conversion. Each unit 40KW/KVA, three in parallel, total of 13" vertical in standard 19" cabinet.

"The ability to completely manufacture and test the system as whole building blocks prior to shipping, while properly extracting and managing the energy storage capacity from each battery, is the key to achieving the lowest possible cost and the highest reliability in the industry"

New energy storage system

Panasonic unveiled its new residential energy storage system, EverVolt, which features a modular design and is available in AC and DC-coupled versions, offering a flexible solution optimized for homeowners' energy needs and budgets. The home energy storage system enhances Panasonic's full suite of home energy solutions, including its signature photovoltaic high-performance HIT portfolio. The Panasonic engineered storage system is compatible with any solar system or inverter and can be tailored to a homeowner's individual needs. In addition to offering both the AC and DC coupled options, the system can be scaled down to as little as 5.7kWh of energy storage or expanded to 34.2kWh. EverVolt offers simple, one-person installation and is field serviceable. It also comes equipped with advanced software and a user-friendly app for homeowners, allowing customization between multiple operating modes visibility into system status. The product is backed by a 10-year product and performance warranty.

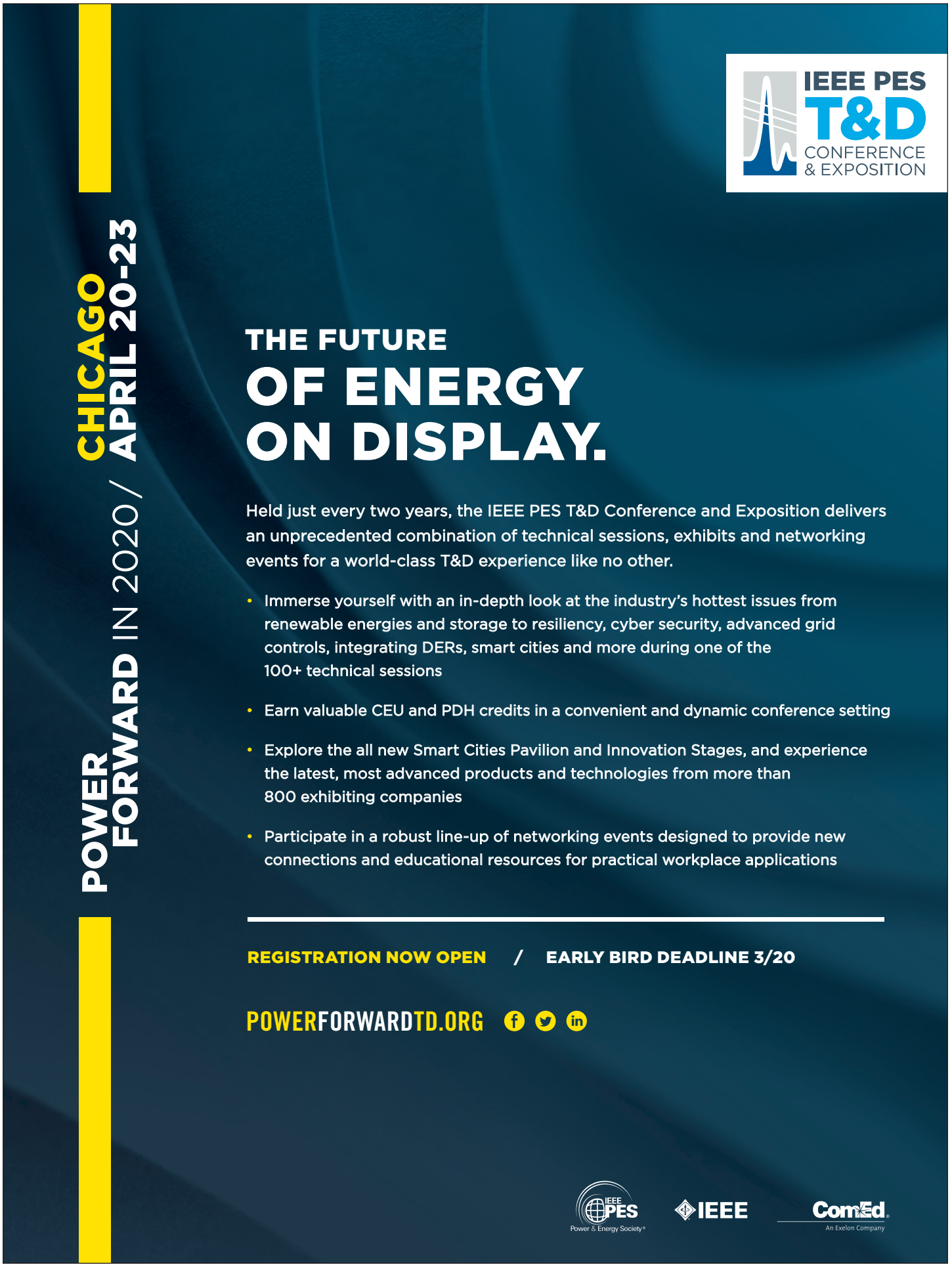
Panasonic Corporation of North America /// www.na.panasonic.com/us



