

North American **CleanEnergy**

2019 ENERGY STORAGE BUYERS GUIDE

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64 Wind product spotlight: Tensioners & Torque Systems



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MY FATHER ALWAYS TOLD ME,

“If you want something done right, do it yourself”. While that lesson didn’t bode too well for my ability to delegate, it explains my lingering distrust of automation. (Yes, I’m typing on a computer and relying on the magic of the internet to connect me to the rest of the world – hypocrisy duly noted). Part of me feels guilty for not embracing the newest technology, but I’m bound to an ingrained sense of personal responsibility. Lately, I’ve noticed that the pendulum of ecological virtue seems to swing between adopting the latest advancements in clean energy, and altering our own behavior to make greener choices.

We’re in the throes of smart stuff. Smart cars, smart buildings, smart phones; all of these tools tend to make us look kind of dumb. There’s a level of perversity in teaching people to abdicate responsibility for everyday tasks: self-driving cars, automated buildings, voice-operated appliances, and terrabytes of memory are here to save us. Why bother learning how to drive carefully, or checking around the office at the end of the day making sure electricity isn’t being wasted, or turning your air conditioner off when you leave the house, or memorizing your best friend’s phone number? I admit it, I used to know my credit card numbers. But now that I buy nearly everything online and my information auto populates the checkout forms, what’s the point?

Have you seen the Disney-Pixar movie *WALL-E*? It sends a rather terrifying message of our potential fate should we choose to relinquish our personal accountability to technology. Spoiler alert: the movie chronicles the gradual devolution of our bodies as we rely ever more heavily on computers to care for us.

Dear friends of mine had the scare of a lifetime when they rolled over their toddler son while backing the car out of a driveway. He ended up being bruised but okay. As it turns out, the car was an older model they were borrowing; it had no backup camera. They were so used to seeing behind them without having to turn around and actually look, that performing such a basic safety step didn’t occur to them. Technology altered their normal pattern of behavior. (I don’t fully trust my car’s backup camera, and still prefer to twist around to see where I’m going).

My childhood was filled with unforgettable eco-imagery: a tearful Indian watching trash pile up on the side of the highway, ominous illustrations of gaping holes in the ozone layer, belching smokestacks, etc. We didn’t trick or treat without doing it for Unicef and comparing our haul of donated pennies at the end of the night. We were reminded to turn off the lights, not waste water with 20-minute showers, pick up trash and keep our streets clean. Years later, when I heard the term “grass roots”, it took me a while to realize it was just a fancy way of saying you were doing things on a local level, another way of promoting personal responsibility.

Even as green advocates strive to bring us closer to becoming a “net zero” society through the adoption of automated and eco-friendly solutions, I can’t help but feel like we’re becoming further removed from the consequences of our individual actions. Last year I heard a rumor that China stopped accepting our plastic in response to the recent tariffs. I was confused because I just figured that all of the cans, bottles, and bags set out on the curb every week made their way to a local recycling station that transformed them on site. Instead, it’s a long, convoluted, and politically charged journey that our throwaways take on their way to a potential repurposing. It may sound naïve, but not having a direct impact on the fate of the things I touch tends to make me feel impotent in the whole cycle of conservation.

I’m not trying to sell anything or sway any opinions. I’m just an old school conservationist contemplating the connection between our daily actions and the big picture of clean energy we’re all aiming for. It’s worth considering that it may not be smart technology, but smart people that will really make a difference.



*Until the robots take over...
Enjoy the read.*

Meg



Talking to kids about climate change

According to an international survey, 58 percent of parents want to speak more about climate change with their children but often don’t have the knowledge to do so or find the topic difficult to explain. In an effort to encourage children to be a greener next generation, Ørsted launched a children’s book and online platform to make it easier for parents to talk to their children about climate change. The book, *Is This My Home?* is available for free as an illustrated digital audiobook that can be downloaded online. This online universe aimed at parents also contains tips on how to talk to children about climate change in a way that appeals to their age as well as answers to difficult question on climate change. It also provides tips on what families can do to help prevent these changes and how children can find relief in taking green action in their everyday lives.

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Engagement in the circular economy

Schneider Electric has won The Circularity 2019 award in the Multinational category. The Circularity, an initiative of the World Economic Forum and the Forum of Young Global Leaders, run in collaboration with Accenture Strategy. It recognizes private and public organizations, as well as individuals, who make a significant contribution to the circular economy. 40,000 tonnes of primary resources avoided being consumed and 30 million tonnes of CO2 saved in 2018 thanks to the circular economy. Schneider Electric’s approach to the circular economy is a concerted move away from the wasteful linear system of “extract, manufacture, dispose” (or “take, make, and dispose”) that is demonstrably damaging to the planet and climate. The Circularity 2019 award recognizes Schneider Electric’s commitment to the circular economy everywhere and at all levels, as part of a universal approach that encompasses all of Schneider Electric’s activities, including; eco-design of products with minimum use of primary raw materials; circular Value Propositions (connected objects, services, leasing, repair, take-back etc.); a circular supply chain (reverse logistics, repair centers, modernization and reconditioning centers etc.); and corporate governance around four “circular economy” indicators in the quarterly non-financial Schneider Sustainability Impact barometer, which impacts remuneration of thousands of Schneider Electric managers.

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Risk Landscape

Cybersecurity for energy & utility operations

by Louie Belt

THE EVOLUTION OF TECHNOLOGY IN ENERGY

and utility operations brings incredible opportunities, as well as risks. The number of technology attacks in the United States doubled last year - hackers targeted power grids, gas lines, and electric utilities. This doesn't even include the 6000 percent spike in ransomware emails, extracting more than \$1 billion from businesses, plus an additional \$75 billion in costs from operational downtime (averaging two days per attack).

With all the publicity on the security threats from infected email and ransomware, the reality is that the risk landscape is much broader. Digital transformation in energy and utility operations comes with inherent hazards. The good news is that technology allows more users in more places. The bad news is that technology allows more users in more places. People accessing your system are no longer limited to the secured walls of one building; whether a substation, branch office, or customer center, information is shared via the cloud, and accessed from both company and personal devices. The number of devices and applications being utilized on a daily basis is also growing. On average, the typical worker will use three or more different devices to access company information; 75 percent say they've experienced attacks on at least one of their devices within the last year.

These endpoint devices are becoming increasingly more difficult to defend. Mobile devices, cloud data, and user behavior are critical to address. So, what's an energy or utility provider to do? What are the best practices to protect information and ensure operations aren't compromised? Direct, multilayer threat protection is the best way to protect your operations and keep them running efficiently.

Multilayer threat protection is best explained in the form of a workplace security stack, focusing on 8 areas of protection. Historically, managers have applied security to one or more levels - but not edge-to-edge, end-to-end security. This requires that all 8 layers be protected. Including the following:

- 1. End point management** - monitoring and proactive/automated remediation for end user devices, whether mobile or in office.
- 2. Advanced malware protection** - detection, containment, and removal of threats across all endpoints.
- 3. Secure remote access** - secure connections to the enterprise network by any device, at any time or location.
- 4. Secure internet gateway** - blocking malicious destinations before connections are established.
- 5. Apple/iOS security protector** - advanced protection for IOS devices over wired, wireless, and cellular networks.
- 6. Mobility management** - single sign-on access to business applications, based upon the user's persona.
- 7. Identity management** - visibility and dynamic control of users and devices accessing wired, wireless, and VPN connections.
- 8. Next generation firewalls** - unified threat management with integrated firewall, IPS, content filtering, and advanced malware protection.

Many endpoint solutions claim to block 99 percent of all threats. With that level of effectiveness, why should you worry about anything else? The reason is the remaining 1 percent of threats - which tend to be the most disruptive and costly to your operations.

For advanced malware protection, the focus is on how to prevent, detect, and reduce risk. We can prevent with antivirus, file-less malware detection, and cloud lookups. To detect, we can use static analysis, sandboxing, malicious activity protection or machine learning. And to reduce risk, we identify vulnerable applications, low prevalence and proxy log analysis.

Another major hazard is presented by the cloud. Users and applications have adapted to the cloud, so must security. With 49 percent of the workforce now mobile, and 82 percent admitting they don't use a VPN, security controls must shift to the cloud. Look to the workplace security stack areas; secure remote access and secure internet gateway to provide protection for those accessing cloud data. This enables users to block malicious destinations wherever they go, even off VPN.

IOS devices also need security protection. Traditionally considered a safe haven, IOS devices are now targeted and vulnerable to attacks, just like other devices. Giving Apple devices the same security attention as Android, Windows, and other SaaS applications in your security plan, will help address some of the remaining threats.

Identity management refers to the user - who they are and whether or not you want to provide them access. A best practice is a single point of identity and access management for all end points across the network, both wireless and wired. This will offer:

- Profiling** - Who is the user, what device, where?
- Posturing** - Is the device clean? Antivirus up to date?
- Quarantining** until device meets minimum standards.
- Access** granted based upon role, device, time, location, application, etc.
- Guest** - Simplified self-service access.
- Real time view and analysis** of all users and traffic.

Implementation of next generation firewalls will complete the multilayer threat protection, delivering integrated threat defense across the entire attach spectrum.

With the increasing technology being utilized in energy and utility operations, cybersecurity should be on the mind of every CTO, CEO, and board member. When we talk about cybersecurity failings, we mostly think about data breaches. Although they are a significant issue, the subject of cyber security in the energy sector reaches further, into an area of greater concern. As attacks on critical infrastructure have surged, we're reminded that, while loss of data is concerning, the loss of electricity is catastrophic to both business and society.




Louie Belt is the US Principal Solutions Architect for Getronics. He specializes in advanced technologies and security, with expertise in SD-WAN, SD-Access (Cisco DNA Architecture), Unified Communications and Collaboration, ACI (Network and Application Centric), Wireless, Mobility, Cisco Security including ISE, Firepower, etc. Louie holds a Bachelor of Science degree in Engineering Physics and resides in Nashville, TN.

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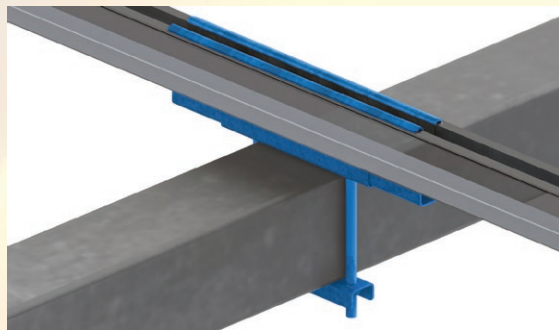
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Forecasting EPC Prices

Challenges and possibilities

by Bill Hargett



As the Investment Tax Credit step down becomes more imminent in 2020, and beyond, EPCs and installers have seen renewed price pressure on lower-cost delivery of solar systems. As a matter of course, construction and delivery firms regularly receive RFPs from owners and developers regarding their project pipelines “post-ITC.” Unfortunately, guidance for EPC pricing 4-5 years in the future is extremely unreliable, and often exacerbated as developer-owners compete on PPAs based on “guesstimate” forward cost curves.

SEIA, NREL, Wood McKenzie, and others continue to publish quarterly reports on residential, commercial, and utility scale system pricing. Even a cursory look at these reports will show that a) yes, pricing has come down 25 percent since 2015, and b) the vast majority of gains are due to module and inverter price dynamics. While installation companies can optimize purchasing through volume orders or master supply agreements, most contractors and developers have similar price visibility into the modules, inverters, and racking prices. These major components can make up over 55 percent of the turnkey cost, and dramatically change project economics because of prevailing duty and tariff legislation. From an EPC perspective, owners may then apply considerable pressure to optimize price on the 40-45 percent balance of plant, which largely consists of direct labor, engineering, and overhead/margin.

In the emerging solar industry of 5-10 years ago, technology and delivery risk incurred higher margins and contingencies, typically in the mid to high teens. Margin expectations have declined significantly since the early 2010s (to the mid and low single digits), even as improvements have been made to reduce the amount of direct management and overhead. However, many in the solar industry regularly hear of projects and contractors burned by unexpected geotechnical, labor, permitting issues,

et al. If these risks are not sufficiently captured, then they are priced in as contingency or change orders, provided the EPC contract entertains them. Margins are unlikely to be up for negotiation going forward.

As an overall portion of pricing, engineering is a relatively small percentage (roughly 2-5 percent), though a vitally critical component to the overall project success. While there may be opportunities to offshore some of the drafting work, the nature of local code compliance and local familiarity can often require specialist, time-intensive participation. Combined with a constrained technical-labor market, third-party engineering prices also appear to be increasing.

This leaves labor and productivity improvements. Direct labor can contribute 12 to 15 percent of project costs, with several large caveats: What are the prevailing and union or open shop wage requirements? Are there competing industries and projects? In short, labor costs and productivity must be measured in terms of the local competitive dynamics, such as how to compete with local projects that reduce labor availability, and how to reduce workforce turnover in the face of challenging site conditions (who wants to work in central Florida or central Texas in the middle of August?). Additionally, EPCs must closely evaluate remote site locations as to how they can find capable workforces to complete the work.

It's important to note that installation rates have improved significantly over the last several years; some tracker manufacturers now have a global supply network with the ability to support installation velocities of 10MW to 15MW (or more) installed per week. Much of this improvement has been due to the very significant engineering and design work that racking companies have put into reducing the number connection nodes on their equipment, in addition to providing extensive support in optimizing phased delivery (other firms have attempted to make headway in prefabricated racking “tables” that can be effectively craned/winchd from the back of a truck and installed as blocks, though it remains unclear how truly cost effective this will be given upfront costs of prefabrication). Anecdotally, however, dramatic increases in delivery and productivity rates are unlikely to improve without some form of automation, which has yet to gain industry-wide traction. The incremental process of improving

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are unlikely to return, meaning that price information based on unquantified site risks, several years into the future, is going to be highly conservative. Further, as all signs point to banner installation years for utility-scale solar, we may start to see limited EPC capacity for both project delivery, and pre-construction forecasting.

Bill Hargett is Director of Business Development – Renewables for JE Dunn Construction Company. Serving more than 13 years in the industry, Bill has project development and equipment and engineering sales experience, both internationally and domestically. His expertise includes functional technical knowledge of large-scale Power Generation technologies, Battery Energy Storage Systems, Photovoltaics, Gas to Liquids, Combined Heat and Power, Concentrated Solar Power, and Geothermal.

JE Dunn Construction /// www.jedunn.com

installation productivity is countered by anticipated normal year-over-year wage inflation (roughly 2-3 percent annualized). The political and moral judgements regarding wage inflation and buying power aside, the fundamental issue is that, as major component costs of a solar project continue to decline, labor is going to make up a larger and larger share of the overall cost – a portion likely to grow for the foreseeable future.

In large part, the phenomenal growth curve of solar has been driven by broader macroeconomic trends, such as manufacturing supply capacity in China and import tariff assessments. Importantly, improvements in module efficiencies have also played a role in cost reductions; a general rule of thumb being that every 10W increase in module wattage can yield \$0.005/watt savings on racking, wiring, and installation labor. However, laboratory improvements in module efficiencies can be challenging to commercialize across multiple manufacturing lines; theoretical efficiency limits may mean increasingly marginal returns on R&D investment. As China cuts its renewable subsidy program, a potential panel supply glut could mean less focus on efficiency and cost improvements in the short term.

The EPC industry has not bottomed out on cost improvements. If we've learned anything, it's that if you're not innovating, you're dying. On the whole, organizations have found the low-hanging fruit, and have passed those savings to the customer; now it is time to climb the tree to get the harder-to-reach cost-saving opportunities. The days of predictable 10 percent annualized cost reductions



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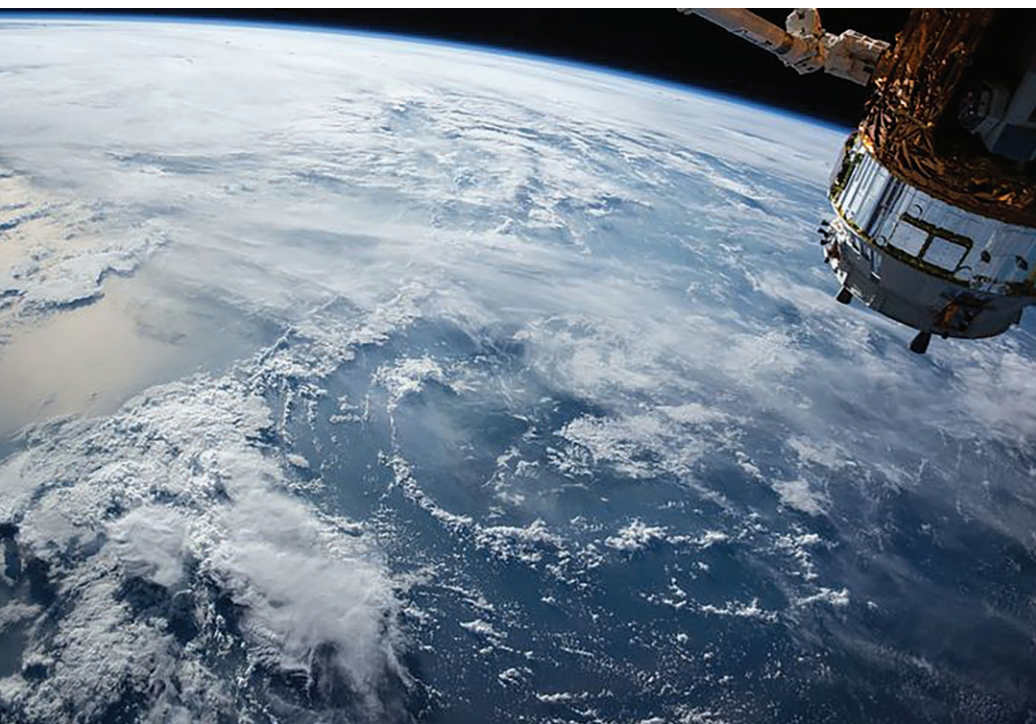
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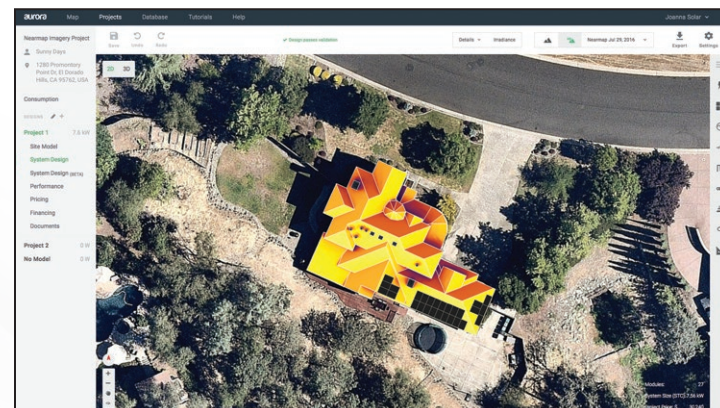
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HD Aerial Imagery for Solar

Setting a new standard

by Tim Frank



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SINCE THE EARLY DAYS OF SOLAR,

determining the scope of any given project has required an on-site assessment of the potential job, eating up hundreds of hours for solar companies, their analysts, and the installer (not to mention the safety risk and liabilities attendant to these assessments). Along came the ability to use satellite imagery to qualify properties; it wasn't a perfect solution, since much of the roof detail is lost at maximum zoom levels, and critical measurements like pitch were unattainable. Particularly for roofs with complex shapes, solar companies have found it nearly impossible to assess the scope of their projects accurately, leading to multiple change orders, over/under stocking of panels, and wasted installer time.

Satellite imagery further complicates the solar qualification process, making it challenging to determine whether nearby trees would block enough of the roof to render solar not viable for a particular structure. Additionally, the images tend to be dated. Images are expensive to produce, so satellite capture is not repeated frequently - making it next to impossible to obtain current imagery for use in solar assessments.



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The next 'great leap forward' - HD Aerial Imagery

Available high-resolution aerial imagery is far superior in helping companies accurately assess potential projects. With resolution that is typically many times sharper than free satellite imagery, HD aerial imagery reveals critical features of locations at a level of detail unmatched by satellite images. The results help solar teams save time and money, and serve their customers better.

How? Here are some of the benefits:

Prospect Remotely

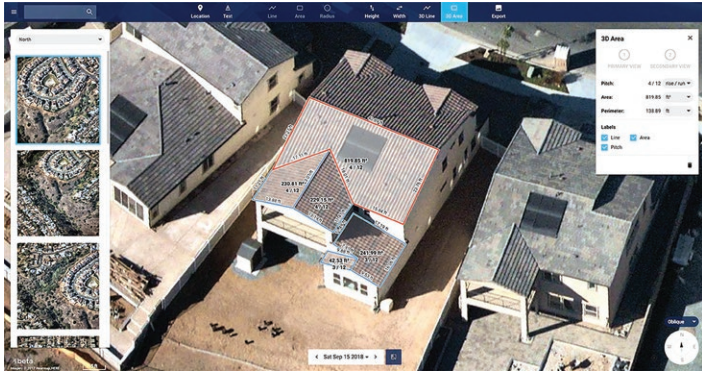
Up-to-date images, combined with solar industry tools, provide installers with all of the details they need, from quote to activation. Solar companies can do all the work without leaving the office. One contractor doubled its qualifications through image analysis, and significantly reduced the turnaround time on the qualification process.

Design Correctly

Sending technicians to measure a property for estimates is time-consuming and costly, when you factor in insurance, safety, or even lost opportunity. On-site evaluations can cost a company as much as \$300 per assessment. A typical solar technician can measure about five roofs per day; not only do costs add up, but additional opportunities can be lost to companies using precise aerial imagery to perform 'Virtual Site Assessments.'