Given the reality of the aforementioned factors, the total installed costs of energy storage systems can be reduced by leveraging the power of the modularity.
The traditional pieces of storage architecture - a battery container, a power conversion system (PCS), and a control system - all come together; it would be like driving around in a hybrid car with the battery in a trailer towed behind, and one of those travel pods from the 80's on the roof to hold the electronics. Our industry can do better. The winners in energy storage will achieve a high level of flexibility and integration that others can't match.

Greg Tremelling is VP Business Development at Oztek Corporation, which provides power conversion systems, design assistance, and engineering support with off the shelf product,s as well as semi-custom designs that build off existing product platforms.

Oztek Corporation
/// www.oztekcorp.com



Integrating Solar Microgrids

Reduces the impacts of power failures

by Lloyd Wilford

As the largest source[1] of potential renewable energy, solar power is often touted as the next great hope for the green revolution. While solar is indeed a top option for renewable energy, the environmental impacts are not the only reason the solar industry is expected to grow 50% globally[2] in the next five years. Remote locations, unreliable power grids, and collective conservation efforts all add to the necessity for flexible, cost-effective solar systems.

When the power goes out, all current source or pure grid-tie solar systems fail for lack of an energy storage system. Therefore, a standard setup may not work for the kinds of environments described above. It makes sense, since it would be unsafe for solar power to keep running through the grid when the main power goes dark. Utility teams can't work on lines they don't know are live. Most solar customers don't realize their systems are grid dependent. Even in a busy city center in the middle of the day when the sun is shining brightly, a grid-tied system will not deliver power if the grid goes down.

Solar power systems that are designed to be self-sufficient in almost any situation are often referred to as a solar microgrid. This type of all-in-one setup requires a different set of equipment, includes battery backup, and an energy storage system (ESS) with higher than base machine functions to control the flow of power.

Up to this point, the problem for the industry has been that not all solar panels, battery backups, and control boxes communicate with each other at the control level. It's very difficult (and expensive) to design a system that incorporates all these moving parts in a useful manner to establish a truly grid independent solution.

A more cost-effective solution is multi-level reticulation. This complex but efficient structure has the potential to reimagine the electrical industry worldwide. Here's how it works: loads - or the devices – that use activity in our factories, businesses, and homes, are not equal. We sometimes think of our electrical supply from the grid as being a single source of power, but that's not a sound philosophy to apply to an independent micro-grid delivery. A single induction (motor) load, like the heating device in our home, is equal to hundreds of LED lights, so in an environment that has electricity as a limited resource, this type of load cannot be treated equally to the lighting system of building. This difference in the loads goes further than energy usage, to the time of day the load is used. The brilliance of Multilevel reticulation is that it allows the management of a variety of circuits throughout a building in different ways at the same time, depending on the types and volumes of loads they are receiving, and their priority use hierarchy.

This multi-faceted flow of electricity allows solar energy to be used directly by the owners when the sun is out, store extra energy in a battery backup system, and deliver any excess back to the grid at a profit. We call this manufacturer agnostic approach Universal Energy Management (UEM). The battery backups can then be used at night, peak times during the day, and even when the grid goes down.