Getting it Right the First Time

Change orders can be a major headache for any solar company, not to mention an easy way to lose contracts. With aerial imagery, however, it's now possible to make accurate measurements on the first pass, allowing a company to identify any obstructions, and present proposals that are correct. When a solar proposal isn't accurate, it creates problems across the board - for salespeople, analysts, and installers - and can annoy the customer enough that he or she goes elsewhere with their project.



timeliness of images, solar providers can reduce change orders, improve their qualification process, and create winning proposals all of which will help build business. This solution saves analyst and installer time, as well as money, so happy customers will recommend your company to others looking for a solar solution.

Tim Frank is Vice President of Marketing at Nearmap, which delivers high resolution aerial imagery multiple times per year. Nearmap provides orthographic (vertical) maps, multi-perspective panoramas, and oblique aerial views, and uploads up-to-date aerial maps to the cloud within days.

Nearmap /// www.nearmap.com

HD aerial imagery can provide both 2-D views, either top-down or orthographic, as well as oblique view angles from all cardinal directions. Thanks to photo-realistic 3-D data, field workers can fully immerse themselves in a virtual environment that simulates the impact of shading or other types of solar obstructions. While the imagery from aerial providers is often available in standalone applications, the most flexible solutions integrate with fully-featured PV design tools.

Qualifying the Right Projects

Not only does current aerial imagery save solar companies significant time (by eliminating a large proportion of on-site visits during the qualification process), but it also can open up solar to more customers. Some HD aerial imagery providers update locations every three to four months, which means that changes to a property – a tree added or removed, for example – is readily visible. Out-of-date imagery does not represent details at this level, and can disqualify a candidate for solar. This translates into a significant waste of time and money for the solar supplier.

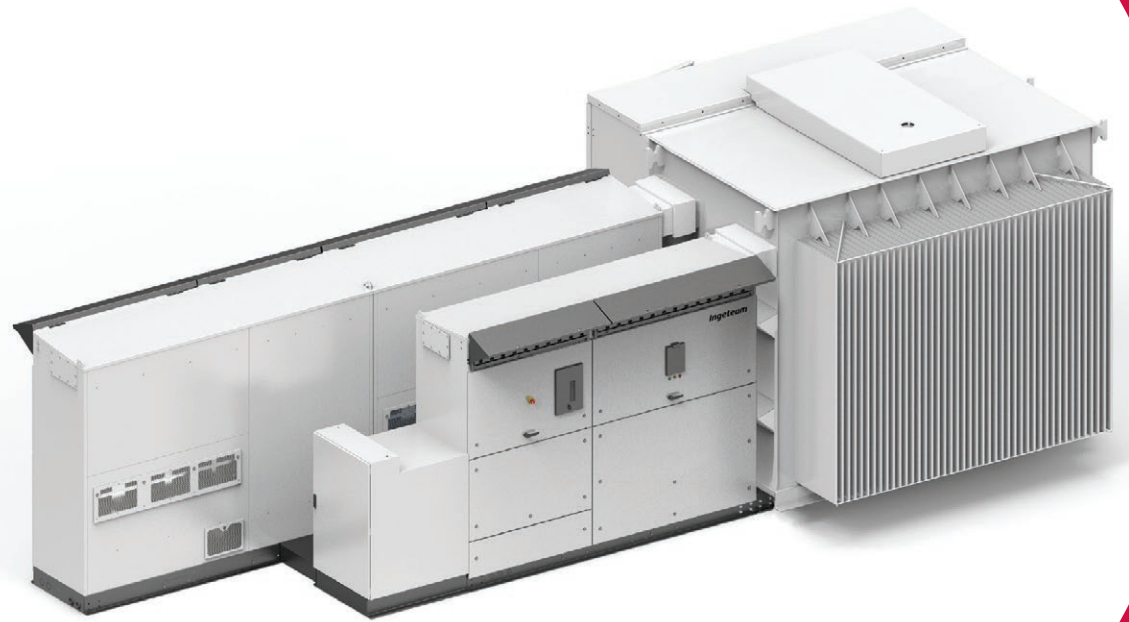
For example, with leaf-on and leaf-off historical HD aerial imagery available to solar companies, projects can be assessed during a shading analysis, making it more efficient to place panels to gain maximum sun reach.

The Wow Factor: Winning the Proposal

By including annotated, high-resolution imagery in proposals, companies can both impress customers, and give them a clear understanding of their project. Imagery also can be used to close the deal, since potential customers can easily visualize precisely how their home or project will look once installers place the panels.

Aerial Imagery Builds Business

There's no question that the use of aerial imagery gives solar companies an edge on their competitors. With vastly improved accuracy and



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READY FOR YOUR CHALLENGES

How Graphite is Lighting the Way to a Solar Future

by Paul Lancaster

An already burgeoning solar power industry faces another significant boost, thanks to one widely used and long-valued material—graphite.

Recent news that solar and wind power could be used to generate as much as 80 percent of all the United States' energy needs, has boosted graphite's status as a hot commodity.

Its vital role in the production of lithium-ion batteries has led analysts to predict that rising prices will continue on their upward trend.

Solar photovoltaic energy is generated by turning sunlight into electricity. At the heart of this process is an extremely pure crystalline form of silicon. When refined to make cells for solar panels, the silicon converts the sun's rays into an electric current for powering household appliances.

Graphite is crucial to silicon production. Its resistance to extreme heat makes it ideal for manufacturing the crucibles and molds used to make silicon, as well as heat shields, thermal insulation components, and even gas ducts.

Storing the power

But what happens when there is no sunlight? Ultimately, solar power's future success comes down to battery storage.

Lithium-ion (li-ion) batteries are one of the most common methods of storing power gained from the sun. At the same time, electric vehicles have flourished in recent years, and battery production has become one of the largest-growing markets for graphite use.

In 2016, 1.2 million tons of graphite was mined across the world. That same year, around a tenth of this weight of synthetic and natural graphite was used to produce battery anodes.

Graphite foam

A number of solar energy advances are also centered around graphite. Researchers from the universities of Manchester and Pretoria are exploring the use of graphite foam for capturing and storing thermal energy from solar farms. Graphite was chosen both for its impressive thermal conductivity and its low cost.

By using actual sunlight concentrated through a lens to test the material, researchers found that foams with a lower density performed best, in terms of thermal behavior.

Graphene

Another form of graphite — the wonder material graphene — features prominently in much research around both photovoltaic cells and battery storage.

Graphene is a two-dimensional material made from a single layer of carbon atoms bonded together in a hexagonal pattern. Not only is graphene extremely strong and light (100–300 times stronger than steel while weighing 0.77mg for every square meter), it is also very conductive. Yet despite this conductivity, graphene cells are currently too inefficient to make them viable to directly replace silicon, although researchers are continuing to examine different ways of using graphene to make solar cells perform more effectively.

One such method involves the use of graphene to strengthen the hybrid material perovskite, commonly used in tandem with conventional silicon.

A second study from Rice University, in Texas, involves using a graphene/nanotube hybrid as an electrode within a dye-sensitized solar cell.

And researchers at the world-renowned Massachusetts Institute of Technology (MIT) are looking at developing solar cells which are 1,000 times more efficient than silicon panels, using graphene and molybdenum-disulphide.

Graphite's heat-resistant properties and diverse grade range means it plays a crucial role in clean energy industries requiring ultraprecise machining. Its light weight, resilience, adaptivity, and strength has cemented its role in the solar power sector. Future developments with graphite, and the super material graphene, will no doubt propel the solar industry to its next level.

Paul Lancaster is the owner of Olmec Advanced Materials Ltd. Olmec has been supplying graphite and carbon products for four decades, and comprehensive quality control program meeting ISOQAR standards.

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ARCONIC





Solar Heats Up in New York

by Manish Nayar

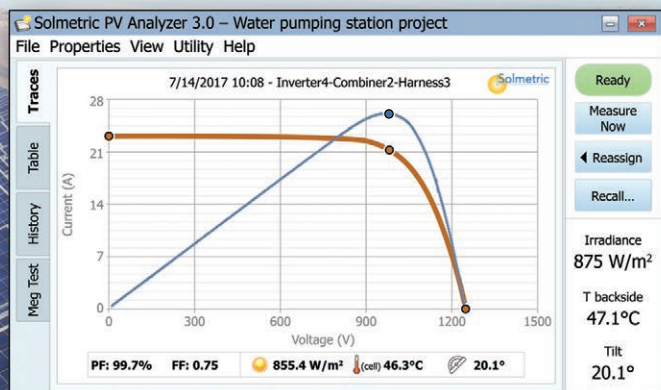
It's been a whirlwind few months in the world of renewable energy. Policies like the Green New Deal mark an exciting stretch of ambitious and bold energy strategies proposed and passed within the last six months. States across the union are accelerating their efforts to pass 100 percent clean energy goals, especially in the wake of California's first statewide 100 percent carbon-free energy mandate, approved last Autumn.

The U.S. elections have put more renewable energy champions in office than ever before, including the election of 22 new Governors, many of whom supported sweeping clean energy goals in their campaigns; some of those states have already begun to move towards those targets. It's an exciting time for those of us in the industry that understand how smart policy can drive growth and investment. Policy goals that seemed impossible just a few years ago have become almost commonplace.

One high profile announcement in particular grabbed national attention: In mid-January, New York Governor Cuomo announced, as part of his 2019 agenda, a doubling of distributed solar by 2025, as part of the path to 100 percent carbon-free electricity by 2040.

Equally important, the New York Public Service Commission approved the implementation of the Clean Energy Standard, which reduces greenhouse gas emissions 40 percent by 2030, and 80 percent by 2050. The commission also approved one of the most aggressive energy storage plans in the country, with the aim to implement 3 GW by 2030, and 1.5 GW by 2025. Taken together, these goals make New York a more aggressive solar state than any other in the country. Even California's and Hawaii's 100 percent clean energy mandates aren't designed to come to fruition until five years after New York is slated to reach its goals. Plus, The Solar Foundation just announced that the number of jobs in the New York State solar industry jumped to 10,000.

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Manish Nayar is Managing Partner at Oya Solar, a North American turnkey solar developer of community, commercial, and utility scale solar projects. Founded in 2009, Oya has a project development pipeline of 850MW, and more than 5,000 acres under development.

Oya Solar /// oyasolar.com

The New York announcement sent a clear message that the state was committed to building a robust, clean energy economy.

Proven solar companies in this area of the country, scouting for a base for U.S. operations, can find a home in New York. It took ambition and guts for Governor Cuomo to make this announcement. The obvious commitment the state has made to the solar industry (10,000 jobs don't just materialize out of thin air) was presaged by smart, sustainable, and stable policy initiatives. New York has been laying the groundwork for years. REV (Reforming Energy Vision) has been a long, and (sometimes) frustratingly slow process. It's a process that guarantees Cuomo's proposal is built on a strong foundation. It also boosts commercial confidence that New York will offer a stable and growing solar market for years to come.

The Governor's commitment is excellent news for the state's economy—particularly rural areas, where farmers and others have the opportunity to earn a reliable monthly payment for welcoming solar. New York is centrally located between the largest and most dynamic solar markets on the East Coast, including Massachusetts, Pennsylvania, New Jersey, and Maryland. Being at the nexus of these solar powerhouses puts New York in the position of guiding these states through their solar transition.

As with any state that is plunging full-speed ahead into the solar market, there will be a need for people who can teach budding solar entrepreneurs how to maximize their land and their investment. Farmers with the land for commercial- and utility-scale solar projects, may not know where to begin. They will benefit from turnkey solar solutions providers to coach them through the process, from finding financing to construction to long-term disposition.

The policy structure and its location - in the heart of the next big solar boom area of the United States - inspires the entire country. States willing to go big on solar policy will be rewarded with job growth and investment. It's an ideal time to invest in New York, and build for the future.

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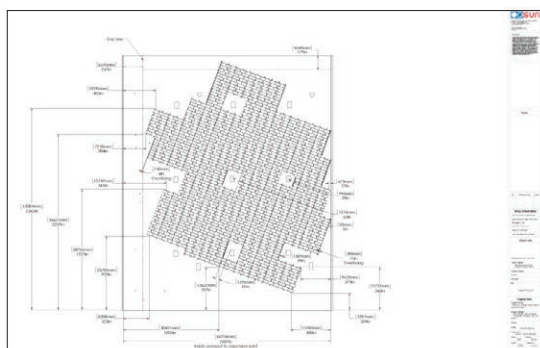
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Bifacial PV

A new approach to PV rooftop design

by Alexandre G-Vanasse



THE LAST FEW YEARS BROUGHT SEVERAL NEW MODELS

of bifacial PV panels to the North-American PV market, along with a wide range of prices and performances. Until recently, most bifacial PV panels were significantly more expensive than standard PV panels; project developers were often reluctant to offer such solutions, not knowing if the real field performance would offset the extra cost. With price points for P-Type (lower bifacial efficiency) bifacial panels and polycrystalline bifacial panels closing in on standard mono PERC panels, and N-Type bifacial panels prices winding down (despite the tariff) the question developers should be asking is: "How do I make bifacial PV projects more profitable than standard projects?"

Rooftop is an ideal application for bifacial PV, due to the prominence of "cool" or "smart" roofs made of TPO and EPDM membrane, especially in states where they tend to be more popular, like California. These can reach a reflectivity of 80 percent or more in the visible spectrum.

Designing for bifacial PVs is quite simple: the goal is to get as much light as possible to reach both the front and back sides of the panel. Initially, the designer looks at the type of structure, tilt angle, and height. Most racking solutions on the market are low profile (at angles ranging between 3, 5, and 10 degrees), and feature a wind deflector, so it's not necessarily easy to pick the right bifacial PV.


Imagine looking through a camera lens - the farther you move away from your subject, and the more tilt you give the camera, the wider your field of view will be. This is similar to how a bifacial PV racking panel receives light on its backside: increasing tilt and height of the panel from the roof will boost its performance. This is demonstrated using PVSYS simulations, and in field studies that are readily available online. The tricky part is choosing a racking solution; any rails under the panels will cause a line of



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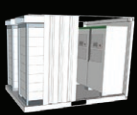
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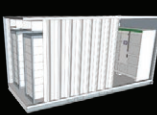
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shadow behind the panel, causing less irradiated cells to act as a resistance to more illuminated cells, and creating hot spots. Also, any wind deflector and ballast blocks will prevent important rays of light from reaching the bifacial panels. To avoid this, use rail-based systems with rails outside the perimeter of the panels, no wind deflectors, and anchored, where roof penetration is a possibility.

15D HP Vs 10D

Increasing the tilt from 10 degrees to 15 degrees will yield an extra 2.4 percent of energy, according to PYSYST 6.77. Bumping up to 20 degrees will add another 2 percent, approximately. Traditionally, moving to a 15- or 20-degree tilt meant increasing the interrow distance (where fewer modules will fit on the same roof), and reducing the total power of the system by 10-15 percent, depending on racking interrow distance. In light of this, few designers adopted the higher tilt approach, instead loading as many panels as they could fit at 5 or 10 degrees. However, switching to bifacial PVs at 10 degrees can quickly yield a 13-14 percent gain on an 80 percent reflective membrane. Further increasing the tilt and height of the system, to 15 degrees tilt and 16 inches, can produce another 2.5 percent (from the front side) and 1.5 percent (from the height), for a total of up to 18 percent increased yield per panel. This changes the profitability of the entire system.

It's possible to yield up to 23 percent more energy per panel by going to 20 degrees, (compared to the same non-bifacial panel at 10 degrees), further offsetting the downside of a smaller system, in power, while also reducing the total absolute cost of the system¹. This means that a lower (absolute) cost system with a smaller nameplate capacity (W), at 15 degrees tilt and 16+ inches height, can generate more kilowatt-hours at the end of the year with bifacial PVs, as compared to standard PVs at 10 degrees. And, although a 20-degree tilt system will produce less kilowatt-hours, there will be much more profitable production from each panel.

Regions with snow benefit even more, since light reaching the backside of the panel will heat-up the front side and melt snow faster than with standard, non-bifacial panels. While there is still room for more literature quantifying such gain, it can be seen as an added, free 1-2 percent or more of additional energy.

With the arrival of low-priced bifacial PV panels, solar developers should take the time to study where these panels become more profitable than using standard monofacial modules. When there is ample space on a roof for a project, a white reflective roof already is in place, or where there is snow, bifacial PVs offer an opportunity to yield more kWh with fewer panels, and an overall lower

cost system (or a slightly more expensive system with the same quantity of panels, but producing a higher return on investment). Increased profitability may vary depending on other project-specific factors, but the potential for greater profits and energy production makes it worth taking a second look at bifacials.

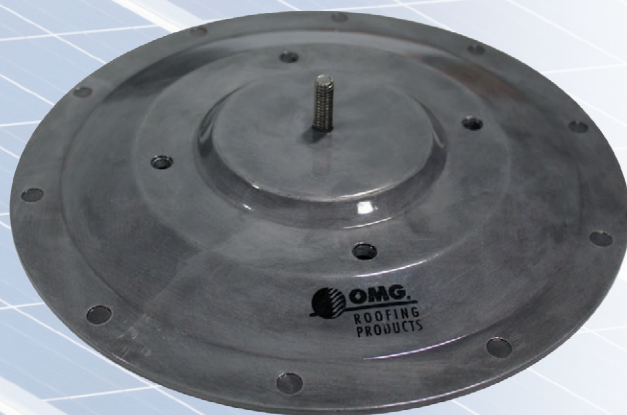
Alexandre G-Vanasse is VP Business Development for Opsun. The company began as a high-tech research laboratory focusing on next-generation solar technologies. Opsun designs and manufactures mounting systems for PV installations for both roof top and ground mount.

Opsun /// opsun.com

¹All above numbers are based on simulations run on PVSYS 6.77, using all the same parameters and N-Type bifacial panels with 75% bifaciality factor (front side/back side).

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Maintenance, Repair, and Operations (MRO) software company, CloudVisit has a renewable energy software solution for the growing demand for clean energy. CloudVisit's MRO software enables industry experts with remote inspection tools. Using these tools, experts can remotely accept inspections of hybrid systems' installation and MRO processes, enabling the hybrid energy industry to expand quicker. CloudVisit's MRO software empowers inspectors to remotely view and approve inspections from the office so they do not have to spend time traveling to remote locations. Remote inspections cut down on travel time and enable on-site technicians to manage their time effectively. Since on-site technicians can request to conference with inspectors, the utilization of remote inspections means the availability of inspectors increases. With an increased availability of inspectors, maintenance problems can be quickly identified and resolved. MRO software combines multiple-participant video conferencing with a workflow management system so every procedure is completed up to standard. Video and audio recordings, as well as images and chats, are securely stored in the cloud and serve as proof of a completed project. No inspection can be approved without documentation and sign-off that each step has been completed. This documentation validates that the hybrid wind farm is safe to use.

CloudVisit, Inc.
/// www.cloudvisit.site



Solar powered surveillance system

Larson Electronics LLC, released a solar powered LED surveillance tower featuring a 1080p full HD camera, two 265W solar panels, a 500aH capacity battery bank with a 120V battery charger, a backup generator, and a telescoping mast that deploys a Class 1 blue LED strobe lamp and security equipment up to 30ft. The entire assembly is mounted on a single axle aluminum trailer for easy transportation, making this a complete, portable solar-powered surveillance system for remote outdoor and rugged locations. This powerful security system is equipped with a 1080p full HD high resolution camera which provides operators with precise 20x optical zoom, integrated long-range IR LEDs with a 850nm wavelength, day/night capabilities, MP4 format, as well as H.264 and MJPEG video compression. This solar security assembly comes with a 1TB, 8-channel network video recorder. Installation only takes minutes via plug-and-play, which automatically detects, displays, and configures system components.

The two included 265W solar panels generate a total maximum output of 0.53kW and have a 45° tilt for optimized sunlight exposure. The compact, high powered blue LED beacon offers 360° of brilliant light without the dark spots or unevenness found in traditional incandescent beacons. This beacon is equipped with auxiliary LEDs on top and features 30 flash patterns and 4 simulated rotating patterns which are controlled from the control box. Rounding out this security solution is a NEMA 3R component control box with a component cooling system, and a 7kW 4-stroke OHV single cylinder engine backup generator. The generator has a keyless electric start and automatically kicks on when battery voltage falls below 12V.

Larson Electronics LLC
/// www.larsonelectronics.com



Flexible operations for efficient productivity

The new PD10R pile driver by Vermeer delivers operator flexibility through the use of a full-function remote control. The PD10R is not equipped with a ride-on operator's station. Designed for installing solar panel configurations, the PD10R pile driver gives the operator a 360° view of the jobsite, makes loading and unloading from a trailer easy, and helps avoid potential obstacles without sacrificing functionality. With the remote control of the Vermeer PD10R pile driver, the operator can engage the hammer, accurately align the pile, and position the machine. The remote control provides various data including pile angle and height information, as well as maintenance information. The new remote-controlled PD10R pile driver is available with a 20ft (6.1m) mast and complements the PD10 model with a ride-on operator station. With auto plumb technology that automatically moves the mast orientation with the touch of a button, both models are designed to meet the tight tolerances demanded by commercial solar installers. The PD10R pile driver can be equipped with an optional laser receiver and is compatible with third-party GPS to help reduce surveying time and maximize productivity. The unit's wide track pad design helps minimize ground disturbance in varying soil types.

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DC coupled storage solution for utility PV market

SMA has introduced a new DC coupled storage solution for utility-scale PV projects. The DC coupled storage solution is built for new PV plants, but it can also be used to retrofit existing PV plants for those operators who want to enjoy the benefits of solar-plus-storage. In many utility-scale applications, DC coupling can offer significant operating cost and efficiency advantages over AC coupled systems. The DC coupled storage solution consists of SMA's Sunny Central EV-US line of inverters with a DC coupling ready option and up to six 500 kW SMA DC-DC Converters.