Because of its versatility, a UEM setup can also be used in circumstances where a home or business needs to be completely independent from a grid system. Isolated resorts far from power lines, schools in poor areas, or conservation centers with tight regulations about the disruption of the landscape, can still have electricity that meets the needs of each unique situation.

An added benefit of using this form of energy management is that it extends the life of the connected batteries. The ability to manage loads according to the specific set of needs at any given moment means that batteries aren't constantly cycling. As anyone with a cell phone or laptop knows, batteries fade over time, and their charge gets shorter and shorter. Cycling half as often means the batteries in a properly managed solar power setup will last twice as long.

When infrastructure wears out or is not invested in adequately, the power will go out. In California this year, millions of people have gone without power[3] as an antiquated system is periodically shut down to avoid dangerous wildfires. In June, a weather-related power outage[4] affected 41 percent of the traffic signals in Dallas, Texas. One week later, a massive grid shutdown left 48 million[5] people with no power across

Argentina, Paraguay, and Uruguay.

Countless homeowners in high-risk areas would benefit from the ability to seamlessly switch over from the standard grid to an energy storage system. As long as its delivery is dependent on the grid, solar can't do this. Thanks to recent innovation, however, more cost-effective and reliable power is available now.

Lloyd Wilford is Chief Technology Officer for Humless, a U.S.-based company that develops new products in the alternative electrical supply and solar energy industry. Lloyd is an educator and computer programmer, and has dedicated the last 5 years of his career exclusively to the advancement of sustainable energy. He is responsible for the installation of the largest Schneider XW platform, Hybrid Alternative Energy system, as well as the world's first integrated housing estate with a mini-grid system.

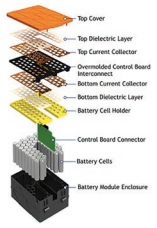
Humless /// humless.com

[1]*https://www.sandia.gov/~jytsao/Solar%20FAQs.pdf*
[2]*https://www.iea.org/newsroom/news/2019/october/global-solar-pv-market-set-for-spectacular-growth-over-next-5-years.html*
[3]*https://www.latimes.com/california/story/2019-11-18/another-power-outage-pge-may-shut-down-grid-northern-california*
[4]*https://dfw.cbslocal.com/2019/06/10/dallas-customers-without-power-oncor-patience/*
[5]*https://edition.cnn.com/2019/06/16/world/power-outage-argentina-uruguay-paraguay/index.html*

Flexible, easy-to-install residential solar-plus-storage

Generac Power Systems' PWRcell is a fully-integrated residential solar energy storage system that is powerful, flexible, efficient, and easy-to-install. PWRcell technologies include expandable battery capacity and on board power monitoring and management as standard. The PWRcell system captures clean energy from photovoltaic solar panels, then stores that energy in the modular, expandable Li-ion PWRcell Battery cells for use when grid power is expensive or unavailable. The system consists of an integrated ecosystem of components, including an expandable battery pack, inverter, and associated hardware. Each component is specifically engineered to seamlessly install and work together. PWRcell features modular battery packs, equipped with 8.6kWh batteries, expandable to 17.1kWh to match any budget. PWRcell also provides homeowners with up to 50A and 12kW of surge capacity, enough to start heavy loads such as air conditioners. Once engaged, PWRcell provides 8kW of continuous power and enough to energize most homes on a typical day. When more power or capacity is needed, additional PWRcell inverters and batteries can be added for up to 34.2kWh of DC-coupled storage. PWRcell is equipped with Generac PWRview technology, an easy-to-use home energy monitoring system that tracks home energy use and provides powerful insights into the home's electricity consumption. With the intuitive PWRview app, data is processed into useful information that allows homeowners to make smart decisions regarding their use of energy, lowering usage to extend the amount of time the home can run on PWRcell-provided energy.

Generac Clean Energy /// www.generac.com



Battery interconnect systems

Interplex, a provider of customized application solutions, has announced availability of the new Cell-PLX custom battery interconnect systems. This new technology streamlines the design and manufacturing of robust interconnects for battery modules across an extensive range of industries. Cell-PLX addresses the intricate complexities of battery module design with a custom battery interconnect system that connects battery cells to current collectors, and a customizable lead frame interface to the battery management system. By tackling the full range of design requirements, it delivers a customized power solution that effectively handles the increasing variety of battery module sizes and configurations. Cell-PLX enables optimal positioning for mating with battery cells, improving connection quality and reliability. Its modular nature also allows for passive and active component placement, including fuses, thermistors, most positive and negative interconnects, cell holder designs, signal interconnects, and harnesses or circuits connecting to the control board.

Interplex /// www.interplex.com

Building Resilient International Supply Chains

What clean energy companies need to know

by Maria Guercio and Martin Kunz

By 2030, the United Nations[1] predicts that the worldwide population will reach 8.6 billion—one billion more people than today. This growth is anticipated to continue into 2100.

Sustaining a growing global population requires access to healthy food, clean air, fresh water, and other natural resources. To meet this need, clean energy companies are investing heavily in new research and development initiatives to power our future. To achieve this, companies must start sourcing parts and components from a wider network of suppliers—ultimately expanding their supply chains to include international markets. In fact, a recent survey of global clean tech executives[2] found that global expansion, and management or growth of supply chains, rank among their top five priorities over the long term.

As supply chains become more interconnected, however, companies are exposed to new risks. While relatively predictable, they can lead to business disruption, and even failure to meet global needs.

For clean energy companies looking to grow their supply chains abroad, either for the first time or to expand into new countries, here are a few things to keep in mind.

Where in the world are supply chains going?

Clean energy companies primarily source supplies from the U.S. and Europe. Yet, despite these two regions providing economic stability and comparatively simple business processes, they will decline in dominance.

Southeast Asia is one area of the world that is emerging as an attractive option; the percentage of companies set to source in the region will more than double over the next three years, to 33 percent. China is also a top destination, ranking as the third most preferred market for sourcing - today and in the future. This shift will add new supply chain complexity, and new risks to be managed.

Risks around the world

Supply chains are critical to a company's success, and are inherently sophisticated no matter where they are located.

As more supply chains expand internationally, businesses and suppliers become more independent, which makes any single disruption potentially significant. For example, within a supply chain network, each supplier has its own suppliers—and those suppliers likely source from other companies. Should any one supplier within this chain suffer a production delay or quality issue, it can have a cascading effect, ultimately affecting the end company's reputation and revenue.

These threats don't just exist in the abstract. At least half of the clean tech executives surveyed suffered a supply chain disruption in the past three years. Among the greatest challenges are quality assurance and production problems, ranked first on the list by clean energy executives. Production problems also posed a serious risk (they came in second).

The reason clean tech executives are so concerned is that, when they depend on someone else to manufacture a component (or several components) for their product, they yield a certain amount of control and oversight. Additionally, emerging markets may have different cultural standards when it comes to quality, which potentially puts a product at risk if this difference is not proactively discussed.

Another significant global supply chain concern is intellectual property (IP) protection - ranked by clean tech executives as the third overall risk to their supply chains. As supply chains become more globalized, it's vital to understand the different laws each country has regarding IP protection and enforcement; these laws are typically less stringent than U.S. laws.

Finally, stability of the legal and political environment in the countries where international suppliers are located is a top concern for clean energy companies. Deciding which supplier to work with can depend on a number of variables: Are they located in a place where there is a stable political situation on-the-ground? Is there a sound infrastructure in place to physically move supplies? How easily can component parts be exported? Even minor changes in a country's legal or political environment can have an outsized impact on a supplier's ability to operate.

Safeguarding international supply chains

Supply chain disruption can have serious implications. Of the companies that suffered a supply chain disruption in the past three years, 80 percent reported that it resulted in a severe business impact, including delayed deliveries, decreased revenue, impacted profit margins, and reputational damage.