The SMA Group
/// www.sma-america.com



Robust and secure connector video campaign

HARTING announced a new campaign for their PushPull product line. Dubbed as "Click & Go," the campaign focuses on the ease of use of the well-established PushPull line. At the center of the campaign is a short video that focuses on the HARTING PushPull connector "bringing to life" various applications in industrial environments. The film highlights why PushPull is a trusted, easy-to-use connector for many industrial applications. The key technology for the PushPull connector is an internal locking mechanism that offers a robust and secure connection without the need for levers or twisting into place. This makes the connector extremely easy to install and uninstall, especially in hard-to-reach places. The connection technology is available in rectangular and circular form factors. An audible click verifies when the connection is made. And with its small form factor, the HARTING PushPull enables miniaturization. Plastic hoods and housings are corrosion-resistant and approved for outdoor use.

The HARTING Technology Group /// www.harting.com



New, higher powered SPOT

Alencon Systems LLC's new SPOT V6 features a number of enhancements to previous versions which make it more versatile and cost effective to deploy. The SPOT V6 includes the ability to have one output for each PV input, which can make deploying the device in PV retrofit applications easy and cost effective. The new version also features enhanced thermal performance for a variety of climates as well as a new mechanical configuration which allows each SPOT to be installed in a matter of minutes. Additionally, the SPOT V6 now allows flexible communications options that can be both wired or wireless and is developed to the most modern cyber security standards available today.

Alencon Systems

/// www.alenconsystems.com



Cost efficient wire hanger

Nine Fasteners' newest product, NFI-Hanger, was designed for ground mount solar installations. Made in the U.S., this wire form slides into a small hole in the panel frame and holds 20+ wires. Produced of hard drawn galvanized steel, the NFI-Hanger has an opening/closing function, eliminating the need to purchase replacement parts. When factoring product costs along with labor costs, over the course of the 25-year life span of a PV system, the NFI-Hanger used on larger systems can save tens of thousands of dollars. The NFI-Hanger is durable in all climates and is currently undergoing testing to be certified to UL standard 1565 for "Positioning Devices within a Solar Installation".

Nine Fasteners /// www.ninefasteners.com



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Programmable industrial controller

Opto 22's new groov EPIC system combines I/O, control, data processing, and visualization into one secure, maintainable, edge-of-network industrial system. groov EPIC lets engineers and developers focus on delivering value, not on triaging loosely connected components. Combining reimagined intelligent I/O with an embedded Linux real-time controller, gateway functions, and an integrated display, groov EPIC offers industrial hardware design with a modern software ensemble, to produce the results engineers want. Connecting legacy systems, controlling processes and automating machines, subscribing to web services and creating mashups, acquiring and publishing data, visualizing that data wherever it is needed, and mobilizing operators are available. In addition, groov EPIC simplifies commissioning and wiring and helps engineers develop rapidly and deploy quickly.

Opto 22 /// www.opto22.com



Options for commercial installations

SolarEdge is introducing the new, more cost-effective P850 2:1 commercial power optimizer for higher power modules. The P850 replaces the P800s power optimizer and can be used interchangeable with the P800s. P850 supports up to 850W and has a new bracket to simplify clearance requirements. It is backwards compatible with the P800s and can be used as a replacement for the P800s in all projects. The P850 connects 2 modules in series and is designed to support 2x 60-cell, 72-cell, bi-facial, or high current modules. The P850 power optimizer joins the P800p power optimizer enabling installers to connect two high power modules to a single power optimizer. The existing P800p power optimizer, is mainly for connection of 2 x 96-cell 5" high current modules in parallel. Together they address the growing use of higher power and higher current modules for PV installations.

SolarEdge
/// www.solaredge.com



Cyber risk cover for renewables

GCube has launched a new Cyber Risk policy, uniquely designed to tackle the specific threats posed to clean energy asset owners by a recent rise in cyberattacks on global power generation and transmission infrastructure. This new offering is designed to cover the specific cyber exposures of renewable energy asset owners, faced with this growing threat. This new product covers owners and operators in any circumstance where the ability to generate power, and the associated revenue, is impacted by a cyberattack on proprietary or third-party IT or OT (Operational Technology) systems. In practice, this means it provides cover for loss of revenue, and incidental expenses, incurred in a range of circumstances, including non-damage events, digital asset destruction, including loss of use or theft of import SCADA (Supervisory Control and Data Acquisition) data, reputational harm, and cyber extortion. Cover can also be extended to include a cyberattack on assets not actually owned by the insured, such as damage to a third-party substation or transmission infrastructure that prevents the export of power.

GCube
/// www.gcube-insurance.com



Molded case circuit breakers for higher-voltage solar power plants

ABB is adding an advanced, new molded case circuit breaker (MCCB) for higher-voltage solar power plants to its Tmax PV range. The breaker, designed to protect combiners, switchgear and inverters up to 1500VDC, is the latest addition to ABB's complete range of protection solutions for utility-scale solar plants. For 1500VDC installations with rated current up to 1200A UL and 1600A IEC, ABB's product range now includes MCCBs and switch-disconnectors. The SACE Tmax PV range makes installation faster and reduces wiring costs for more advanced solar plants, helping utilities and engineers save time. The SACE Tmax PV offers design engineers, panel builders, and inverter manufacturers a single-brand solution for photovoltaic systems installed anywhere in the world. All integrate readily with the electrical and mechanical accessories developed for the SACE Tmax T MCCB range. For systems using string inverters, the SACE Tmax PV range now offers circuit breakers for up to 800VAC, which is type approved to UL 489 specifications and compliant with IEC 60947-2 Standard. ABB's compact circuit breakers can break short circuit currents up to 32kA.

ABB /// www.abb.com

OutBack POWER
member of The a1pa Group™

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Easy to install and easy to own, SkyBox from OutBack Power brings *a new level of simplicity, intelligence, flexibility and control* for those who truly want to take charge of their energy future.

Available now - Contact sales@outbackpower.com to learn more



Testing PV module health

RenewSys launches a PV Module Wellness program allows customers to test their PV modules at the RenewSys' Reliability Lab at no cost. The 'PV Module Wellness' team will test and share a report with vital information. This report will prove crucial for module manufacturers to evaluate their manufacturing technical parameters, revisit raw material selection, and correct any process recipes, if required. This report is especially important in building trust in the module output and life for solar power project developers, EPC players, etc. Thus it will help module manufacturers build confidence in their modules, among all stakeholders. These tests are in accordance with IEC, ISO, BIS, or other relevant international standards.

RenewSys
/// www.renewsysindia.com



Web-based permit package generator

SolarDesignTool has launched a complete web-based permit package generation tool for residential rooftop photovoltaic systems. Each solar permit package contains a cover page, site plan, single-line diagram, placards and labels, attachment plan, fire safety plan, equipment data sheets and certifications, and attachment detail when using rail-based mounting components from Unirac, SnapNRack, IronRidge, or Quick Mount PV. Conceived as an alternative to traditional CAD-based methods of permit package creation, SolarDesignTool's web-based approach allows solar installers to specify a system design in as little as fifteen minutes, then generate and download a complete permit package instantly with a single click. In addition to improved speed and accuracy, automation and economies of scale allow for radical reductions in price. Each permit package comes with unlimited free revisions and a money-back guarantee if rejected by the AHJ.

SolarDesignTool

/// www.solardesigntool.com



Compact fuse-protected varistors

TDK Corporation's compact ThermoFuse NT14 and NT20 series feature a footprint that fits into existing circuit board layouts. The NT14 series (disk diameter 14mm) is designed to absorb maximum surge currents with an 8/20- μ s pulse of 6kA at rated voltages of between 130 VRMS and 680 VRMS, while the NT20 series (disk diameter 20mm) has a surge current capability with an 8/20- μ s pulse of 10kA at rated voltages of between 130 VRMS and 750 VRMS. The NT14 and NT20 series offer a maximum energy absorption of up to 220 J and 480 J for 2 ms, respectively. Both series are available in 2-leaded and 3-leaded types, with the third lead used to monitor whether the fuse has been activated. The ThermoFuse NT series meet UL 94 V-0 requirements, and are also listed as Type 4CA in UL 1449, 4th edition. With their compact dimensions and excellent surge current capability over a broad range of voltages, the NT types are suitable for use in a wide range of applications, such as ballasts for lighting, home appliances, power supplies, inverters for solar installations, frequency converters for drives, and smart meters. They can also be used for the general protection of electrical wiring and installations.

TDK Corporation

/// www.tdk-electronics.tdk.com

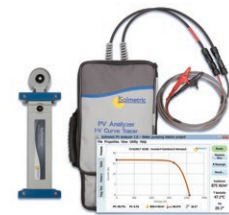


Online monitoring platform

Tigo's new SMART Website features a better user experience on desktop, tablet, and mobile displays. A new summary page shows new a system view, detailed charts, and alerts as well as a more intuitive and aesthetically designed website layout. Information loading for PV sites has quickened with data processing and now has easier onsite and remote troubleshooting steps that match email/SMS alerts. Prompted setup now includes more customized options, added information and steps throughout website and system setup process, and suggestions from users that can be provided on every webpage. The new Tigo SMART Website shows Reclaimed Energy with the appropriate Tigo equipment. It is compatible with the SMART App which is downloadable for iOS and Android through Apple's App Store or Google Play.

Tigo Energy, Inc.

/// www.tigoenergy.com



1500 volt I-V curve tracer

The new Solmetric PV Analyzer IV curve tracer measures strings up to 1500V and 30A. The PV Analyzer provides high accuracy and high measurement throughput, even in hot environments. The wireless irradiance and temperature sensor has a 300ft range. A tablet or laptop connects to the IV unit via built-in WiFi and provides a large, easy-to-use interface.

Solmetric Corporation

/// www.solmetric.com



Solar-powered area lighting

Urban Solar's solar lighting product line, the Streamline Solar Series incorporates lithium-ion battery technology. For parks, pathways, playgrounds, and other open urban environments, the Streamline Solar Series delivers brightness and return on investment. In many cases, the Streamline Solar Series can be installed in minutes without the use of a crane or bucket truck. Immune to power outages and blackouts, standalone systems enhance public safety. As with all Urban Solar lighting systems, engineering and design assistance is available free of charge to ensure that clients only pay for the size of system their project requires. Site inspection services ensure that each install location is solar viable, and light plots and renderings allow Urban Solar lighting designers to size and position systems to deliver light levels that meet IES standards.

Urban Solar Corp.

/// www.urbansolarcorp.com

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Transportable power solution for remote sites

Great Canadian Solar's highly mobile, compact, and flexible self-sufficient solar power station, The Solar Seacan Solution, is designed to provide 100% low-cost renewable energy for any remote power requirements such as construction sites, oil field installations, and micro-grid applications. The 20-foot Seacan consists of a 30kWh Fortress Lithium storage (Two LFP-15 units), two Outback Radian 8048 inverters, and three Outback FM100 charge controllers. The 44 solar modules for a total size of 16.06 kW(DC) are mounted on a mobile and flexible racking system, which allows quick set-up and demobilization.

Great Canadian Solar

/// www.greatcanadiansolar.com



Reliable and versatile grid-connected PV system

With coolcept fleX Steca introduces the successor generation to the established coolcept-topology. Coolcept fleX offers a creative energy concept for any modern home. The brand-new electronic platform is being used as the technological heart of the next generation of solar electronics and connects photovoltaics-based power generation, load management, and even e-mobility. The coolcept fleX platform is open with regard to its future use, it is still implemented on a single board. The small and compact format permits the use of affordable standard components on the circuit board, thus making it possible to use the same device for various differing applications.

Steca Elektronik

/// www.steca.de



Fast-recovery super-junction MOSFETs

STMicroelectronics' MDmesh DM6 600V MOSFETs contain a fast-recovery body diode to bring the performance advantages of the Company's latest super-junction technology to full- and half-bridge topologies, Zero-Voltage Switching (ZVS) phase-shift converters, and applications and topologies generally that need a robust diode to handle dynamic dV/dt . The MDmesh DM6 MOSFETs have reduced reverse-recovery time (t_{rr}) to minimize power dissipation in the diode when turning off after freewheeling. Recovery softness is optimized to enhance reliability. In addition, very low gate charge (Q_g) and on-resistance ($R_{DS(ON)}$), together with a capacitance profile tailored for light loads, allow higher operating frequencies and greater efficiency, with simplified thermal management and reduced EMI.

STMicroelectronics, Inc.

/// www.st.com/stpower



Advanced data manager

Endress+Hauser's Memograph M RSG45 Advanced Data Manager DIN rail version, is an intelligent remote device with extensive communication capabilities, making it suitable for IIoT applications and use as an edge device for getting data to cloud-based servers. It is able to acquire data from up to 20 HART or universal analog input channels and 14 digital inputs, has two analog outputs, up to 12 relay outputs, and makes its data available to IIoT systems and all major automation system architectures via multiple communication interfaces and protocols. The Memograph M mounts on a standard DIN rail, is powered by standard 24VDC or 230VAC power supplies, and has IP20 protection. All connections on the front of the device are designed as pluggable screw or spring terminal blocks, with reverse polarity protection in either case, making connections quick and easy. It provides tamper-proof data recording on 256MB of internal memory compliant with various legal directives, a 32GB SD card, and a 32GB USB drive. Built-in software includes FDM Field Data Manager for visualization, analyzing, backup and reporting; audit trail software consistent with FDA21 CFR part 11; and Itherm TrustSens temperature sensor calibration. The Memograph M can generate e-mail or SMS messages to alert users of alarm conditions or process events. Messages can be sent to several recipients simultaneously or automatically forwarded to a recipient/destination. Messages can be confirmed, relays controlled remotely, and current values queried by any web browser.

Endress+Hauser

/// www.us.endress.com/RSG45



QuadPod™ Solar Canopies



Quest is committed to optimizing system design, engineering and fabrication resulting in more satisfied site owners.

90% of the construction for QuadPod solar canopies takes place on the ground offering best-in-class speed, efficiency and safety.

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From both sides now.



Single-Axis
Tracker



[PV SOLAR TRACKER]
E476688



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AND DISCOVER ALL
THE SF7 FEATURES**



Soltec

SF7 Single-Axis Tracker standard features provide for drop-in bifacial compatibility with higher mounting height, shadow-free backside, and wide-aisle reflecting surfaces. In addition to intrinsically optimizing bifacial gain, the standard features enable other economic and performance benefits compared to the leading competitors.

Racking & Mounting

Along with quality panels, it's important to ensure a solid base and a supportive structure for a successful solar installation. The following highlights a variety of mounting and racking solutions that are available, along with their key features, to help solar designers and installers find the best option for their project

SEE AD ON PAGE 7



OMCO SOLAR

Product: Field-Fast Fixed-Tilt Mounting System

Application: Ground-mount, utility-scale

Angle: 5° to 45°

Material: Galvanized U.S. Steel per ASTM A653 latest edition

Pre- or Post-assembly: Pre-assembly

Certifications/Approvals: UL 2703

Warranty: 20-year limited warrant

Key Features:

- The bill of materials for each project typically consists of 5 to 7 pre-assembled components for ease of installation;
- A team of 3 installers can build up to 8 Field-Fast tables per hour;
- Costs less at every stage of construction, including logistics, staging, installation, permitting and more;
- Factory-direct, which means OMCO can deliver mounting systems to a project site with very minimal lead-time;
- 4 strategically located US manufacturing plants (AZ, AL, OH, and IN) reduce lead time and freight costs for any project.

www.omcosolar.com

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QuickBOLT

Product: Low Profile QuickBOLT with Microflashing

Application: Roof-mount

Material: Stainless Steel backed EPDM Washer and Stainless Steel L-Foot

Angle: 90°

Pre- or Post-assembly: No assembly required

Certifications/Approvals: UL Certified, Tensile, Load, and Water Testing (ASTM E331 and E2124)

Warranty: 25-year warranty

Key Features:

- Asphalt Shingle Mount that does not require the installer to lift shingles;
- The collar on the Bolt compresses the Microflashing to create a leak-proof seal;
- The Low Profile QuickBOLT with Microflashing can be installed in less than 1 minute, saving time and money;
- Spec sheets, test results, and certifications are all available online;
- Over 300,000 QuickBOLTs have been installed with ZERO leaks reported.

www.quickbolt.com

APA SOLAR RACKING
INTRODUCES
TITAN DUO

- 25% Less East-West rails
- 20% Less components
- Lowest per part count per MW
- 2-High Portrait ideal for Split Cell Modules
- Lowest back panel shading for Bifacial Modules

GROUND SCREW

- For hard soils, solid rock, sandy soils
- Easy post height adjustment
- Great for shallow install
- Simple installation

APALTERNATIVES.COM
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DynoRaxx

Product: Flat and pitch roof solar racking

Application: Flat and pitch roof

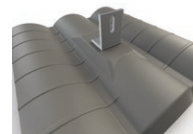
Angle: Fixed 10°

Material: Fiberglass

Warranty: 25-year warranty

Certifications/Approvals: UL2703

www.dynoraxx.com



Unirac, Inc.

Product: FLASHKIT TR

Application: Tile replacement for Flat, Spanish, and W-Shaped tile roofs

Angle: Various

Material: Stainless steel and aluminum

Pre- or Post-assembly: Pre-assembled

Warranty: 25-year warranty

www.unirac.com



SunWize Power & Battery

Product: Large Format Side of Pole Mounts

Application: Side-of-pole mount

Angle: 15° to 60°

Material: Aluminum with stainless steel hardware

Pre- or Post-assembly: Post-assembly

Warranty: 1-year warranty

Certifications/Approvals: Certified up to 140MPH Wind Speeds per IBC 2012, ASCE 7-10, Zones B & C

www.sunwize.com



ILSCO

Product: Copper Flex Braid

Application: Grounding and bonding

Material: Electro-tin plated pure copper

Pre- or Post-assembly: Pre- and post-assembly

Certifications/Approvals: UL 467 Listed

Warranty: One-year manufacturer's warranty

www.ilsco.com



Sentinel Solar

Product: Titan Mounting Systems
Application: Ground-mount
Angle: Adjustable
Material: Galvanized steel, aluminum
Pre- or Post-assembly: Pre- and post-assembly
Warranty: 5-year structural defects warranty, 1-year electronics defects warranty
www.sentinelsolar.com



EJOT Fastening Systems, L.P.

Product: EJOT Solar Flashing
Application: Ground-mount
Angle: Sloped roofs
Material: Aluminum
Pre- or Post-assembly: Pre-assembly
Certifications/Approvals: 100% IBC compliant, IAMPO ER0308
Warranty: 10-year warranty
www.ejot-usa.com



AIMS Power

Product: Pole Mount and Ground-Mount Racks
Application: Ground-mount, pole-mount
Angle: Adjustable
Material: Steel, aluminum
Pre- or Post-assembly: Pre-assembly
Warranty: 10-year warranty
www.aimscorp.net







We're Chasing the Sun



Clearline Technologies

Product: C-Port Rooftop Supports
Application: Roof supports for solar racking and conduit
Angle: Full range
Material: Rubber and galvanized steel
Pre- or Post-assembly: Pre-assembly
Certifications/Approvals: LEED credits
Warranty: 10-year warranty
www.c-port.net

RBI Solar's Sunflower™ Single-Axis Tracker

-  One Size Foundation Throughout the Array
-  No Special Tooling Required for Install
-  Over 100 MW Deployed
-  Terrain Following Capabilities



(513) 242-2051 | www.rbisolar.com | info@rbisolar.com

SEE AD ON PAGE 31



PREFORMED LINE PRODUCTS
The connection you can count on.

Preformed Line Products

Product: POWER MAX

Application: Roof-mount

Angle: Flush, Dual Tilt, 5°, and 10° Tilt

Material: High impact, temperature and UV resistant

Pre- or Post-assembly: Pre-assembled pan and clamp

Warranty: 10-year manufacturer's warranty

Certifications/Approvals: UL 2703

Key Features:

- Corrosion resistant;
- Unique Inter-Row Spacing (7.5" – 19.5");
- Seismic attachment options;
- Handles roof undulations;
- High wind speed options;
- Top down clamping up to 50% faster installation.

www.preformed.com

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RBI Solar

Product: Sunflower Single-Axis Tracker

Application: Single-axis tracker

Angle: +/- 55°

Material: Galvanized steel

Pre- or Post-assembly: Pre-assembly available

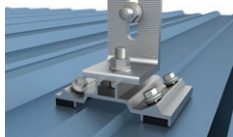
Certifications/Approvals: UL 2703

Warranty: Varies

Key Features:

- One-size foundation throughout the entire array;
- Terrain following capabilities +/- 10% North/South slope;
- Lowers land acquisition costs;
- No dampeners required;
- Over 100MW commissioned across the U.S.

www.rbisolar.com



SunModo Corp.

Product: EZ Grip Metal Deck Mount

Application: Roof-mount

Material: Aluminum

Pre- or Post-assembly: Post-assembly

Certifications/Approvals: UL 2703

Warranty: 20-year warranty

www.sunmodo.com



Advanced Racking

Product: Advanced Rail-free

Application: Roof-mount

Angle: 0°

Material: Aluminum

Pre- or Post-assembly: Pre-assembly

Certifications/Approvals: UL 2703

Warranty: 20-year warranty

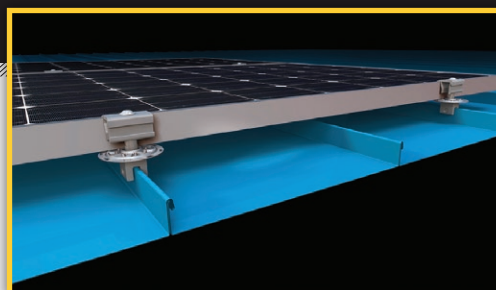
www.advancedracking.com

**TESTED. TRUSTED. ENGINEERED.
THE RIGHT WAY!™**

PV KIT™ 2.0

Designed to save you time and money.

S-5! offers a new and improved PV Kit—PV Kit 2.0—boasting lower installation time and cost for flush-mounting PV. The kit comes preassembled with MidGrab or EdgeGrab for a more comfortable and efficient installation. Using a single tool to drive the top bolt, PV Kit 2.0 eliminates several installation steps with fewer lugs/ground wires required.