By understanding international supply chain risks, clean energy executives can implement the necessary risk mitigation best practices to curb their exposures. When launching or expanding their international supply chains, they should keep the following in mind:

- Never rely on a sole supplier. Companies should have multiple sources for critical supply components.
- Engage proper vetting practices when building their network. Beyond looking at physical characteristics like storage facilities and transportation routes, understand their sub-suppliers and how they, too, could impact production.
- Set objectives and comparable metrics from the beginning to track supply chain resiliency. Hold suppliers accountable.
- Consult with legal experts on the IP laws and protections in a supplier's home country. Based on that information, consider whether assembly of select components should be done in-house.

Despite the best protections, disruptions still may occur. In this case, it is important to have the necessary insurance policies in place to help protect your business and your balance sheet. When selecting an insurance provider, consider their industry expertise, global footprint, and whether they will be able to provide immediate, on-the-ground assistance in the countries where your supply chain network resides. In many cases, your insurance provider can also lend expert insight into how to build a resilient global supply chain in the first place.

Powering the future

Clean energy companies are doing vital work to responsibly power our future. Predictable, yet risky, global supply chain vulnerabilities shouldn't stand in their way. By implementing simple safeguards today, the future of clean energy will remain bright.

Maria Guercio is VP, North American Clean Technology Practice Leader at Chubb, and Martin Kunz is VP, Clean Tech Executive Field Underwriter at Chubb. Chubb is the world's largest publicly traded property and casualty insurance company, serving consumers and companies of all sizes with traditional and specialty insurance products and claims and risk engineering services

Chubb /// www.chubb.com

[1]*https://www.un.org/development/desa/en/news/population/world-population-prospects-2017.html*
[2]*https://www.chubb.com/us-en/_assets/doc/wp-cleantech-11-18.pdf*

Media converter

Antaira Technologies introduces the FCU-6001-SFP+ media converter which is equipped with one 10G/5G/2.5G/1G Base-T auto-negotiation port and one 10G Base-X SFP+ slot. It supports 10Gigabit Ethernet media conversion from copper 10GBASE-T to fiber multi-mode or single-mode, utilizing 10GBASE-SR or 10GBASE-LR SFP+ transceiver installed in the SFP+ slot to extend distances to servers, switches and patch panels. The deployment distance can be extended from 984ft (300m) in multi-mode and up to 37 miles (60km) in single-mode. They are designed for use in network environments where the ultra-high bandwidth provided by 10Gigabit Ethernet is required, for example, data center cloud computing, enterprise backbones, campus networks, and carrier infrastructure. The FCU-6001-SFP+ supports chassis as well as wall mountable orientations and provides an operating temperature range from 32°F to 122°F (0°C to 50°C).

Antaira Technologies /// www.antaira.com

Affordable LED floodlight with ceramic heat sink design

SANSI has introduced the new C2020-BW 30W floodlight, which has a hollow structure and an air convection design. Replacing 200W traditional halogen bulbs with a 30W LED, the 120° wide-angle optical lens provides an illuminating effect, which makes the overall lighting environment harmonious, beautiful, and comfortable. It is used in commercial exteriors such as hotels, landmarks, exterior walls, and bars. Suitable as a replacement for floodlights with halogen lamps (up to 200W), it provides energy savings of up to 90%. The 30W outdoor light is rated at 3,000 lumens with a minimum of 100lm/watt. Ceramic heat dissipation LED technology provides both even and fast heat dissipation. The hollowed out design ensures good ventilation, quick heat dissipation with longer lasting light performance and lifetime and has an IP66 waterproof and flame retardant PC shell. The included remote control allows for 16 different colors of lights and 4 kinds of color changing patterns including flash, strobe, fade, and smooth as well as a memory function and sensitive sensor. One remote control can control several LED flood lights at the same time with a sensory distance of 33ft - 49ft (10m - 15m). Easy to install and mount.