- Preassembled EdgeGrab and MidGrab
- Low profile bolt head provides a sleek and clean finish
- 1" gap between Midgrab, providing wind load reduction per ASCE 7
- UL 2703 Listed

CONTACT YOUR S-5! DISTRIBUTOR TO LEARN MORE



Esdec

Product: ClickFit

Application: Sloped composite shingle roofs

Angle: 0° to 45°

Material: Aluminum, steel

Pre- or Post-assembly: Pre-assembly

Certifications/Approvals: IBC, IRC, SBC, NFPA, NEC, UL/ANSI 1703, UL/ANSI 2703, ASCE/SEI-7

Warranty: 20-year warranty

www.esdecusa.com



The Right Way!™ | www.s-5.com | 888-825-3432



Ecolibrium Solar

Product: EcoFoot Ballasted Racking

Application: Flat-roof

Angle: 5° and 10° flat-roof

Material: Black, ASA-PC, UL Listed Resin

Pre- or Post-assembly: Pre-assembly

Certifications/Approvals: UL 2703 (grounding and bonding, mechanical loading, fire type I and II modules), ICC waterproofing, SEAOC seismic compliant

Warranty: 25-year warranty

www.ecolibriumsolar.com



TRA Snow & Sun

Product: Shadow Power Awning System

Application: Commercial, residential fixed

Angle: Side vertical walls

Material: Aluminum

Pre- or Post-assembly: Post-assembly

Warranty: 25-year manufacturer's warranty

www.trasnowandsun.com



Magerack Corporation

Product: MageMount II Rail-less Solar Mounting System

Application: Roof-mount

Material: Aluminum alloy and stainless steel

Angle: Pitched

Pre- or Post-assembly: Pre-assembly

Certifications/Approvals: UL 2703, Class 'A' Fire Rating

Warranty: 25-year warranty

www.magerack.com



RoofClamp

Product: RC and RCT Mounting Clamp

Application: Standing seam metal roof

Material: Aluminum

Pre- or Post-assembly: Post-assembly

Certifications/Approvals: Tested up to 2,400lbs with 600lbs allowable loading when properly installed

Warranty: Lifetime warranty

www.roofclamp.com



Solar FlexRack, competitive in all the right ways

✓ EXCELLENT PRODUCTS

✓ WORLD-CLASS ENGINEERING

✓ FULL TURNKEY PROJECT SERVICES

✓ FLAWLESS PROJECT MANAGEMENT

✓ COMPETITIVE PRICING

With over 2 GWs of product footprint across the US and Canada, Solar FlexRack has a proven track record of delivering high-quality solar tracking and mounting solutions. We bundled those reliable racking products with our best-in-class project services to provide complete turnkey project support to EPCs and developers.

With a wide selection of mounting solutions for crystalline and thin film, Solar FlexRack delivers the right tracker and racking solutions for your utility-scale solar projects, regardless of terrain or climatic conditions.

With all the right pieces in place, Solar FlexRack has made additional changes to deliver the most competitive offering yet. See our download below for the full story.



For EPCs, Developers, IPPs, and Utility-Scale Solar Installers
Download: "Competitive In All The Right Ways"
solarflexrack.com/competitive

And learn how Solar FlexRack has become more competitive, what customers say about them, and their latest product and solar project updates.



SEE AD ON PAGE 32



Polar Racking

Product: PRG: Flat ballasted rooftop racking

Application: Rooftop

Angle: 5°, 10°, 15°

Material: Galvanized steel

Pre- or Post-assembly: Post-assembly

Certifications/Approvals: UL 2703

Warranty: 10- to 20-year warranty

Key Features:

- Quick and easy assembly, using one tool;
- Build array and lay ballast without PV modules;
- Fewer ballast stones (3-5 psf);
- Simple wire management;
- Single bay modular;
- Competitively priced.

www.polarracking.com

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KINETIC Solar Racking and Mounting

Product: K-Flash

Application: Pitched-roof, ground-mount, and flat roof

Angle: Flush-mount up to 40°

Material: Anodized, extruded aluminum

Pre- or Post-assembly: Some pre-assembly required

Certifications/Approvals: Fully engineered, LCAB, UL 467, CSA-C22.2 No.41

Warranty: 20-year warranty

Key Features:

- Easy-to-use, quick-to-install;
- Knowledgeable staff;
- 100% watertight flashing;
- Low per-watt price;
- Widely available.

www.apalternatives.com



Atlantic Clean Energy Supply

Product: AR10-2 Rail-less Racking system

Application: Roof-mount

Angle: Up straight

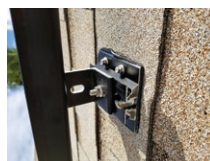
Material: 304 stainless steel aluminum

Pre- or Post-assembly: Pre-assembly

Certifications/Approvals: UL

Warranty: 10-year warranty

www.atlanticces.com



Roof Tech, Inc.

Product: RT MINI

Application: Rooftop self flashing flush mounting for L-foot/rail systems

Angle: Flush mounted, 0° to 45°

Material: Aluminum, stainless, and butyl

Certifications/Approvals: ICC ESR 3575, PE Stamped Letters

Warranty: 20-year warranty

www.roof-tech.us



Try Our New Online Configurator



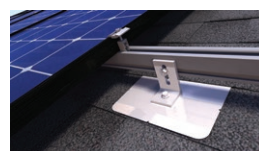
FastRack510™

- Commercial Flat Roof and Ground Mount PV
- Integrated 5° and 10° tilt options
- Inner-row spacing at 10" or 13"
- Quick installation with all top mount hardware
- Compatible with all framed modules
- Fully ballasted with optional mechanical anchors
- Roof friendly with low PSF
- Full engineering services available
- UL1703 Class A - UL 467

415.648.1299

www.sollega.com

info@sollega.com



Quick Mount PV

Product: QRail Racking System

Application: Roof-mount, commercial, residential

Angle: Low and steep sloped roofs

Material: Aluminum

Pre- or Post-assembly: Pre-assembled components

Certifications/Approvals: IBC/IRC 2015, IBC/IRC 2012, ICC-AC428 2012, ASCE 7-05, ASCE 7-10, CBC/CRC 2016, ANSI/ UL 2703 Ed. 1, FBC/FRC 2017, Aluminum Design Manual 2010, 2015, SEAOC PV2

Warranty: 25-year warranty

www.quickmountpv.com



Nuance Energy Group, Inc.

Product: Osprey PowerPlatform, Osprey PowerRack

Application: Ground-mount racking with earth anchor foundations

Angle: Available from 15° to 45°

Material: Galvanized steel

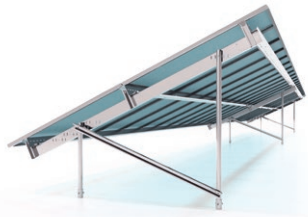
Pre- or Post-assembly: Pre-assembled from factory, field installation with handheld tools

Warranty: 25-year warranty

Certifications/Approvals: CPP Wind Tunnel tested, UL 2703

www.nuanceenergy.com

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APA Solar Racking

Product: TITAN

Application: Ground-mount

Angle: Adjustable

Material: Galvanized steel

Pre- or Post-assembly: Some pre-assembly

Certifications/Approvals: UL Listed

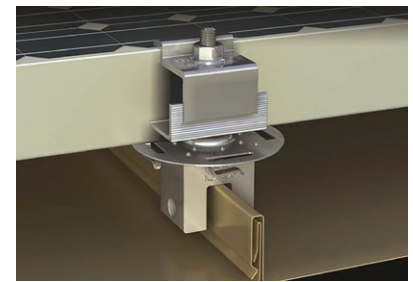
Warranty: 25-year warranty

Key Features:

- TITAN Series is an asymmetrical design which means the above ground racking only has 3 East/West Rails;
- 25% less East/West rails for installations along with the brackets and fasteners that go along with it;
- 20% less components and the low part count per MW;
- Low man hours per MW for installation;
- The TITAN Series comes standard with either a single driven C-pile or a Dual Screw foundation.

www.apalternatives.com

SEE AD ON PAGE 28



S-5!

Product: S-5 PV Kit

Application: Roof-mount, standing seam, and exposed fasten (trapezoidal and corrugated)

Angle: Flush to roof

Material: Aluminum 6061 T6

Pre- or Post-assembly: Either pre- or post-assembly

Certifications/Approvals: ANSI UL 2703 listed (module mounting), ETL UL1703 (grounding/bonding)

Warranty: 25-year manufacturer's warranty against manufacturer defect

Key Features:

- Works with all S-5 clamps and S-5 brackets;
- Unprecedented holding strength with S-5 clamps;
- Costs less than .08 cents for mounting hardware;
- Direct attach solution, no rails or racks necessary.

www.s-5.com



KB Racking

Product: EkonoRack 2.0

Application: Flat roof, grounded once per array

Angle: 5°, 10°, 12°, 15°, 20°

Material: High grade, corrosion-free aluminum components

Certifications/Approvals: UL 2703 Certified, ETL Certified

Warranty: 10-year warranty, extended warranty available

www.kbracking.com



SunEarth, Inc.

Product: RexRack

Application: Roof-mount

Angle: 20° to 60°

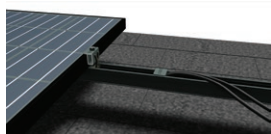
Material: Corrosion resistant anodized 6063-T6 structural aluminum and stainless steel

Pre- or Post-assembly: Post-assembly

Warranty: 5-year finish warranty, 10-year structural warranty

Certifications/Approvals: ICC-SRCC

www.sunearthinc.com



SnapRack Solar Mounting Solutions

Product: Ultra Rail

Application: Roof-mount

Angle: 0° to 90°

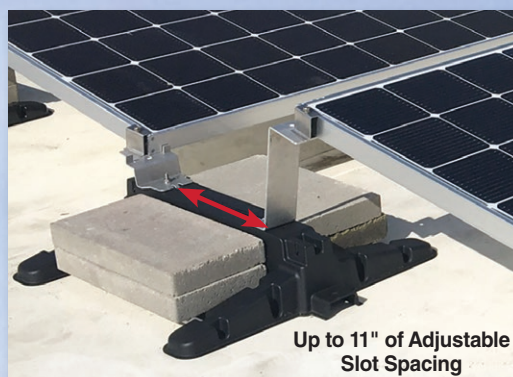
Material: 6000 Series Aluminum, stainless steel, galvanized steel, and aluminum flashing

Pre- or Post-assembly: Pre-assembly

Certifications/Approvals: UL Standard 2703 for Grounding/Bonding, Class A Fire Rating Type 1 & Type 2 Modules, UL Certified Modules, Stamped Structural Engineering Reports

Warranty: 25-year warranty

www.snapnrack.com



Up to 11" of Adjustable Slot Spacing

The new racking system that maximizes the number of solar modules and energy production on flat roofs.

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Dual Tilt



Flush Mount



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preformed.com

SEE AD ON PAGE 34



AceClamp by PMC Industries, Inc.

Product: Hi Tower Solar Anchor

Application: Roof-mount

Angle: Parallel to the roof

Material: 6000 series aluminum

Pre- or Post-assembly: No assembly, bracket only

Certifications/

Approvals: Pending

Warranty: 20-year limited warranty against product defects

Key Features:

- Wind tested for winds over 157 miles per hour;
- Reinforced liquid-applied roofing system creates water impenetrable surface and is South Florida Code approved for winds up to 200 miles per hour;
- The newly introduced Bermuda Racking System provides a secure anchor point for photovoltaic solar panels;
- The AceClamp solar anchor applies two opposing fasteners which provides higher pullout forces;
- Aesthetically pleasing Island-Style tested roof system for sale in markets that can be battered by hurricane force winds.

www.kineticsolar.com

SEE AD ON PAGE 19



OMG Roofing Products

Product: PowerGrip Universal Roof-mount

Application: Roof-mount

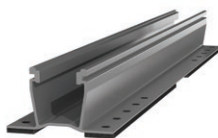
Material: Heavy duty cast aluminum

Warranty: Through roof system manufacturer

Key Features:

- Reduces or eliminates ballast in commercial solar racking systems;
- Includes a base ring and protective cover plate for waterproofing;
- Transfers load to the structural roof deck and doesn't require membrane welding;
- Compatible with all commercial roofing systems;
- Each unit provides up to 3300 lbs of tensile strength, 2500 lbs of shear strength, and can support compressive loads up to 2000 lbs.

www.omgroofing.com



Everest Solar Systems

Product: MiniRail XPress

Application: Trapezoidal metal roof

Angle: Flush to roof

Material: Aluminum

Pre- or Post-assembly: Pre-assembly

Certifications/Approvals: UL 2703 Listed

Warranty: 25-year warranty

www.everest-solarsystems.com



TerraGen Solar

Product: TGR flat roof mounting system

Application: Any type of flat roof

Angle: 0° to 35°

Material: Aluminum and steel

Pre- or Post-assembly: Pre-fabrication completed

Certifications/

Approvals: Tested to UL 2703 standards, Wind tunnel tested in accordance with ASCE 7 Standard, National Building Code of Canada (NBCC) 2005 [2010], International Building Code (IBC) 2006 [2012], Ontario Building Code (OBC) 2006 [2012]

Warranty: 10-year warranty

www.terragensolar.ca



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Allied Tube & Conduit

Product: Mechanical/Structural Steel Tube

Application: Racker, tracker, and ground-mounted systems

Angle: Round, Square, Rectangular, Oval

Material: Galvanized Steel

Pre- or Post-assembly: Pre-assembly with capability to fabricate/assemble

Certifications/Approvals: UL 2703

Warranty: 1-year implied warranty

www.atc-mechanical.com



DCE Solar

Product: Contour

Application: Ground-mount

Angle: 5° to 30°

Material: Galvanized steel structural members, stainless steel hardware

Pre- or Post-assembly: Pre-assembly of C-beams to angle braces

Certifications/Approvals: UL 2703

Warranty: 20-year warranty

www.dcesolar.com

SEE AD ON PAGE 35



Solar Connections International

Product: R-Panel PowerMount-S with Solar Connection Kit

Application: Roof-mount

Angle: Varies

Material: 6061-T6 Aluminum

Pre- or Post-assembly: Post-assembly

Certifications/Approvals: UL 2703, UL 1703, and TAS 100 (Miami-Dade Approval)

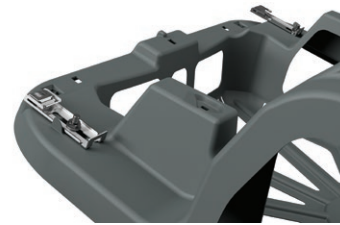
Warranty: 20-year warranty

Key Features:

- Single piece PowerMount simplifies installation and reduces cost;
- Solar Connection Kit is UL 1703 and UL 2703 listed and approved;
- PowerMount-S Attachments are strategically fastened on the rib, keeping the system safe from water and debris;
- GroundBonding Technology creates a conductive bond from panel to panel without extra tools or parts;
- Cable Management Disc allows for cables to be top loaded and secured, making cable management clean and simple.

www.solarconnections.com

SEE AD ON PAGE 30



Sollega, Inc.

Product: Sollega Universal Slide-on Clamp

Application: Flat-roof (for use with Sollega FR510 commercial flat roof ballasted/hybrid racking system)

Material: Zinc coated spring steel

Certifications/Approvals: UL 2703 pending

Key Features:

- Universal clamp works with all framed modules;
- No tool required for installation, simply pull on and the teeth bite into aluminum;
- Ships on Sollega FR510 ready to install;
- Available Q2 2019.

www.sollega.com



MT Solar, LLC

Product: Fixed Ground-Mount

Application: Ground-mount

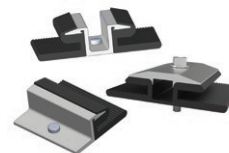
Angle: 35°

Material: Steel

Pre- or Post-assembly: Post-assembly

Warranty: 10-year warranty

www.mtsolar.us



Clark Rubber & Plastic

Product: Custom plastic and rubber components

Application: Roof, ground-mount, and utility-scale

Angle: Any

Material: Rubber and plastic

Warranty: To specification

www.clarkrandp.com



ISA Corporation

Product: Solar Racking - Clamp-on

Application: Service station canopies, steel roofs

Angle: 0° to 10°

Material: Aluminum

Pre- or Post-assembly: Pre-assembly

Certifications/Approvals: Structurally approved for most areas

Warranty: 15-year warranty

www.isa-corporation.com

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Bifacial PV Panels can collect energy from both sides, therefore an adapted racking solution must be used to maximize sunlight reaching the backside of the panels.

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Work with our experts to increase any bifacial project's performance and ROI!



- Custom Engineered PV Racking
- All aluminum rugged design
- UL 2703 Listed



SEE AD ON PAGE 37



Structural Solar LLC

Product: Canopy and Ground Mount Structures

Application: All parking areas and ground mounts

Angle: up to 45°

Material: Galvanized and aluminum structures

Pre- or Post-assembly: From supply only to fully installed

Certifications/Approvals: AISC

Warranty: Structures durable for 40-years

Key Features:

- Structural design;
- Manufacturing;
- Construction.

www.structuralsolar.com

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Opsun Systems, Inc.

Product: SunRail Bifacial

Application: Rooftop, ground-mount, wall-mount

Angle: 5° to 30°

Material: Aluminum

Pre- or Post-assembly: Pre-assembly in option

Certifications/Approvals: UL 2703

Warranty: 20-year warranty

Key Features:

- High tilt and elevation, no obstruction behind the panels, and knowledge of bifacial design and optimization;
- All aluminum and stainless steel design, built to endure harsh environments;
- Custom engineering and support to assure the racking meets all projects requirements, including roofs with limited capacity, high winds, high snow loads, very tall buildings, and unique wallmounts.

www.opsun.com



EcoFasten Solar

Product: Rock-It System 3.0

Application: Rail-Free, employs a streamlined design, utilizes N/S adjustability and provides a fast, easy installation

Angle: Fixed

Material: Aluminum

Pre- or Post-assembly: Top-down leveling gives the installer the ability to level the array during or after the install

Certifications/Approvals: Conforming to UL 2703: First Edition (tested by NRTL TÜV Rheinland)

Warranty: 10-year warranty

www.ecofastensolar.com



AEROCOMPACT, Inc.

Product: AEROCOMPACT G

Application: Ground-mount

Angle: 10°, 15°, 20°

Material: Aluminum EN AW 6060 T64, module mid-clamps aluminum EN AW 6063 T66, stainless steel screws, galvanized stainless steel ballast trays

Pre- or Post-assembly: Pre-assembly

Certifications/Approvals: TUV certified, conforms to UL 2703, Wind tunnel tested

Warranty: 25-year limited warranty

www.aerocompact.com

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Spice Solar

Product: Spice Built-In Racking

Application: Roof

Material: Galvanized steel, aluminum

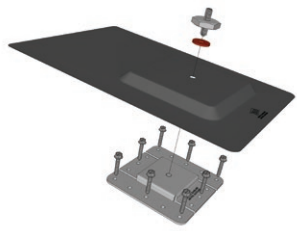
Pre- or Post-assembly: Pre-assembly

Certifications/Approvals: UL-1703, UL-2703, FSEC, LADWP, CA Fire Codes, System Fire Class Rating A, Type 1 & 2 Modules

Warranty: 10-year warranty

www.spicesolar.com

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Zilla Corporation

Product: Zilla Double Stud XL Flashing Assembly

Application: Roof-mount

Angle: Flush mount on comp shingle roofs

Material: SS stud, aluminum nut, aluminum flashing, galvanized base plate

Pre- or Post-assembly: Post-assembly using 3/8" hex drive socket

Certifications/Approvals: Passed 3rd party testing for roof flashings in accordance with AC 286 evaluation standards using the methodology of UL 441

Warranty: 25-year limited product warranty

Key Features:

- Attaches to decking, eliminating time to locate rafters, rafter splits, shingle cutting, and caulking;
- Features install method of attachment first, flashing second, and waterproof seal third, providing three layers of patented waterproof protection;
- Reduces training and time spent on the roof up to 50% or more and allows arrays to be specifically located;
- Is compatible with Zilla roof top mounting systems and most other racking systems;
- Made in the USA.

www.zillarac.com

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TERRASmart

TerraSmart

Product: TF3 Landscape Rack

Application: Fixed-tilt, ground-mount, commercial, utility-scale

Angle: Up to 35°

Material: Hot dip galvanized structural steel

Pre- or Post-assembly: Pre-assembly options available

Certifications/Approvals: UL 2703, CPP Wind Tunnel Tested

Warranty: 20-year warranty



Key Features:

- Yielding to table sizes up to 6 x 8, TF3L accommodates more panels per foundation;
- TF3L system reduces overall site cost and optimizes panel capacity;
- The fixed-tilt racking system is paired with TerraSmart's versatile ground screw foundation that can work in any soil condition;
- Adapts to steep slopes and accommodates arduous soils;
- Consisted of 66% less hardware, there are no extra parts or pieces. This aides in rapid installation with a proven 30% quicker install time in the field.

www.terrasmart.com

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SINGLE PIECE R-PANEL POWERMOUNT

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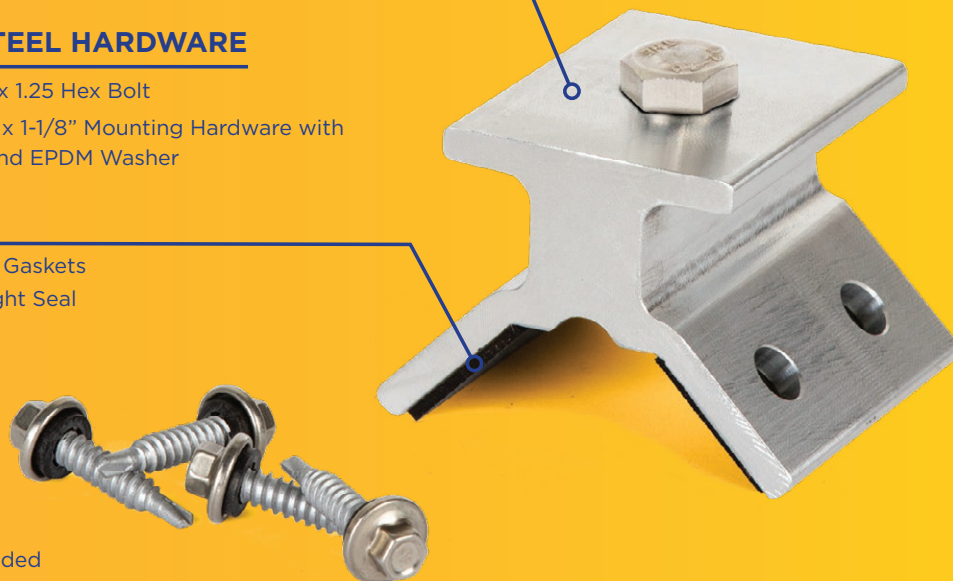
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Fits Majority of R-Panels
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Stainless Steel M8 x 1.25 Hex Bolt
Stainless Steel #14 x 1-1/8" Mounting Hardware with Single Piece Cap and EPDM Washer

EPDM SEAL

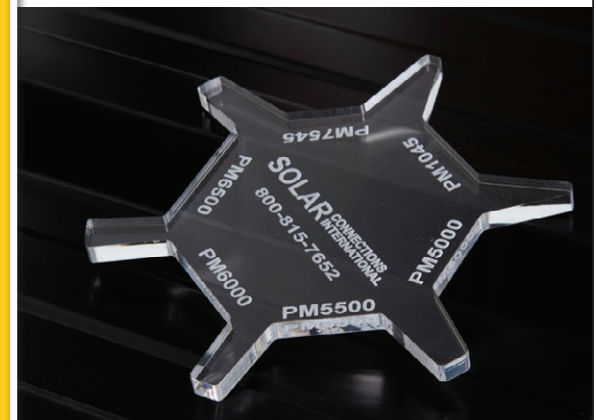
Pre-Applied EPDM Gaskets
Premium Water Tight Seal



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Solar Structures & Carports

Solar power carports and structures take full advantage of large areas, such as parking lots, for the purpose of producing electricity while, at the same time, providing shade and a covered area for users. Gaining popularity over recent years, these solar structures are ideal for generating renewable power without sacrificing valuable real estate. The following listing offers details about some of the more popular options available on the market today.

SEE AD ON PAGE 5



Baja Carports

Product: Full Cantilever T w/ bolted connections

Roof Inclination: Roof tilt angle of 5° to 15°

Height Clearance: 7' to 25' engineered clearance

Depth: Covers two rows of parking, provides maximum vehicle clearance and maximum space coverage

Space-to-Column ratio: 2:1 typical with 4:1 max

Configuration: Pre-fabricated galvanized steel with bolted connections, purlins directly attached to beams. No additional racking system required

Options: Tapered or straight beams, wide-flange (W beam) or structural steel [HSS] columns, trim fascia, and can be painted on-site. Additionally, the Full Cantilever T is compatible for accessories (installed by others), EV stations, and LED lights. Its columns can be acceptable for either wrapped columns or concrete bollards

Panel type: Neutral, can design engineered to any panel size



Power generated: Based on module vendor selection, orientation (portrait or landscape), and location. Baja can accommodate proposed PV layout specifications and improved integration

Certifications: Licensed (registered) general contractor. Licensed (registered) engineers. Baja Carports has the credentials to work in all 50 states

Key Features:

- Covers two (2) rows of parking, provides maximum vehicle clearance and maximum space coverage;
- Engineered to meet live loads up to 60psf and wind speeds to 160mph per local jurisdiction building codes;
- Maximizes solar panel production and coverage in either portrait or landscape to achieve and meet property's project's needs;
- All steel components are pre-fabricated for fast assembly and installation on-site;
- Custom engineering allows for compatibility with all solar panel sizes and manufacturers.

www.bajacarports.com

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RBI Solar

Product: CP-Tee, CP-Truss, CP-LS, CP-G, DSA-PC

Roof Inclination: Various options

Height clearance: 10' and 14' standard, various options available

Depth: Site specific

Space-to-Column ratio: Site specific

Configuration: Portrait standard

Options: Finishing (Galvanized, Paint, Powder Coating), Raised Pier Foundations, Underdecking, Gutters/downspouts, Flashings

EV charging: Available options

Panel type: Compatible with all commercially available module type

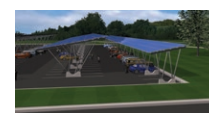
Power Generated: Site specific

Certifications: UL 2703 options available, EOR services for all 50 states in-house

Key Features:

- Maximizing parking functionality;
- In-house design, engineering, manufacturing, installation teams;
- No on-site welding;
- Customizable to project specific requirements.

www.rbisolar.com



Inovateus Solar

Product: Solar Carport

Roof inclination: 7°

Height clearance: 14' 6"

Space-to-Column ratio: 18'

Configuration: East/West Facing V-Shaped

Options: Architectural options, roofing, lighting

EV Charging: Available

Panel type: Canadian Solar including bi-facial frameless

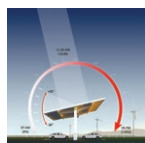
Power generated: 15516 MWh/year

www.inovateus.com

Kinetic
SOLAR RACKING AND MOUNTING

- Commercial and residential solutions
- Flat roof pitched roof and ground mount

www.kineticsolar.com



Scarlet.red

Product: SCARLET Tiltport
Roof Inclination: Tracking -30°/+30°
Configuration: 40' x 40' size, 25 to 33KWp per unit
Options: Waterproof / non-waterproof
EV charging: Optional
Panel type: Tier 1 panels, 60-cells or 72-cells
Power Generated: Up to 2032 KWh/Kwp
www.scarlet.red



Arning Companies

Product: Custom solar canopy structures
Roof inclination: Per customer specifications
Height clearance: Per customer specifications
Depth: Per customer specifications
Space-to-Column ratio: Customized to fulfill design needs
Configuration: Any
Options: Customized
Panel type: Supplied by others
Certifications: AISC, PEI, AWS
www.arningco.com



Poly-Tex, Inc.

Product: Tri-Plane Truss Solar Canopies featuring Poly-Tex's modular truss members
Roof Inclination: 0° to 30°
Height clearance: Based on customer and code requirements
Depth: Unique to each configuration
Space-to-Column ratio: Capable of 66' spans between columns
Configuration: Wide variety of custom designs available for parking ramps and parking lots
Options: Hot-dip galvanizing, field painting
EV charging: Easily incorporated
Panel type: Poly-Tex will design and engineer to any panel size
Power Generated: Based on the module type and PV layout. Poly-Tex will design and engineer to current footprint or required system size
Certifications: Licensed engineer, certified welders and over 30 years of experience in structural design and manufacturing
www.poly-texsolar.com



Skyline Solar of AZ

Product: Solar Carport Structures
Roof Inclination: 0° to 15°
Height clearance: 7' to 25'
Depth: 10' to 50'
Space-to-Column ratio: 2:1 to 6:1
Configuration: Landscape or portrait

Options: Single or double cantilevered, double post and beam, straight or tapered beams, exposed piers, deck, painted or galvanized

EV charging: Charging station can be attached to the columns

Panel type: Specified by integrator

Certifications: AISC Certified fabrication shop, OSHA Certified / CPR trained crews, Certified field welders

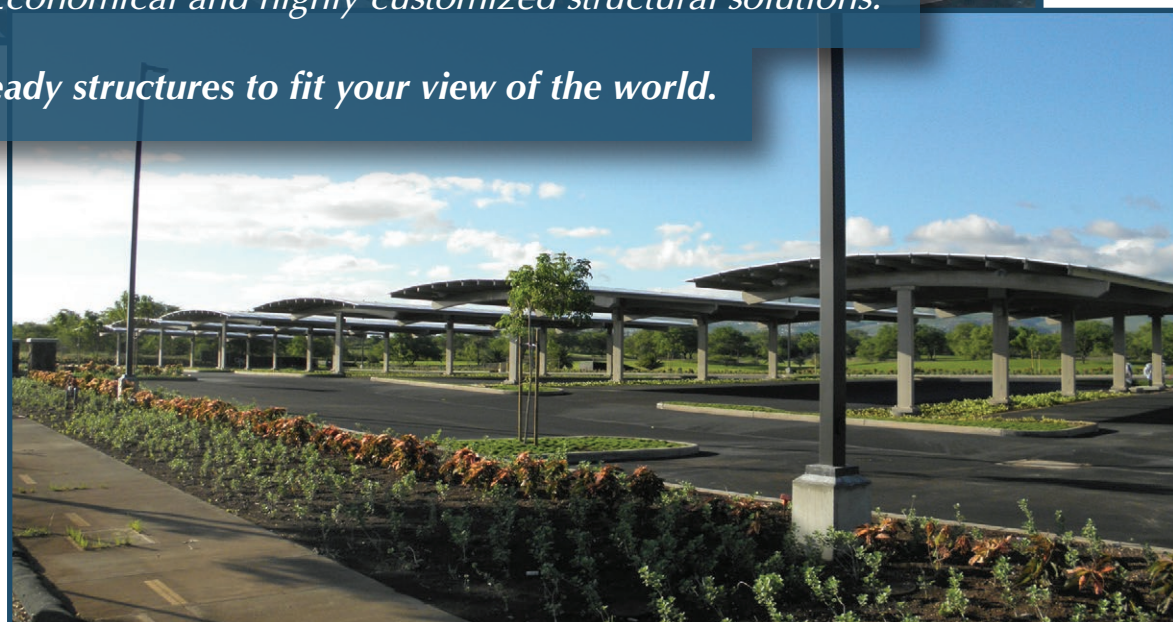
www.skylinesteelinc.com

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SEE AD ON PAGE 36



Kinetic Solar

Product: Solar Carport

Roof Inclination: 10°

Height Clearance: 7.2'

Depth: 20'

Space-to-Column ratio: Single carport occupies 2 parking spots (min 8.8' parking spot width)

Configuration: 24 Panels, landscape

Options: Off-grid with battery, grid-tied with FIT (non-roo'op), and net-metering

EV Charging: Level I or II EV chargers to charge up to 2 vehicles

Panel Type: Can accommodate any panel

Power Generated: 6.85kW system size. The installation is an off-grid setup with batteries from Canadian Energy.

Key Features:

- Level III fast DC chargers with battery option can be integrated with larger carports;
- Durable, modular, easy installation;
- Engineered to withstand over 150mph winds;
- No loss of parking spots;
- Innovative foundation solution with no excavation.

kineticsolar.com

SEE AD ON PAGE 37



Structural Solar LLC

Product: Solar Carports, canopies, pavilions, ground-mounts

Roof Inclination: 0° to 25°

Height Clearance: Unlimited

Depth: up to 60'

Space-to-Column ratio: Columns typically on 27' centers

Configuration: All types

Options: Architectural options, roofing, lighting, charging stations

EV Charging: Yes



Panel Type: All types of modules including bi-facial frameless modules in water management system

Power Generated: No limit

Certifications: AISC certified fabrication and coating

Key Features:

- Licensed across the USA;
- Module-ready structures;
- Durable for 40 years.

www.structuralsolar.com

SEE AD ON PAGE 24



Quest Renewables

Product: QuadPod solar canopies

Roof Inclination: 0° to 10° tilt

Height Clearance: 9' to 16'

Depth: 14' to 46'

Space-to-Column ratio: 10 spaces per column

Configuration: Long span, double cantilever

Options: Battery storage, inverter mounting, lighting, marine environment coating, rain water capture, snow retention

EV Charging: Yes

Panel Type: Panel agnostic system

Power Generated: Varies based on panels selected

Certifications: UL tested

Key Features:

- Fewer foundations improve financial predictability of carport projects;
- 90% on-the-ground assembly contributes to onsite efficiencies and up to 50% labor savings;
- High capacity canopies enable more kilowatts per acre under high snow and wind where high power density is needed.

www.questrenewables.com



Park n' Shade Inc.

Product: Custom designed and engineered solar carports and shade structures

Roof inclination: 0° to 20°

Height clearance: 7' to 25'

Depth: 10' to desired depth (36' to 40' is typical)

Space-to-Column ratio: 1:1 to 3:1

Configuration: Semi-cantilever, full-cantilever, TEE- cantilever, double post, super-structure

Options: Galvanized, wide flange I-beam, tube steel, weld or bolt-together frames, painted to match client's request, slide-in solar purlin with UL 2703 compliant mounting clips, underside decking

EV charging: Can be designed and built into the carports

Panel type: System is designed to the client's chosen module

Power generated (per kilowatt-hour): Dependent on the client's layout and chosen design. Park n' Shade will design-build their carports to fit each individual project.

Certifications: Licensed contractor, certified welders, DSA PC designs, engineering licensed in all 50 States and Territories, installation crews are OSHA certified

www.parknshade.com



M Bar C Construction

Product: Design/Build Solar Carports and Canopies

Roof Inclination: 0 to 7°

Options: Module installation, underside decking, top side decking, concrete bollards, paint, hot dip galvanizing, aesthetic features

EV charging: Optional

Panel type: Any

Panel type: Based on project size

Certifications: General Contractor, Structural Steel Contractor, Certified Welders

www.mbaronline.com

Solar Carports

Design and installation best practices are crucial to achieve optimal coverage and production



2018 Installation Winner:

Baja Carports

Voted by Solar Power World user community; SPW released its seventh annual Leadership in Solar Program winners this past January 2019.

Baja Carports' in-house design engineers and project managers place emphasis on the proposed site's layout first; "fact-checking" the property for its canopy feasibility. Following our best practices allows Baja to value engineer the solar support system configuration to best perform for the property and its owner, while also being economically efficient. A credible and experienced installer will tell you that no two parking lot properties are the same! To achieve optimal coverage and PV production, the project's entire installation must be site-specific. An installer who sees the project as being boilerplate is one to pass on.

Baja's preliminary customer discussions cover property specifics such as elevations and other constraints, as well as wind and live load requirements which determine the canopies structural elements to meet its local jurisdiction building codes. Additionally, the property's soil composition is needed to engineer the structure's footings design. For some properties we encourage a thorough geotechnical soils report to get a much better idea of what's underneath the asphalt and dirt. Keep in mind nowadays properties get repurposed. Utilities underneath get moved or are unmarked. The report can save the customer time and more importantly money!



The goal is always to know more than we need to about the property's parking lot; it's entries, exits, foot-traffic, ADA requirements, fire-lanes, loading dock locations, dumpsters, water run-off, etc., Knowledge is power, literally. Baja's expertise in parking lot design can lead to a more effective array system(s) as well as drive aisle maneuverability.

Baja Carports solar support systems cost-efficient configurations are generally pre-fabricated galvanized steel with bolted connections, and no field welding. All our solar support systems are delivered ready to install by Baja's installation crews and managed by a Baja project manager. Our team has designed, engineered and installed thousands of projects nationwide since 1981, requiring custom configurations on challenging properties with existing parking lots.

Visit bajacarports.com or call (800) 366-9600 to speak with a sales representative today!

Tracking Systems

An advanced mounting system for photovoltaic panels, solar trackers maximize the sun's energy by tracking its progress across the sky. Versatile enough to provide highly efficient solutions for both large and small projects, solar trackers can generate more electricity in the same area as their fixed-tilt counterparts. Below, we explore some of the solar tracking systems available on the market today.

SEE AD ON PAGE 25



Soltec

Type of Tracker: Horizontal single-axis
Drive System: Enclosed slewing drive, DC motor
Tracker Length: 147' 12" (45.1m)
Tracker Height: 12' 12" (3.95m)
Pile Count: 7 piles per 90 modules
Modules per Row: 90
Module Mount: Omega rails with cinches, rivets, or bolts
Slope Tolerance: n/s 17%; e/w unlimited
Tracking Range: 120° +
Standard Configuration: 2 x 45
Preventative Maintenance Required: Yes



Tracker Power Consumption: 249kwh/MW-year
Certifications: UL 3703, IEC 62817, EN 1090, IEC 61326-1
Key Features:

- Limited shadowing, high bifacial performance;
- Best captures early and late day bifacial potential;
- No special parts or installation operations;
- All other Soltec's SF7 cost-effectiveness features included.

www.soltec.com

SEE AD ON PAGE 9



GameChange Solar

Type of Tracker: Single-axis
Drive System: Linear actuator
Tracker Length: Up to 340' (103.6m)
Tracker Height: 51" typical / ground clearance + 9" adjustment range
Pile Count: 450/MW typical
Modules per Row: Up to 102 72-cell crystalline
Module Mount: SpeedClamp
Slope Tolerance: 15%
Tracking Range: 45°, 52°, 60°
Standard Configuration: 1 up in portrait

Certifications: UL 2703, UL3703, CPP Wind Tunnel

Key Features:

- 30-year actuator field life, -30°/+50°C rated, IP66 rated;
- Grease-free maintenance;
- Secure monitoring and control tracker array in real-time via encrypted cloud portal, SCADA solution available;
- Real time tilt and battery level information, remote control for each tracker's tilt;
- Overall 10% lower O&M cost, 65% lower vegetation O&M cos.

www.gamechangesolar.com



STI Norland

Type of Tracker: Horizontal, single-axis, dual-row
Drive System: Rotative electromechanical actuator
Tracker Length: 196.85' (60m)
Tracker Height: 4.92' (1.5m)
Pile Count: 19 piles per tracker of 120PV modules
Modules per Row: 60 (configurable)
Module Mount: Bolt, clamp, or rivet
Slope Tolerance: 15% n/s / 10% e/w (for the two torque tubes of the same tracker)
Tracking Range: 110° (+/-55°)
Standard Configuration: 1V
Preventative Maintenance Required: Annual review
Tracker Power Consumption: Powered from the grid (< 0.035Kwh/day), self-powered option available
Certifications: UL2703, UL3703, IEC 62817 (in process)
www.stinorland.com



AllEarth Renewables

Type of Tracker: Dual-axis
Drive System: GPS-based tracking powered by a hydraulic power unit
Tracker Length: 20' to 25' (6.09m to 7.62m), depending on tracker model and panels used
Tracker Height: 18' to 20' (5.48m to 6.09m), depending on tracker model and panels used
Pile Count: Simply supported on a single mono-pole
Modules per Row: 20 or 24 panels total
Module Mount: Rail and clamp system
Slope Tolerance: Maximum 10% grade
Tracking Range: Yaw range 0° to 360°. Tilt range 0° horizontal to 60° off horizontal
Standard Configuration: 4 columns x 5 rows, or 4 columns x 6 rows, depending on tracker model. Panels in landscape orientation
Preventative Maintenance Required: Greasing main gear every 3 years, hydraulic fluid change every 10 years. Annual inspection recommended
Tracker Power Consumption: Approximately 50kWh per year
www.alleearthrenewables.com



Axsus Solar

Type of Tracker: Horizontal table based single-axis tracker
Drive System: Independently driven rows. Each table in the row is connected by a flexible drive shaft which is driven by one 24VDC motor per row. There is one drive on each pile to eliminate dynamic loads and move the table
Tracker Length: Standard 12-module table: 39.37' (12m); Standard 180-module row: 593.8' (181m)
Tracker Height: 4.54' (1.383m) to pivot point
Pile Count: 2 piles per table
Modules per Row: Up to 180 modules per row
Module Mount: Grounding clip, compatible with all module types, including FSS6
Slope Tolerance: +/- 10% within a 12 module table, +/- 5% between tables
Tracking Range: 120°
Standard Configuration: Dependent on site conditions; 1 module in portrait, tables can be between 19.69' and 39.37' (6m and 12m) long
Preventative Maintenance Required: No special maintenance required
Tracker Power Consumption: For a 180 module row - Peak 200W, Nom. 30W
www.axsussolar.com

SEE AD ON PAGE 29



Solar FlexRack

Type of Tracker: TDP 2.0 Horizontal Single-Axis Tracker with BalanceTrac

Drive System: Zero-Maintenance Distributed Slew Drive

Tracker Height: Per project specifications

Pile Count: 7 modules per pile

Modules per Row: Up to 90 modules

Module Mount: Self-aligning, auto spacing direct bolt

Slope Tolerance: Up to 10% n/s

Tracking Range: Up to 110° (+/- 55°)

Standard Configuration: 1 in portrait, 2 in landscape (crystalline); 4 in landscape (thin film)

Preventative Maintenance Required: Zero

Tracker Power Consumption: Self-powered or 31kWh per tracker/year

Certifications: UL 2703

Key Features:

- Adaptable with crystalline or thin film, optimized for 1000V and 1500V modules and installation is easy with no prying, adjusting, or special tools;
- Self powered option available, and independently driven rows provide easy access for mowing, cleaning, and other maintenance;
- Lower per-unit fixed costs for BOS savings;
- Programmable technology to mitigate inclement climatic conditions;
- Independent tables increase design flexibility to maximize land use;
- Smart backtracking reduces row shading to optimize energy production for high power density.

www.solarflexrack.com



NCLAVE

Type of Tracker: One-row single-axis

Drive System: Slew drive / linear actuator

Tracker Length: 295' (88.9m)

Tracker Height: 4.9' (1.49m)

Pile Count: 7/8

Modules per Row: 90

Module Mount: Rails, clamp, rivet

Slope Tolerance: Up to 20% grade n/s

Tracking Range: +/- 55°

Standard Configuration: 2V x 45

Preventative Maintenance Required:

Minimal; grease slew drive once every 2 years, optional every 10 years

Tracker Power Consumption: 50kWh-year

Certifications: TUV NORD, ISO 9001:2015, ISO 14001:2015, EN 1090, IEC62817

www.nclavegroup.com



NEXTracker

Type of Tracker: Single-axis tracker

Drive System: One slew gear, 24VDC motor and self-powered controller w/dedicated solar panel per row

Tracker Length: 283' (85m)

Tracker Height: 4.5' (1.4)

Pile Count: 11/80

Modules per Row: 80-90

Module Mount: Shared mounting rails with integrated module frame grounding. Rails pre-align to locating holes in torque tubes.