SANSI Tech
/// www.sansitech.com

Compact, high-performance disk varistors

TDK Corporation announced the EPCOS Compact S14 AdvanceD-MP series of metal oxide disk varistors that feature smaller dimensions with the same performance as the EPCOS S14 AdvanceD-MP standard series. The disk diameters of the new B72214P2* varistors range from 13mm to 14mm, a reduction of approximately 3mm. Like the standard S14 series, these components offer a maximum surge current capability of 6kA at 8/20 µs according to IEC 62368-1. The Compact S14 series covers a wide operating voltage range from 130 to 460VRMS. The multiple pulse varistors are designed to be used in power supplies as the primary protection against low-level repetitive surge currents. The optimized design results in an improved derating performance over time. All types have UL, CSA, VDE and IEC approval. Due to compact dimensions and electrical characteristics, the Compact S14 varistors help design engineers reduce the size of products and are suitable for a wide range of applications. These include switch-mode power supplies, drivers for LED lighting, home appliances, and smart meters.

TDK Corporation
/// www.tdk.com

eventscalendar

JANUARY

16-17 **Solar, Storage and Smart Energy Expo Northern California**
Hilton Union Square – San Francisco, CA; www.events.solar/exponorth/

FEBRUARY

04-06 **Intersolar North America**
San Diego Convention Center – San Diego, CA; www.intersolar.us

04-06 **Wind Power Finance & Investment Summit**
Omni La Costa Resort & Spa – San Diego, CA; www.infocastinc.com/event/wind-power-finance-investment

10-13 **GLOBE 2020**
Vancouver Convention Centre – Vancouver, BC; www.globeseries.com

12-13 **The Energy Expo**
Miami Airport Convention Center (MACC) – Miami, FL; www.theenergyexpo.com

19-20 **Solar and Energy Storage Northeast**
Westin Boston Waterfront Hotel – Boston, MA; www.events.solar/northeast/

24-26 **Solar Power and Energy Storage Mountain West**
Hilton Denver City Center – Denver, CO; www.events.solar/mountainwest/

26-27 **AWEA Wind Project O&M and Safety Conference 2020**
Hotel Del Coronado – Coronado, CA; www.awea.org

MARCH

11 **IREC Vision Summit**
The National Housing Center Auditorium – Washington, DC; www.irecvisionsummit.org

12-13 **Solar and Energy Storage Florida**
Bahia Mar Fort Lauderdale Beach – Ft. Lauderdale, FL; www.events.solar/northeast/

25-28 **NABCEP Continuing Education Conference**
Sheraton San Diego Hotel & Marina – San Diego, CA; www.nabcep.org

APRIL

01-02 **f-cell+HFC 2020 Hydrogen and Fuel Cell Event**
Vancouver Convention Centre – Vancouver, BC; www.hyfcell.com

07-09 **AWEA Wind Project Siting and Environmental Compliance Conference 2020**
Omni Shoreham Hotel – Washington, DC; www.awea.org

08-10 **ESA's 2020 Annual Energy Storage Conference & Expo**
David L. Lawrence Convention Center – Atlanta, GA; www.esacon.energystorage.events.org

20-21 **Solar and Energy Storage Southeast**
Georgia World Congress Center – San Diego, CA; www.events.solar/southeast/

20-23 **IEEE PES T&D Conference & Exposition**
McCormick Place – Chicago, IL; www.ieee-d.org

MAY

04-06 **SEPA 2020 Utility Conference**
Charlotte, NC; www.sepapower.org

14-15 **Solar, Storage, and Smart Energy Expo Southern California**
Marriott Marquis – San Diego, CA; www.events.solar/expo/

19-21 **Midwest Solar Expo**
Graduate Minneapolis – Minneapolis, MN; www.midwestsolarexpo.com

JUNE

01-04 **AWEA WINDPOWER 2020 Conference & Exhibition**
Colorado Convention Center – Denver, CO; www.awea.org

04-05 **Solar and Energy Storage Texas**
Hyatt Regency Hotel – Houston, TX; www.events.solar/texas/

SEPTEMBER

14-17 **Solar Power International 2020**
Anaheim Convention Center – Anaheim, CA; www.solarpowerinternational.com