Slope Tolerance: 15% (8°) n/s; unlimited e/w

Tracking Range: 120° (+/-60°)

Standard Configuration: Portrait

Certifications: Grounding/bonding: UL2703; Structural design: ASCE7-10, Tracker: UL 3703

www.nextracker.com



Scorpius Trackers, Pvt., Ltd.

Type of Tracker: Horizontal single-axis, tilted single-axis, dual-axis

Drive System: Linear actuators (array), gear motor drive (row)

Tracker Length: 206' (63m) (n/s row length)

Tracker Height: Up to 6' (1.8m)

Pile Count: Between 225 to 450, depending on configuration

Modules per Row: Up to 126

Module Mount: Clamps or bolts and washers

Slope Tolerance: e/w 14%, n/s 5%, row tracker

Tracking Range: +/-60° in e/w

Standard Configuration: 2 or 1 up in portrait, 2 or 4 in landscape

Preventative Maintenance Required: Not required

Tracker Power Consumption: self-powered

Certifications: Wind tunnel, Independent Engineers Certification

www.scorpiustrackers.com



Array Technologies

Type of Tracker: Horizontal single-axis

Drive System: Flexibly linked rotating driveline

Tracker Length: Variable, maximum 330' (91m)

Tracker Height: Variable, nominal range 4' to 6' (1.2m to 1.8m), minimum 4' (1.2m)

Pile Count: Variable, average 7 modules per pile

Modules per Row: Variable, maximum 100 standard crystalline modules per row

Module Mount: Single-bolt module clamp

Slope Tolerance: N/S axis: 15% grade standard, E/W axis: 40° cone of flexibility along driveline

Tracking Range: +/- 52° standard, +/- 62° optional

Standard Configuration: 90 modules per row, 32 rows per module block

Preventative Maintenance Required: None

Tracker Power Consumption: 400kWh/MW-year

Certifications: UL 3703, IEC 62817, CE Declaration of Conformity

arraytechinc.com



GP Joule

Type of Tracker: PHLEGON Horizontal Single-Axis Tracker

Drive System: DC linear electrical actuator

Tracker Length: 139' (42.5m) to 195' (59.5m) per tracker

Tracker Height: 5'5" (1.7m) top of post; 11' (3.35m) at max tilt

Pile Count: 0.1 pile per module; average 310 piles/MWdc

Modules per Row: Up to 84 modules per tracker

Module Mount: Rail, direct bolting

Slope Tolerance: 10° to 15° n/s

Tracking Range: -45° to +45°

Standard Configuration: 3x4 landscape

Preventative Maintenance Required: None required

Tracker Power Consumption: 2-3MWh/yr/MWdc

Certifications: CE, CSA, UL, RWDI

www.gp-joule.com



Arctech Solar

Type of Tracker: Independent horizontal single-axis tracker

Drive System: One slewing gear, 24VDC motor

Tracker Length: 147.63ft (45m)

Tracker Height: 6.56ft (2m)

Pile Count: 7

Modules per Row: 90

Module Mount: Any solution

Slope Tolerance: Up to 20% n/s slope

Tracking Range: Up to 120°

Standard Configuration: 2V45

Preventative Maintenance Required: Not required

Tracker Power Consumption: 0.08kWh typical

Certifications: BV, UL 2703, UL3703

www.arctechsolar.com

Ground Screws

Ground screws are becoming the choice in foundation methods. They eliminate the need for concrete and allow foundations to be quickly set. The following highlights a variety of available options to suit different applications and soil conditions.

SEE AD ON PAGE 29



Solar FlexRack

Product: Ground Screw Foundation Solution

Description: Solar FlexRack's Ground Screw Solution significantly reduces costs and complications for developers and EPCs in difficult subsoil solar project conditions. It eliminates refusals in tough terrains and its versatile design features accelerate the installation process.

Material: Fabricated, hot-dipped, galvanized steel

Thickness: 72.04" to 95.66" (1830mm to 2430mm), customized solutions available

Length: 3 different sizes available

Flange Size: 3 standard sizes and custom options available

Thread Width: Varying per size

Thread Pitch: Varying per size

Key Features:

- Reliable regardless of rocky or difficult subsoil conditions;
- No refusals and associated contingency costs with piles in dense gravel, rocks, boulders, or ledges;
- Low impact machinery can be used;
- Telescopic upright extension allows for easy vertical adjustment so racks transition perfectly across the row;
- Requires a smaller pre-drill hole, reducing time and costs.

www.solarflexrack.com

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APA Solar Racking

Product: APA Ground Screw

Description: APA Ground Screws are manufactured for challenging solar sites. They use heavy wall tubing for the main shaft of the screw. The tips of the screw are forged, making them extremely hard to help penetrate into or pass by underground obstructions. The threads are welded with a patented automated welding process to provide a consistent and strong weld along the entire length of the thread. Ground screws come with a durable hot dipped galvanized coating to protect them from corrosion.

Material: Hot-dipped, galvanized steel

Thickness: 0.137" to 0.157" (3.48mm to 3.98mm)

Length: 47" to 85"

Flange Size: Various

Thread Width: 0.375" (9.5mm)

Thread Pitch: 1.5" to 2.0" (38.1mm to 50.8mm)

Threads: 24 to 40

Key Features:

- A ground screw is a suitable foundation for rocky, hard pan, and caliche soils;
- APA has ground screws between 2.5" and 4.5";
- Can be used with tracking systems and other racking;
- Available in multiple different lengths such as 40", 61", 73", and 85";
- The Dual Tracking system screw is now available.

www.apalternatives.com

SEE AD ON PAGE 43



TerraSmart

Product: Ground Screw

Description: TerraSmart's Ground Screws are formed from a single steel pipe. The material is finished with a corrosion resistant, hot-dipped galvanized coating for long-lasting foundations. The custom spiral thread design minimizes embedment depth while increasing installation efficiency. It has a forged-tip to fight through arduous soils, including rock, and has a 20-year limited warranty.

Material: Steel tube with a hot dip galvanized finish

Length: 82" (208cm)

Flange Size: 3" diameter

Key Features:

- Have been installed in some of the toughest soil environments in the U.S., i.e. bed rock, caliche, volcanic rock and glacial till;
- Excel in undulating terrain that allow solar racks to be built on high slopes;
- A simple and cost-effective solution to soil conditions prone to frost heave. The threads on TerraSmart's ground screw are embedded below the frost line depth, which mitigate ice lensing force;
- Ground screw foundations reduce upfront costs, accelerate project timelines, and eliminate subsurface risks.

www.terrasmart.com

American Earth Anchors
The best screw you will have in the dirt™
46" Penetrator™
Field-tested to 9,000 lbs downward pressure

REPLACES CONCRETE FOOTINGS

- No digging
- No pouring
- No forms
- No waiting

EASY LEVELING Screw down, screw up

2" Schedule 40 pipe fits over
Custom brackets for any pipe size

americanearthanchors.com
corinne@americanearthanchors.com 1-508-520-8511

SEE AD ON PAGE 42



American Earth Anchors

Product: PE46-Hex8

Description: 46" aluminum screw anchor that can replace concrete footings. The 8" extended hex head comes with two 3/8" clear holes for direct mounting of a 2" schedule 40 pipe. The PE46-Hex8 screws in and out with an impact wrench for easy leveling, will not rust, and weighs only 12lbs.

Material: Heat treated aluminum

Thickness: 1.75" (4.45cm) shaft

Length: 54" (137cm)

Flange Size: 4" (10.16cm)

Thread Width: 3" (7.62cm)

Thread Pitch: 2.25" (5.72cm)

Threads: 17

Key Features:

- Replaces concrete footings, no digging, forms, pouring, or waiting;
- Tested for up to 14,000lbs of pull out and 9,000lbs of down pressure;
- Aircraft quality 356 alloy, heat treated cast aluminum;
- Fast installation with 1 3/4" socket and impact-easy leveling by screwing up or down;
- Made for temporary or permanent application.

www.americanea.com



Milspec Earth Anchors

Product: Solar Helical Pier

Description: Solar pier with helical plate is a foundation alternative to cement or driven H-beam. Milspec's solar helical pier allows for greater loads and has an extremely high pullout resistance. With a 50-year minimum lifespan, they are easily removed and can be reused.

Material: API pipe

Surface Treatment: Hot-dipped galvanized

Diameter: 2 3/8" (6.03 cm), 2 7/8" (7.3 cm), 3 1/2" (8.89 cm), or larger if needed

Thickness: .190w to .337w

Length: 5' to 10' (1.5m to 3m) as needed

Flange Size: As required

Thread Pitch: 3" (7.62cm)

Threads: 1 to 3 helices

www.milspecanchors.com



Almita Piling, Inc.

Product: Helical Pile Foundations

Description: Almita Piling offers engineered helical pile foundation designs, fabrication and installation, and supplies and supports renewable energy solar, and wind projects.

Material: Steel, galvanized, pipe, and helix

Thickness: Variable

Length: Up to 328' (100m)

Flange Size: Variable

www.almita.com



ECO Foundation Systems

Product: Ground screws

Description: Groundscrews are a replacement for concrete pier footings. They offer an extremely fast and strong foundation system in almost any substrate, including rock, and can be installed quickly, with racking being installed simultaneously. Double ground mount production with no increase in overhead.

Material: Hot dipped galvanized structural steel

Thickness: Sidewalls 0.12" to 0.20" (3mm - 5mm) thick

Length: 3' to 10' (0.91m to 3.05m)

Flange Size: Various sizes depending on application

Thread width: 1/2" (1.27cm)

Thread Pitch: 2" (5.08cm)

Threads: 10 to 20

www.ecofoundationssystems.com



**EXPERIENCE
YOU CAN
BUILD ON**

Learn why developers have trusted TerraSmart to build 2 GW's of racking projects on over one million ground screws.



TERRASMART
START SMART. BUILD SMART.

terrasmart.com

Metal Fabrication for Solar Structures

Customized shapes and formed structures designed to mount, secure, and support solar panels are a significant component to any reliable solar power project. This is where processes such as roll forming and extrusion come into play. The following highlights some of the main companies involved in metal fabrication processes for solar components and related support structures.

SEE AD ON PAGE 23



RPM Rollformed Metal Products Ltd.

Process/Technology: Custom rollformed metals, product assembly, and project development

Materials: Steel: Pre-Galvanized (ASTM A-653), CRS, HRPO, Galvalume, Gavanneal, Chrome Coated Steel; Aluminum Alloys; Various types of stainless steel; Copper; Brass

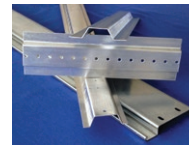
Sizing: Aluminum Thickness from 0.0180" up to Galvanized Steel - 0.168"

Shapes/Structures: Custom, Dedicated, and Standard - Angles, U - C - Z Channels. Flat, Complex, Non-Welded Tube, Welded Aluminum Tube, Other

Key Features:

- 27 rollforming lines;
- 3 fabricating facilities;
- Dedicated and standard tooling;
- Engineering support;
- Metallurgist support.

www.rpmroll.com



Johnson Bros Roll Forming Co.

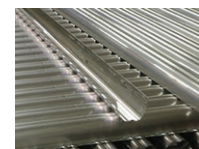
Process/Technology: Modernized equipment and tooling designed to offer roll forming services with the latest automated technology, including: pre-notching; pre-punching; cut-to-length; and post-fabricating, combined with the cut-length operations

Materials: All metals, including: ferrous and non-ferrous in either plain or pre-anodized; pre-painted; pre-laminated; pre-embossed; perforated; duplex; special alloy; pre-hard tempers; and more

Sizing: 0.005" to 0.150" thickness, and coil widths up to 20" wide before forming; maximum height of profiles 5.25" in the vertical axis

Shapes/Structures: Profiles; panel frames; reflectors; trim; support structure framing; Hat shapes; C-channels; U-channels; Zees; rings; and many other custom shapes for solar components

www.johnsonrollforming.com



Samson Roll Formed Products Company

Process/Technology: Over 40 production lines offering custom roll forming services including a fully integrated service to develop, engineer, produce, and package component parts or finished products. Additional services provided include: pre- and post-punching/notching, secondary stamping, assembly, and Run and Ship Programs

Materials: Pre-coated, painted, anodized, embossed, galvanized, or laminated metals

Sizing: Range for finished profiles: 0.005" to 0.250" Thickness, 3/4" to 12" Slit Width, 6" to 480" Length, Up to 4" Maximum Part Depth

Shapes/Structures: Parabolic shaped channels, C, U, and hat channels, in a range of different coating weights, for use as brackets, photovoltaic array supports, or solar panel framing/trim, and other custom shapes for the solar industry.

www.samsonrollform.com



SOLAR CANADA

Canadian Solar Industries Association
ANNUAL CONFERENCE & EXPOSITION
May 8-9, 2019 | BMO Centre, Calgary, Alberta



SolarCanadaConference.ca

Organized by



Deutsche Messe

March 12th-13th, 2019
Fort Lauderdale, FL

events.solar/florida

Solar Power Florida brings together the Florida solar and storage markets. The event features in-depth discussions about topics relevant to the sunshine state, such as EVs, microgrids, building for resiliency, and more. Solar Power Florida will also bring in Caribbean-based companies and officials interested in learning how they can enhance their solar program.

show in print

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



UL listed solar wire management clip

Nine Fasteners' DCS-1307 solar wire management clip is designed to hold 1 or 2 PV wires securely to most standard module frames. As with all of NFI's solar wire management clips, this clip is manufactured entirely in the U.S., is UL Listed for installations in both the U.S. and Canada, and incorporates a rolled outer edge for maximum wire safety.

Nine Fasteners, Inc.

www.ninefasteners.com

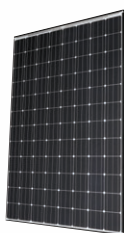


Long-term, reliable energy storage

Suitable for large-scale residential, commercial, and microgrid high capacity energy storage applications, Rolls 5000 Series 2 volt 2 YS 62P model is designed to deliver long-term reliable energy storage, offering heavy-duty thick plate construction for extended cycle life, dual-container case design for added durability and high Amp-Hour capacity (4860 AH @ 20 Hr), backed by a 5-year full replacement warranty.

Rolls Battery Engineering

www.rollsbattery.com



More power from every roof

Panasonic HIT AC Series Module combines the efficiency of HIT solar modules with the intelligence of Enphase microinverters to deliver maximum power production from every roof size and shape. An Enphase IQ 7X microinverter with Individual MPPT tracking is integrated with HIT high efficiency solar technology, offering extreme efficiency and high power output for residential solar systems. The all-in-one smart panel enables more power, easy installations, low costs and high ROI. Panasonic's HIT X-Phase AC Module's low temperature coefficient of -0.258%/° generates more solar power on the warmest days.

Panasonic

na.panasonic.com/us/solar



Universally compatible mounting and racking attachment

The Standing Seam Power Clamp is a solar panel mounting and racking attachment that can attach to virtually any solar panel frame. The Standing Seam Power Clamp can attach to any standing seam profile and provides robust strength using their WaveLock technology with optional 1, 2, or 3 points of attachment. Offering ease of installation, the Silver Bullet Fastener includes a rounded bullet tip to maximize strength and won't damage the paint or pierce the seam. The Standing Seam Power Clamp is compatible with most manufacturers' L-Foot brackets or use their Universal L-Foot with RatchetLock Technology for a railed system.

Solar Connections

www.solarconnections.com

GROUND MOUNT WIRE MANAGEMENT

NEW NFI-Hanger



- 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

March 25th-28th, 2019
San Diego, CA

www.nabcep.org

The content presented in this conference is geared toward seasoned PV industry professionals who have several years of installation, solar + storage, technical sales, design, O&M, or system inspection experience. This is the only industry event that allows NABCEP Board Certified Professionals to obtain as many as 21 hours of continuing education credits needed toward their recertification. Although, the conference is primarily intended for NABCEP Certified Professionals who need continuing education credits in order to maintain their certification, renewable energy professionals seeking to advance their career can earn up to 18 hours towards certification eligibility.

show in print

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



Home solar and battery storage

Panasonic HIT offers an efficient solar module, providing homeowners with decades of reliable sustainable power. Add 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 can offer a 25-year warranty on HIT solar panels which covers product, performance, parts, and labor.

Panasonic

na.panasonic.com/us/solar



Hybrid, long-life energy storage

UltraBattery is a new dimension in lead battery technology: a hybrid, long-life energy storage device containing both an ultracapacitor and an AGM battery in a common electrolyte, for highly efficient partial-state-of-charge use. With the introduction of the UltraFlex 48V Solution, this technology is available for commercial and residential applications as an integrated battery solution. Each UltraFlex unit comprises 16 x UltraBattery 12V monoblocs with integrated system monitoring and control, and over-current protection on each string.

MK Battery

www.mkbattery.com



Wire management with integrated grounding

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 it can act as the EGC and GEC. The new system uses grounding hardware on the L-brackets that allows 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 Products

www.cabproducts.com/solar-power



Deep cycle batteries

Trojan's Solar Industrial line of deep-cycle batteries are engineered specifically to support renewable energy systems with large daily loads where the batteries are cycled regularly. These high amp-hour capacity batteries are suitable for use in large off-grid photovoltaic (PV) systems, off-grid hybrid PV systems, grid-tied PV systems with battery backup, smart grid peak shifting systems, and a variety of other applications. Tested to meet both IEC and BCI standards, the Solar Industrial line features advanced battery technologies that deliver reliable power. Trojan's Solar Industrial line provides a combination of performance and function.

Trojan Battery Company

www.trojanbattery.com



Dependable, long-lasting batteries

Constructed to deliver long-term reliable energy storage in a heavy-duty, dual-container design, Rolls 5000 Series 2 volt 2 KS 33P model offers heavy-duty thick plate construction for extended cycle life and durability, convenient modular cell assembly, and high Amp-Hour capacity (1766 AH @ 20 Hr), backed by a 5 year full replacement warranty.

Rolls Battery Engineering

www.rollsbattery.com



Terrain following single-axis tracker

The Sunflower design by RBI Solar eliminates the limitations associated with other commercial single-axis tracker systems and redefines how trackers are utilized in the marketplace. With terrain following capabilities, independent/variable row lengths and one foundation type throughout the array; installation is made simple, requiring no special tooling.

RBI Solar

www.rbisolar.com



PV sales and design software

Aurora streamlines and automates the solar design process, empowering solar installers to focus on what matters most—satisfying customers. Whether residential, commercial, or both, Aurora provides the tools needed to go from address and electricity bill to full PV design and sales proposal within 15 minutes. Aurora is used by solar installers across the U.S. and around the world, with over 16,000 installations designed in their software every week.

Aurora Solar

www.aurorasolar.com

ZILLA®

SOLAR MOUNTING UNLEASHED

ZILLARAC.COM | 720-880-6700



Battery-based inverter/charger

Combining the surge and power capabilities of a low-frequency inverter with the agility and compactness of a high-frequency design, the MultiWave inverter/charger will deliver more power with less weight, achieve peak efficiency in excess of 95% across a wide load range, and is fast enough for use in uninterrupted power supply (UPS) applications. MultiWave's charging capabilities, up to 100 amps, can quickly and effectively charge advanced batteries including lithium types. With adjustable voltage and frequency settings, the new 4kW 230Vac Inverter/Charger is designed for the global marketplace. Flexible and easy to install, MultiWave features a high-resolution display for programming and data access. A built-in DIN-rail module mounting expansion system allows adding-on generator control, system monitoring alert capabilities, battery management systems (BMS), and other future-ready features as they become available. 120 and 120/240AC versions are also available.

Morningstar Corporation

www.morningstarcorp.com



Flexible and durable bonding solutions

Engineered bonding solutions for applications requiring a flexible and durable bond between structural steel and moving components of a solar array, such as photovoltaic systems using single or dual axis trackers. WILEY and BURNDY BRAID products are used to create an electrical connection between two pieces of electrically conductive metal where a WEEB washer is not required. For applications that call for bonding anodized aluminum or coated metal surfaces the WEEB BONDING JUMPER is a solution. The WEEB Washer teeth eliminate the need to remove nonconductive coatings (e.g. paint and powder coat) when making a bonding connection. Available in various lengths, hardware sizes, and AWG equivalents. Listed to applicable UL standards.

Hubbell

www.hubbell.com/wiley/en/



Pre-engineered integrated solution

The pure black Solaria PowerXT-AC panel offers a pre-engineered, integrated solution delivering AC power that lowers costs, reduces design / installation time, and enables more energy production in real world conditions. PowerXT-AC allows system modularity and design flexibility by enabling single module building blocks rather than requiring full strings.

Solaria Corporation

www.solaria.com



OUR CUSTOMERS EXPECT A LOT.

THAT'S WHAT WE GIVE THEM.

Rolls
BATTERY ENGINEERING



THE LONGEST LASTING
BATTERY FOR YOUR
OFF-GRID HOME.
ROLLSBATTERY.COM

April 25th-26th, 2019
San Diego, CA

events.solar/expo

With a desire for a clean and modern grid, California's historically advanced policies have made it the most progressive, and largest solar and storage markets in the U.S. Leveraging the momentum of this market, the California Solar Power Expo now features two days of education specifically targeted at the California solar, energy storage, home building, and emerging renewable markets, hands-on product demonstrations from vendors, and unparalleled networking opportunities.

show in print

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



Black mono modules

Axitec's AXIblackpremium solar modules are suited for installations where the black exterior design must match performance. These high performance monocrystalline solar modules reach efficiencies up to 19.55%, guarantee high power output, and a spinning meter.

Axitec Solar

www.axitec.us



New standard of energy efficiency

Introducing the all-new Panasonic HIT+ premium series solar panels. HIT+ modules boost panel efficiency to over 20%. With low degradation rates and temperature coefficients, HIT+ provides efficient solar panels which generate more electricity year after year.

Panasonic

na.panasonic.com/us/solar



Convenient, maintenance free battery

Offering long-term reliable energy storage, Rolls sealed VRLA AGM-S Series 6 volt S6-460AGM model offers convenient maintenance-free operation and exceptional cycle life in a durability ABS case, delivering high Amp-Hour capacity (415 AH @ 20 Hr), backed by a 3-year full replacement warranty when used in Renewable Energy applications.

Rolls Battery Engineering

www.rollsbattery.com



Automated solar site models

Streamline the solar design process and focus on designing the PV system, not modeling the project site. Introducing the 3D Modeling service from Aurora Solar, an accurate all-in-one solar design and sales software. With Aurora's 3D Modeling service, solar contractors can now request a precise 3D model of a residential solar project site which will be ready in their account within 3 hours. The tool is a great option for hard-to-design sites or especially busy times.

Aurora Solar

www.aurorasolar.com



Solar field wiring

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. Plug in the panel strings, plug into the inverter, and just walk away.

Shoals Technologies Group

www.shoals.com



Single-piece, flat-base mounting system

Introducing the new Universal PowerMount-9000S to be used with virtually any R-Panel Roof System. The single piece design simplifies installation and reduces cost. The flat base allows the mount to be installed between ribs making it universal across all R-Panel metal roofs. Use the PowerMount-S with any manufacturer's L-Foot or Solar Connections' Universal L-Foot to attach any rail system. Go railless and use the Solar Connection Kit with their GroundBonding Technology. The SCI Kit is UL 1703 and UL 2703 listed and approved.

Solar Connections

www.solarconnections.com



Solar wire management clip

Nine Fasteners' newest solar wire management clip; NFI-1701 was designed in conjunction with Enphase Energy for use with IQ series of microinverters. This clip is a rail mounted solution capable of securing one or two IQ cables to the rail. It is also capable of holding one or two standard gauge PV wires. The clip, as with Nine's entire product line, is manufactured right here in the U.S. Constructed out of .025" thick 301 1/2 hard stainless steel material and incorporating a rolled outer edge for maximum wire safety. The NFI-1701 is UL Listed for use within solar installations.

Nine Fasteners

www.ninefasteners.com



Mounting solution providing value and performance

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UpTower Safety and Evacuation

What's the plan?

by Doron Fuchs (B.Sc.)

ONE OF THE CHALLENGES IN THE FIELD

of safety is being ready to evacuate an injured person at any time, and as quickly as possible. This is no simple task to perform - especially if that injured person happens to be at least 200 feet above the ground. Every emergency situation starts with a **first responder**. The first responder's job is to remain calm and lucid to determine what life saving procedures are required, and which are immediately available. Depending on his or her professional background (whether paramedic, MD, etc.) the first responder may not know how to treat all type of injuries. At this point, the site manager has called already for emergency services and alerted the rest of the staff on site.

The next major hurdle is evacuating the injured or incapacitated person before emergency help arrives, so that treatment can progress at ground level. Regardless of the **type of injuries**, the main objective is to avoid deterioration of the injured party until and during evacuation. The procedure should be immediate, quick and easy to perform, intuitive, well-rehearsed, and known to as many people on site as possible. Too many stories about wind turbine work accidents involve injured people that, due to incorrect or delayed evacuation, suffered complications from injury, and even death.

There are several classes of evacuation solutions; choosing the right one could be the difference between life and death. The best chance of avoiding worsening any injury requires the combination of a special harness and neck brace.

Basic evacuation solutions – ropes

Ropes are considered to be always present on site at a wind turbine, and are the most basic means of getting anyone safely to ground. They usually need to be brought up, as the team won't carry while climbing 80m on the ladder. However, they still require that specific procedures be followed and appropriate accessories used for manually controlling the descent. Evacuating from uptower requires that at least 3 rescuers be trained and qualified to safely move an incapacitated or injured person. Staff involved in this procedure must undergo regularly scheduled training and practice drills at least once a month. They have to be highly skilled in the rope climbing field. There may be significant delay before specialists can reach the site, along with the extra time needed to assess the situation and devise a rescue plan. The whole evacuation procedure may take between 2 to 4 hours, or longer.

Preinstalled evacuation solutions

Preinstalled equipment specially designed for evacuating the injured from uptower include descending devices combined with additional features for immobilizing the incapacitated.

These devices require at least one rescuer to accompany the injured party, another two rescuers that will know how to install it, as well as another rescuer to supervise the operation. The downside of utilizing something preinstalled is that it's neither appropriate nor available for sites that are dynamic, like construction sites or maintenance. Preinstalled descending devices normally need 3-4 qualified trained responders for safe operation.

This method of evacuation may take between 90 minutes to 3 hours to complete.

Portable Descending devices with internal rope control

As with preinstalled descending devices, the portable version requires at least one rescuer to accompany the injured person to the ground. Although it has the advantage of being available for use at dynamic sites, this equipment can't actually be left on the site until needed. Not only is it rarely carried by technicians, but it must be brought by the first responders.

Evacuation using a portable descending device usually takes anywhere from 60 minutes to 2 hours.

Brought to site descending equipment

This type of descent equipment usually consists of a tripod carrying a cable descent device. At least 3 rescuers are needed to operate this setup. Also, because it needs to be installed prior to use, it requires qualified installers. It provides safe evacuation at dynamic sites like construction sites or crane maintenance.

The entire procedure may take between 2 to 4 hours, or longer.

Portable Controlled descending devices

This solution adapts to any type of site. Not only is it portable, but it's rigid enough to be left on location. This device provides the added benefit of an automatic controlled rate of descent, as well as portable anchoring.

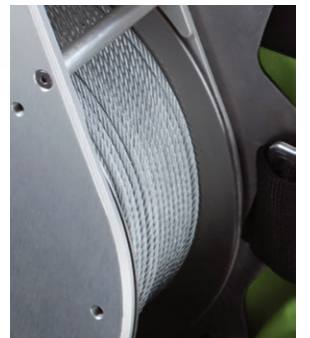
Special training is not necessary, since the design is more intuitive and allows for immediate use and quick evacuation. The injured person can be assisted by either a first responder or a peer.

This method of evacuation takes from 10 to 40 minutes.

Wind turbines are reaching dizzying heights - but whether you're moving a wounded person to ground level from 60 feet or 300 feet, you face the same basic problem: getting them down to safety as quickly as possible, with the least amount of danger to both first responders and the injured person. In order to conform with regulations and ensure the safest work environment, company owners and operators must choose the best evacuation solution available for their site and situation.

Doron Fuchs is the Director of International Sales & Business development for SkySaver. SkySaver manufactures a backpack with a safety harness that can safely lower a person to the ground from any height up to 260 feet, with a 520-foot model to be released shortly.

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AI and the Automated Future of the Wind Industry

by Chris Shroyer

As wind energy production picks up speed, owners and operators are finding themselves hyper-focused on managing infrastructure efficiently. Blades are a major component driving turbine efficiency. Damaged or worn blades lead to significant efficiency loss, so regular inspections have become critical. But with inspections comes data. Massive amounts of data.

Whether it is a large utility provider managing a fleet of hundreds, or a private company with several turbines or farms, owners and operators are buried in data. Processing data from a single inspection can take weeks, consuming valuable time that should be spent focusing on critical areas of generating revenue.

There's a new technology in the wind industry with a unique solution to data management and analysis challenges: artificial intelligence (AI). Industry leaders have been perfecting automated, machine learning technology developed specifically for the wind industry. This revolutionary AI breakthrough is cutting data analysis time by 75 percent or more. Let that sink in.

AI is game-changing technology that creates efficiencies and expands brainpower, giving teams extra time to focus on strategy or growth.

Delegate Your Data Analysis

Sifting through hundreds – sometimes thousands – of inspection images takes human teams several days or more. Categorizing, analyzing, and transforming this data into intelligence that influences maintenance and repair decisions, takes a significant amount of time and resources; the final result may still be lacking in consistency.

When data analysis is automated by AI, time spent in front of a computer screen is greatly reduced, freeing teams to refocus their energy on strategic priorities. This groundbreaking AI can process any type of image data, whether new data captured via drone or ground-scope, or legacy data that's backlogged and still waiting to be processed. AI is always learning - with each data set, it gets better at detecting and reporting anomalies.

Trust the Accuracy of Your Data

Regardless if you have the most talented team of analysts, human errors are unavoidable. A certain level of human fatigue exists when processing large amounts of data. Even the best can have their eyes glaze over after unending hours of analysis. It's human nature. That



Proprietary AI is able to extract damage and locate anomalies in less than optimal capture conditions.

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The Future of the Wind Industry is Automated

AI is allowing leaders in the wind industry to take back their time. Trusting the accuracy of data grants the ability to make smart decisions, fast. Blades can now be repaired economically, before small areas of damage become big problems that severely decrease efficiency. The solution to inspection data processing challenges is here and it's increasing our productivity, renewing our focus, and creating efficiencies greater than we ever thought possible.

Chris Shroyer is the President of BladeEdge, a cloud based, artificially intelligent analytics engine that uses inspection images, regardless of capture method, to transform raw data into actionable intelligence.

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means the possibility of errors always exists. Can you trust that your data is accurate? Can you trust the evaluation process? Can you guarantee that your team catches the same details in every inspection? AI can.

Automated AI analysis processes provide consistency in the evaluation of damages. Each inspection builds upon the last, creating the ability to track damage and wear over time, with currently 98.8 percent confidence in the accuracy of the data. Human brains don't work this way. We're innovators and problem solvers – not data processors.

Minimize Efficiency Loss

Wind energy is dependent on maximizing efficiency. Damage, wear, and blade degradation can lead to 5-25 percent efficiency loss, which translates to significant lost revenue. Any amount of efficiency loss adds up quickly; blades can degrade at an exponential rate if left unmanaged. The key to decreasing efficiency loss is catching damage early, and planning proactive maintenance and repairs – in short, you need data, and you need it fast. You don't have days to determine if you're looking at a smudge or dirt or hairline fracture. Every minute of inefficiency and downtime comes at a cost.

Possibly the most useful benefit of AI analysis is the capacity for fast, streamlined reporting. Automated reports are generated faster than ever before, with a level of sophistication that highlights the blades or turbines that need immediate attention – and with 98.8 percent confidence in data accuracy, you can trust that what you've reviewed is correct. There's no need to comb through the entire dataset. (Unless that's your thing - we're not saying you can't dive into the data, only that you don't have to anymore).



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Global Wind and Solar Fluctuations

The need for more detailed resource reporting

by Pascal Storck



WHAT DO RENEWABLE ENERGY PROJECT OWNERS

in India, Germany, and the USA have in common? The answer; in the summer of 2018, they all experienced first-hand just how fickle wind and solar resources can be as a source of fuel – and revenues.

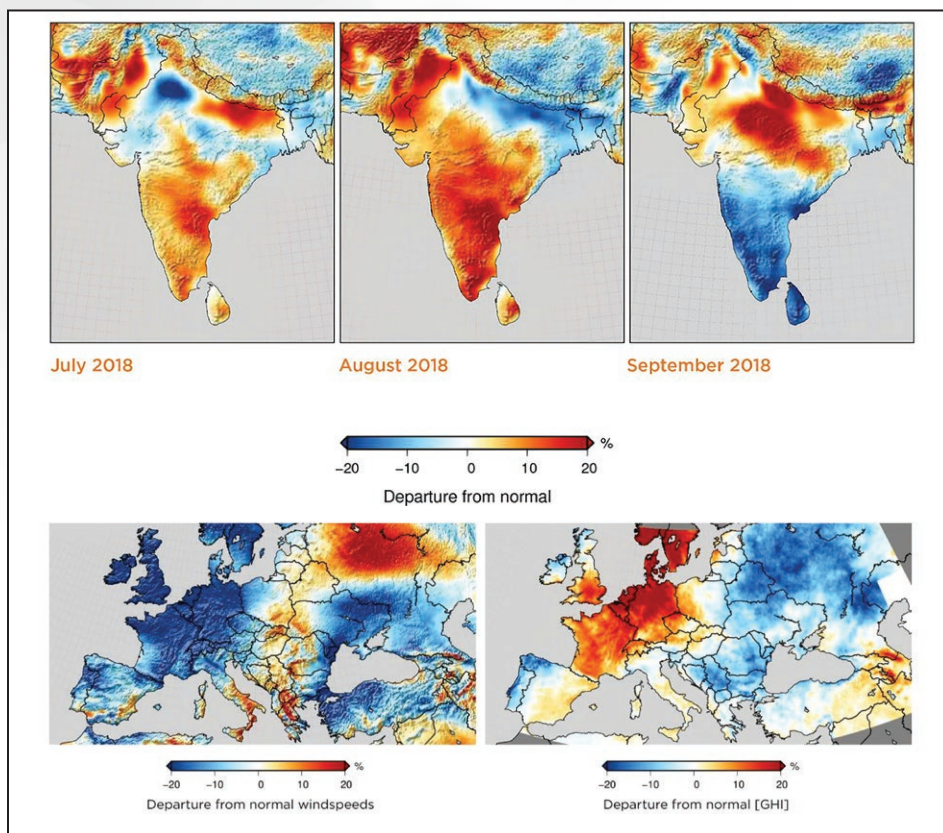
In May, wind energy operators in many regions of the United States saw wind speeds drop up to 20 percent below long-term averages – only to pick up again in June, with an almost complete reversal in key markets, like Texas and Oklahoma.

Throughout June, July, and August, European asset owners were affected by resource anomalies on an even greater scale than their American counterparts. The meteorological conditions behind the summer's heatwave in Western Europe contributed to a widespread 'wind drought'; wind energy project performance suffered in markets including the UK, France, Spain, Germany, and much of Scandinavia. These below-par winds were cited in the quarterly financial reporting of a number of major wind energy producers, at the end of both quarter three and quarter four.

At the same time, as one of Europe's hottest summers on record curtailed wind generation, solar plant performance in many of these countries increased. This striking example of 'negative correlation' between the wind and solar resource helped to 'plug the gap' in generation in Europe.

In India, wind farm owners experienced a change in fortune of a different kind. In July and August, after a prolonged year-on-year decline in wind speeds (during the annual monsoon season), the 2018 season brought significantly stronger winds. In key power markets, including Tamil Nadu and Andhra Pradesh, wind speeds were up to 20 percent above the long-term average recorded during the regions' traditional high-wind season.

The overall picture across all of these prominent wind markets is mixed. In each case, there are factors at play that could be used as evidence to support the argument that 'it all balances out in the long run.' However, such significant departures from



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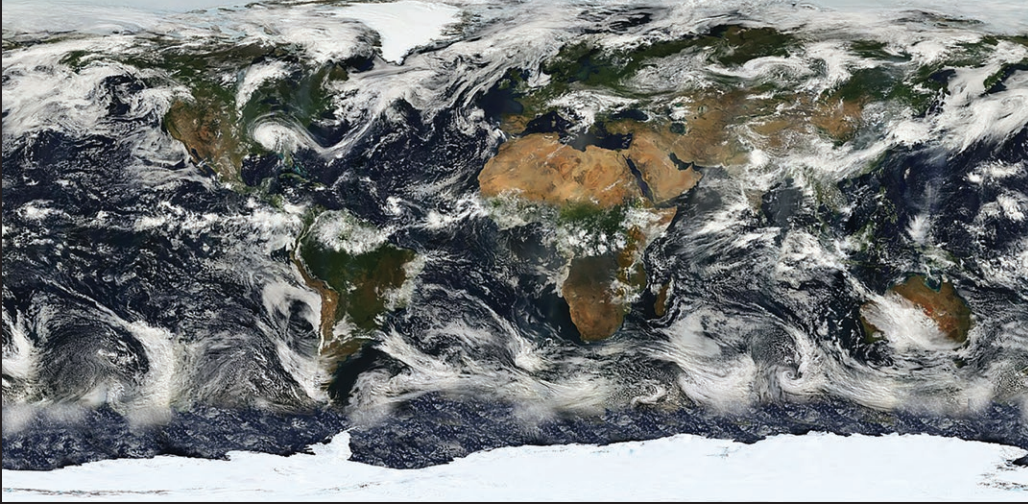
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long-term averages may not only create doubt over the use of these averages as a reference point, but also highlight the more immediate challenge operators face in financial planning. Even if resource anomalies were to balance out over the long run, this might not help asset owners whose individual portfolios may lose out.

Cumulative under- or overperformance has a significant impact on annual operating and financial results. It may also contribute to surprise shifts in project value, which can have potentially damaging effects on both shareholder value and investor confidence. The burden falls primarily on operations teams and asset managers to present data in the boardroom that gets to the bottom of exactly what factors have



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contributed to changing performance on a month-by-month basis, and to refine their financial forecasting accordingly.

Typically, pre-construction estimates of wind speeds and actual energy production figures are used to forecast a site or portfolio's energy production (the energy budget). Deviations in actual performance from the energy budget are easy enough to track, but, all too often, under- or overperformance is attributed to weather variation.

Abnormal wind speeds are regularly cited as a leading cause of underperformance in wind energy operators' financial reports, but more needs to be done to isolate and accurately quantify their effects. In doing so, we can more clearly understand whether other factors are at play, and help reduce financial uncertainty.

The first step to achieving this is to analyze how more recent weather anomalies – such as those seen in the USA, Europe, and India - have impacted projects on a portfolio-wide and project-by-project basis. Looking back in greater detail at what happened to the on-site resource during a given period of underperformance is fully achievable – and helps operators gain an overview of just how much resource fluctuations really made a difference.

In turn, project operators will benefit from greater flexibility and increased accuracy, allowing them to re-calibrate their energy budgets on a rolling, monthly basis. For the purposes of financial planning, and to avoid unpleasant surprises, situating performance in its short-term context is just as important as looking at pre-construction estimates and long-term averages.

In the absence of reliable data, it may be tempting to label unexplained differences in asset and portfolio performance as weather impacts. To deal with the impact of resource fluctuations on budgets, however, it's vital to seek a greater level of detail to support financial reporting.

Pascal Storck is Director, Renewable Energy at Vaisala, a global company that serves selected weather-dependent markets where accurate, real-time, uninterrupted, and reliable weather data is essential to run efficient operations.

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Reliable Insulation System for Wind Turbine Generators

by Jon Vaquerizo

Energy policies around the globe continue to focus on the increasing need for renewable energy, and the wind industry is at the lead of developing technologies. To remain competitive in the clean energy market, the Cost of Energy (CoE) must be considered, along with other main factors such as CAPEX, OPEX, reliability, and component lifetime.

Wind turbines include, in the nacelle, electric generators such as Doubly Fed Induction Generators [DFIG], Squirrel Cage Induction Generators [SCIG], and Permanent Magnet Synchronous Generators [PMSG]). One specific design has to perform under very different and demanding conditions in all kinds of environments: low/high temperature, standard/high altitudes, dust and desert conditions, low/high humidity levels, coastal areas with corrosion, and situations with chemical stressors. Even within the same wind farm, generators differ in performance depending on the power distribution layout. The life expectancy of components can be affected by external factors such as over-voltages. Additional operating inconsistencies in the field, like grid configuration, different frequency converter operation modes, and switching frequencies during synchronization/grid disconnection, are not always part of the specification requirements or insulation system evaluation standards.

The Electrical Insulation System (EIS) is critical in designing a generator, and a key factor in the life span of the component. Unfortunately, 95 percent of repairs cannot be addressed up-tower, so reliability is a must. It's always a trade-off when weighing the cost of the EIS against the need for safety and reliability. In order to reduce the time-to-market, EIS standardization is based on minimum requirements based on common standards such as IEC, MEMA, IEEE, and UL/CSA. Again, many of these standards are developed under ideal conditions, and don't account for all of the variables on site. This is where company experience comes into play, with the practice of total quality management (TQM), research and development (R&D) and continuous improvement (CI).

A standard strategy is to reduce the CoE for an existing wind turbine by delivering more power to the grid in various conditions. Generator and turbine manufacturers understand this; both work towards optimizing the all electrical system Average Energy Production (AEP). The generator always works harder under more demanding conditions, so the electrical insulation system has a big impact on the generator's lifetime, especially when considering today's "new normal" expectation of a 25-year component lifespan.

Having an EIS certified by a 3rd party laboratory, such as UL, is normally required for a



Image 1: Indar Electric 40kV and up to 300C equipment for EIS testing

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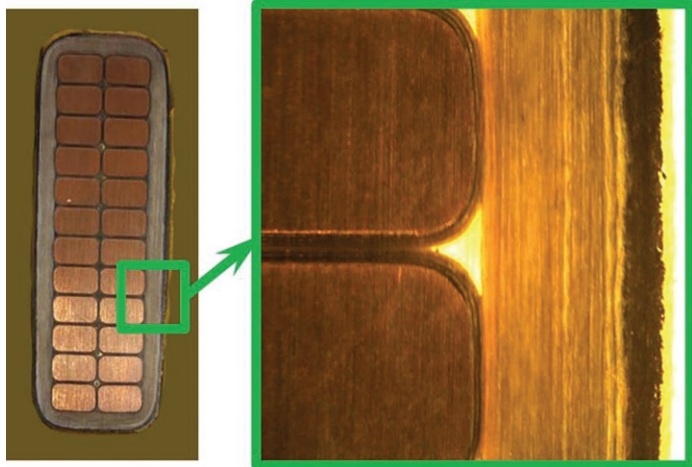


Image 2: Indar Electric macroscopic analysis (20x to 40x magnification) of coils after internal testing.

newly listed generator – most customers also expect this. Remember that this evaluation is just a baseline for the correct behavior for the life of the equipment. Gathering data from the SCADA systems goes a long way in understanding the real operating condition of the generator onsite. R&D must regularly perform laboratory testing to obtain the different regression curves for the EIS under different conditions (Electrical Ageing [EA], Thermal Ageing [TA], Thermal & Electrical-Ageing [TEA] (see image 1), Chemical Ageing [CA]. The Design Of Experiments (DoE) methodology also helps to identify the different effects of manufacturing parameters, design criteria, or new materials, all of which contribute to a reliable EIS.