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7	AWEA - CleanPower	www.cleanpowerexpo.org
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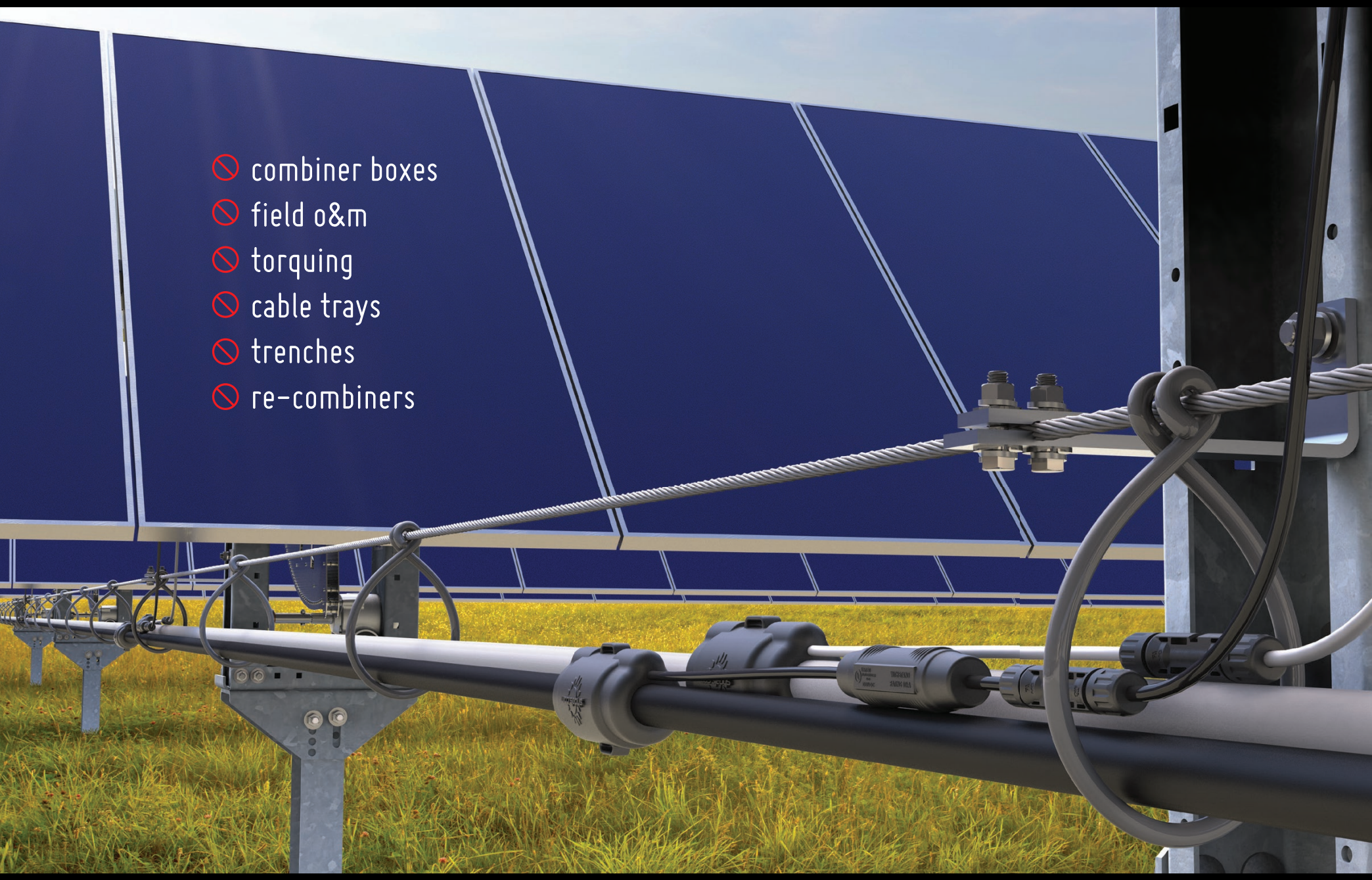

The BLA (Big Lead Assembly®) takes all the guesswork out of wiring your solar field. Using Shoals' latest in-line fuse and wire manufacturing technology, we offer you a site free of DC string combiners. The entire load is combined into a single pair of aluminum conductors running from the string combiner to the inverter. There's no need to trench for DC feeders or hang string combiner boxes. And when terminated with the BAC connector, the whole array is plug-&-play. Plug in the panel strings, plug into the inverter, and just walk away!

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