In addition to the EIS electrical testing, complete diagnosis can be done using the following quantitative measurements: insulation resistance (IR), Surge Test, Dissipation Test, and Partial Discharges (PD). Individually, each test provides valuable information, but the total data offers a much better understanding of insulation behavior and evaluation during the previously mentioned tests. Macroscopic analysis (20x to 40x magnification) of coils tested – see image 2 – provides even more valuable information to help improve the manufacturing processes and materials.

With hundreds of generators reaching the 20-year point, it's time for an end-of-life assessment. Decisions will be data driven, using all available monitoring equipment and techniques. Having a clear footprint of the generator status will improve the accuracy of generator "real life" consumption, and guide risk analysis for its life extension.

Is your generator EIS ready?

Jon Vaquerizo is Global Technical Manager for Indar Electric's Wind Energy Business Unit. Indar Electric is a subsidiary of Ingeteam. With more than 75 years of industry experience (22 in the Wind Industry), the company has installed 29 GW in wind onshore to date. It maintains facilities in the USA (Milwaukee) and Spain (Beasain).

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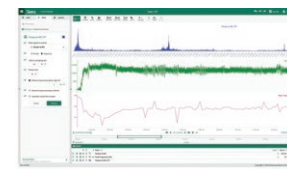


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Advanced analytics solution

Seeq Corporation's latest release, R21, is an analytics solution for process manufacturing customers. Seeq enables engineers and scientists in process manufacturing organizations to rapidly analyze, predict, collaborate, and share insights to improve production outcomes. New R21 features reflect both the growing use of Seeq for publishing analytics-based views to other employees, and the increased complexity of the use cases where engineers use Seeq. For publishing insights, Seeq has expanded "scorecards," a feature for the display of calculated tables in Seeq Workbench and Organizer. Scorecards are used for tabulated metrics, measurements, and other summary data, and may be presented in tables with conditional formatting support and user-defined columns, for example roll-ups by batch or plant. R21 also adds frequency analysis capabilities, often referred to as "FFT," to transform segments of a time-series signal into the frequency domain. Seeq users access the frequency analysis tool via an intuitive panel which guides them through the transformation process and displays results as a power spectrum, or they can access FFT functionality as a formula in Seeq's scripting environment.

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Conquering the Sub Layer Paradox

by Marc Breault



THE TERM “TERRA FIRMA” OFTEN ALIGNS WITH THE

sentiment of voyagers returning from adventures at sea, as they encounter relief from the solid ground beneath their feet. For those involved in the operations of industrial and infrastructure projects, such as road construction, the literal concept of terra firma translates to a variety of conditions, many of which directly affect the simple movements of people, the transportation of goods, and the access to areas where natural resources can be sourced.

Experts tasked with finding solutions to the many challenges of constructing reliable, safe, and long-lasting roadways and access points, deal with a vast number of factors that affect the quality and durability of these projects.

The energy and mining industries in western Canada are synonymous with the provisions of commodities across Canada, and throughout the world. Large plays, where valuable natural resources are sourced, are often in areas virtually inaccessible; unstable land foundations such as high-water tables and soft layers of earth, impede access to these locations. The performance and demands of the heavy equipment required to operate these regions rely on the foundations beneath them to be extremely sturdy. Which presents a paradox: how to create strength where virtually none exists.

Reportedly, construction industry consumes 16 percent of water, 25 percent of raw timber, and 40 percent of stones, sand, and gravel, as well as 40 percent of the total energy produced in the United States annually. Road construction is one of the major contributors to consumption of these materials. Construction requires a huge amount of resources that are costly, and hard to replace. The industry has been dealing with challenges such as the virgin aggregates mining, hauling to the construction site, and the process of onsite construction, along with the necessary heavy construction equipment (the emissions from which contribute to more carbon dioxide and other pollutants to the environment).

One innovative solution can be found in geocells. To overcome the issues faced by “sustainable construction”, geocells can minimize the need for virgin aggregate; in turn, this reduces the carbon footprint of the construction project. An expandable, honeycomb shaped, 3D system that can be infilled with different materials - such as sand, gravel Recycled Asphalt Pavement (RAP) and Recycled Asphalt Concrete (RAC) - provides a stiff layer that can support heavier loads. 3D confinement of material reduces the pressure applied to the subgrade soil, improving the modulus of the reinforced material by up to 7.5 times (for geocells comprised of a nano-polymeric alloy).

Geocell technology is not new. It made its mainstream debut in the late 1960s, during the Vietnam war. Developed by the US Army Corps of Engineers as a viable means to land heavy equipment on beaches, the technology was later licensed for civilian applications (following an evolution of alloy materials containing polyolefin, and engineering thermoplastic polymers). The resulting product has changed the way many roadway construction projects are being built. Benefits include substantive economic savings, as well as exponentially increasing the life and durability of the roadway.

In Alberta, Canada, notable projects include a 1000-meter roadway testing. The project was led by the University of Alberta near Nisku, where cement-treated base went head-to-head with a polymeric alloy product, to measure and contrast their destructive properties. Another project took place in the village of Ryley, Alberta, where a residential street was in grave need of rehabilitation. In both cases, geocell technology provided the solutions and savings - both economically, and in future maintenance requirements. The Ryley project realized a 10 percent savings on initial construction, 25 percent on asphalt required, 25 percent on excavation, and an overall 20 percent savings over conventional methods. By completion, CO2 emissions were reduced by 20 percent, along with a 50 percent reduction in long-term maintenance demands, and a 15 percent increase in support capacity.



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ILSCO /// www.ilsco.com



The 93,500kg of reduced CO2 emissions in this project alone, defines the successful conquest of the paradox of such projects' demands to achieve strength and difference.

All energy, mining, and forestry projects rely on heavy equipment. These types of projects are naturally situated in remote areas that depend on stable site access routes, and efficient and safe operations. Matting has long been a solution to contend with the needs of establishing a solid temporary ground surface. Matting has been useful to an extent, notwithstanding the challenges of extreme ground, and seasonal weather conditions. Load support design and construction for these apparatuses are crucial; they have become major geotechnical stumbling blocks, since they must be situated on stable foundations. Paradoxically, they're often situated on weak subgrades, wetlands, muskeg, or high water table areas.

With mats commonly weighing between 1,000kg to over 4,000 kg, the most durable mats are constructed using three-ply oak, softer woods (such as fir), or even steel, depending on the specific requirements of the project and equipment. Mats are quickly assembled on site with a solid core, resist wane, and can have a project life of up to seven years, depending on material used, how accurately it's installed and aligned to its appropriate need, and equipment loads.

Marc is President of two organizations - Paradox Access Solutions, and Stratum Logics. He is a serial entrepreneur who, drawing upon years of successful business experience, creates motivational corporate cultures of mentoring, hands-on training, and support, to transform vision into industry-leading enterprises. With six patents under his belt in the road building industry, Marc realized there were new technologies that would substantially reduce construction costs, while providing more sustainable solutions.

Paradox Access Solutions
/// www.paradoxaccess.com

Stratum Logics
/// www.stratumlogics.com



Energy management software

The technology group Wärtsilä announced the release of GEMS 6 (Greensmith Energy Management System, version 6), the latest generation of its software platform serving grid-scale deployments globally. GEMS 6 offers a set of capabilities used to integrate a broad array of generation assets including solar, wind, hydro, storage, and thermal. GEMS 6 is component-neutral to provide maximum flexible and has integrated 16 different batteries to date, each according to the application needs of each project. GEMS 6 can be used independent of energy storage. Using software-based intelligence and machine learning to enhance grid systems and networks, GEMS 6 offers a wide library of algorithms and applications. With GEMS, renewable energy sources and engine systems can now be equally modeled and simulated in a virtual environment using real-time data, which allows GEMS to be lab-tested, rather than on-site, and offers significant cost efficiencies in testing time, outages, and time-to-market. GEMS also integrates weather and load forecast data to optimize an entire grid system. GEMS can operate autonomously and automatically, based on either a rule-based engine or machine-learning, to act and function according to different or specific conditions sensed within integrated systems such as solar and/or the grid itself. GEMS is capable of processing more than 100,000 points of data per second in default mode and uses data analytics to improve the way in which it optimizes energy storage and the overall grid system into which it is integrated.

Wärtsilä Energy Solutions /// www.wartsila.com/energy

HEICO FASTENING SYSTEMS

The best value to secure bolts.

HEICO-LOCK® WEDGE LOCKING SYSTEMS

MADE IN GERMANY!

The **HEICO-LOCK® wedge locking system** is the reliable solution to the problem of **securing bolted joints** in high vibration assemblies against self-loosening by rotation!

WWW.HEICO-GROUP.COM



OH BABY! We have cut the cord on RAD Extreme Torque Machines. Come check it out at AWEA Windpower Expo Booth 3528.



- Range from 250 to 3000 ft/lbs
- Torque and angle feature
- Automatic 2-speed gearbox
- Programmable preset torque settings
- Latest Li-ion 18V battery
- High accuracy +/- 5%



WIND ENERGY SOLUTIONS

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- TURNKEY BOLTING SERVICES
- COMPLETE OEM TORQUE AND TENSION SYSTEMS
- BOLTING CONSULTATION SERVICES
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- REPAIR SERVICES FOR MOST TOOL MODELS
- DBRAD DIGITAL TORQUE CONTROL SYSTEMS
- ELECTRIC GEAR TURNING SYSTEMS
- WTG SPECIFIC BOLT TENSIONING SYSTEMS
- HYDRAULIC WRENCH SYSTEMS
- WTG SPECIFIC SELF LOAD INDICATING FASTENERS

info@torkworx.com

888.502.WORX

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Tensioners & Torque Systems

The proper alignment of a bolted joint can be achieved by using either torque or tension methods of bolting. Proper bolt loads must be realized during installation or the integrity of the joint will be compromised, leading to misalignment and, if left unchecked, the ultimate failure of the joint. In this issue, we look at some of the tensioners and torque systems available today.

SEE AD ON PAGE 61



Torkworx, L.P.

Product: Multi-schedule Base Bolt Tensioner

Description: Multi-schedule Tensioning Systems can accommodate #9, #10, #11 75Ksi, and 90Ksi plus 1-1/4" and 1-3/8" 150Ksi Grade Base Bolt hardware.

Bolt Diameter: #9, #10, #11, 1-1/4", and 1-3/8"

Stud Protrusion: 10" (254mm)

Max Stroke: 0.7" (18mm)

Max Load: 140,000lbs (622kN)

Hydraulic Pressure Area (in²) & (mm²): 6.74" (4350mm)

Outside tool diameter: 5.19" (132mm)

Overall height: 8.74" (222mm)

Overall distance between stud CLs: 4.37" (111mm)

Weight: 25 lbs (11.38kg)

Key Features:

- Elliptical design fits very narrow applications;
- Built in Stroke Limiting Valve - No over-stroking;
- Built in Cycle Counter for accurate usage tracking;
- Dual purpose aluminum handle serves as an ergonomic handle for moving the tool and protects the hydraulic connection from damage. In case of failure, the hose cannot eject from inside handle.

www.torkworx.com

SEE AD ON PAGE 64



ITH Engineering

Product: ITH Bolt Tensioning Cylinder

Description: ITH bolt tensioning cylinders are designed for tightening large diameter bolts of all major OEM wind turbine applications including: foundation rods, tower bolts, bearing bolts, and more. High accuracy and repeatability ensures consistent even loads throughout bolted joints. Combine with the Micro-MAX pump for a lightweight and compact bolting system.

Bolt Diameter: M16 and larger

Key Features:

- Designed with OEMs for all turbine applications;
- Lightweight and compact designs;
- Patented safety features;
- High load accuracy and repeatability;
- Fast operation using one or multiple tensioners simultaneously.

www.ith.com



Norwolf Tool Works, Inc.

Product: X-Driver System

Description: The X-Driver system is a multi-patented, double-acting hydraulic torque wrench based on a power head that works with 3 different drives: A Drive - low profile hex ratchet, M Drive - low profile cassette, and V Drive - square drive. A slim, fast, easy, and versatile hydraulic wrench.

Power System: Hydraulic

Drive Size: Assorted

Torque: Assorted

Weight: Assorted

Noise Level: Assorted

www.norwolf.com



Emerson

Product: Professional-Grade Greenlee Torque Screwdriver

Description: Greenlee's new torque screwdriver meets the 2017 National Electric Code (110.14D), and the torque driver in the set is calibrated within tolerance according to ASME B107.300-2010. The kit includes a dozen Phillips and Slotted 3.5" and 6" shank sized bits and seven preferred 6" shank sized nut drivers.

Power System: Handtool

Drive Size: Varies

Torque: 5 to 40ft/lbs

www.greenlee.com/newdrivers

ACRADYNE DELIVERS High Tech for High Torque

Critical bolting demands tools that deliver high torque with SUPERIOR PERFORMANCE. AcraDyne's Controller combined with the HT Series tools features a bolting system that beats the competition in accuracy, speed and safety.

- Built-in transducer at the square drive, for optimal monitoring and control
- 100 times faster than the hydraulic competition
- One of the most accurate high-torque tools in the world today
- 250 Nm-12,000 Nm — in Pistol, Angle, and Inline models
- One of the world's ONLY traceable system at the square drive—Accurate & Traceable Data
- Designed and MADE IN THE USA

FOR MORE INFORMATION CALL www.AIMCO-GLOBAL.com 1-800-852-1368 **AIMCO**



alki TECHNIK GmbH

Product: alkitronic EFCip / ECWip Electric Torque Multipliers

Description: alkitronic EFCip / ECWip Electric Torque Multipliers from 60 to 6,500Nm. Consistent torque accuracy on all international power supplies. Precise shut-off with on-site voltage-controlled portable generators. Models ECWip angle tools low height for restricted access applications.

Power System: Electric

Torque: 45 to 4,795 ft/lbs (60 to 6,500Nm)

RPM: 70 to 3 RPM

Weight: 20lbs to 40lbs (9kg to 18kg) without DMA

www.alkitronic.com/en

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Norbar Torque Tools

Product: EvoTorque 2

Description: The EvoTorque 2 has the ability to memorize multiple targets, work IDs, user IDs, and readings. The unique Audit Mode is a sophisticated feature for testing pre-tightened bolts with minimal impact on the original fastening torque.

Power System: Electric versions for 110Vac or 230Vac

Drive Size: 3/4" to 1"

Torque: 100 lb/ft to 4500 lb/ft; 135 to 6101Nm

RPM: 12

Weight: 23lbs (10.4kg)

Key Features:

- Factory calibrated and certified to $\pm 3\%$ accuracy regardless of fluctuating voltages;
- 3000 readings in internal memory, time, and date stamped;
- Includes PC software 'EvoLog' for data management and tool configuration;
- Measures in Torque, Torque and Angle, and Torque Audit mode for pre-tightened bolts;
- USB and Bluetooth 4.0 data transfer (also called Bluetooth Smart).

www.norbar.com

SEE AD ON PAGE 64



ITH Engineering

Product: Hydraulic Torque Wrench type CX

Description: ITH type CX is an ultralight wrench system that maximizes speed and versatility. The ultralight housing and TWIN swivel hose connection make handling easy. The quick-release reaction arm has an asymmetrical shape and can be flipped to shorten or lengthen its reach in addition to 360° rotation.

Power System: Hydraulic

Drive Size: 3/4" to 2 1/2"

Torque: 1475 to 29,500 ft/lbs (2,000 to 40,000Nm)

Weight: 4.6lbs to 75lbs (2.1kg to 34kg)

Key Features:

- High-speed dual-hose operation;
- Ultralight housing;
- Quick-release reaction arms and drive inserts;
- Asymmetrical reaction arm can be flipped and rotated 360°;
- TWIN swivel hose connection.

www.norbar.com



Stahlwille Tools, LLC

Product: Stahlwille Manoskop 730 Quick

Description: A time proof torque wrench with long term accuracy and no need to reset to zero due to the wear resistant mechanism design. This torque wrench now comes with improved features such as an ergonomic handle, and provides quick and easy setting of required torque. Quick adjustment from outside, no disassembly needed.

Power System: Manual

Drive Size: 1/4", 3/8", 1/2", 3/4"

Torque: 5 to 812ft/lbs; 6 to 650Nm

Weight: 1.8lbs to 7.2lbs (0.8kg to 3.3kg)

Noise Level: 75db when click of torque wrench is triggered

www.stahlwille-americas.com

Enerpac

Product: ETW-Series Electric Torque Wrenches

Description: ETW-Series Electric Torque Wrenches are well suited for complex jobs which demand precision and traceability. This tool features an easy to use touch-screen control box and easy to access controls on the back of the wrench. All are shipped with a calibration certificate.

Power System: Electric

Drive Size: Square drive range 1" to 1 1/2"

Torque: Min. Torque of 200ft/lbs (270Nm) to 1200ft/lbs (1625Nm); nominal torque of 1000ft/lbs (1355Nm) to 6000ft/lbs (8135Nm)

Weight: 18lbs to 42.1lbs (8.2kg to 19kg)

www.enerpac.com



Atlas Copco

Product: Revo HA

Description: The Revo HA is a swiveling transducerized tool. It uses traceability, angle control, and monitoring to assure perfect joint quality. These high torque models can operate at comparatively high speeds. With multi torque setting buttons and operator feedback on the display, the tightening process is shortened greatly.

Power System: Electric

Drive Size: 3/4" to 1 1/2"

RPM: 10 to 65

Weight: 14lbs to 29lbs (6kg to 13kg)

Noise Level: <70db

www.atlascopco.com/en-us/itba

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AcraDyne, a division of AIMCO

Product: AcraDyne GenIV Critical Torque System

Description: AcraDyne's critical torque system is an advanced bolting/tool system. The iEC Controller/Tool system measures traceable, dynamic torque directly at the square drive. The built-in transducer ensures accurate torque values. The system works with all AcraDyne tools, covering torque ranges up to 12,000Nm.

Power System: Electric 110V or 220V

Drive Size: 1/4" to 1.5"

Torque: 1 to 8850ft/lbs; 2 to 12,000Nm

RPM: 3.5 to 1481 RPM

Weight: 2bs to 52.5lbs (1kg to 24kg)

Noise Level: <66db (A)

Key Features:

- Compatible AcraDyne high torque tools available in 5 handle configurations;
- Program up to 256 parameters with as many as 20 steps per parameter;
- Programmable strategies including Torque Control, Angle Control, and Yield Control;
- Controller is self-contained in weatherproof, rugged carrying case;
- Torque delivery and accuracy is unaffected by changes in gear efficiency, normal tool wear between calibrations, temperature, voltage, or motor performance.

www.aimco-global.com

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RAD Torque Systems

Product: E-RAD Blu Torque Wrenches

Description: The E-RAD Blu precision torque wrenches are designed to provide a high degree of accuracy (+/- 2.8%) and repeatability (+/- 2%). These advanced electronic pistol grip torque wrenches combine the legendary RAD gearbox design and AC Servo motor technology to reduce bolting time up to 300%, as compared to conventional hydraulic wrenches.

Power System: Electric 120V or 230V

Drive Size: 3/4" to 1.5"

Torque: 100 to 7500ft/lbs; 135 to 10,000Nm

RPM: up to 30 RPM

Weight: 11.9lbs to 33lbs (5.4kg to 15kg)

Noise Level: 75db

Key Features:

- High accuracy +/- 2.8%;
- Data collection;
- Interchangeable handles per controller;
- Password protection;
- Bluetooth connectivity with RAD Smart Socket.

www.radtorque.com

SEE AD ON PAGE 61



Torkworx, L.P.

Product: DBRAD3000-2

Description: Digital B-RAD powered torque wrenches are digital, cordless, and lithium-ion battery tools. With advanced, patented technology containing digital display and single increment torque settings, they also offer a torque and angle option.

Power System: Battery

Drive Size: 1"

Torque: 250 to 3000 ft/lbs; 350 to 4000Nm

RPM: 13

Weight: 13.6lbs (6.2kg)

Noise Level: 80

Key Features:

- Programmable preset torque settings;
- Latest lithium-ion 18V battery technology;
- High accuracy of +/-5%;
- Automatic 2-speed gearbox;
- Torque and angle available.

www.torkworx.com



Snap-on Industrial

Product: 3/8" Drive Speeder Handle Flex-Head Ratchet

Description: The 3/8" Drive Speeder Handle Flex-Head Ratchet acts as two tools in one with the flex-head ratchet with an offset handle and a speeder. This design makes the ratchet a fast way to manually tighten or loosen fasteners.

Power System: Manual

Drive Size: 3/8"

Torque: 100 ft/lbs (recommended working torque)

Weight: 1.2lbs (0.54kg)

www.snapon.com/industrial



Ingersoll Rand

Product: QX Series Cordless Torque Multiplier

Description: Transducerized, programmable cordless precision bolting tool with full data recording and wireless capabilities

Power System: 20V power platform with brushless motors

Drive Size: 3/4" to 1"

Torque: Up to 1,475ft/lbs (2000Nm)

Weight: 8lbs to 15lbs

Noise Level: <70 dB(A)

www.ingersollrandproducts.com/QXM



PROTO Industrial Tools

Product: PROTO Precision 90 Micrometer Torque Wrench

Description: The new PROTO 1/4" and 3/8" Drive Precision 90 Micrometer Torque Wrenches feature a 90-tooth ratcheting head and a torque range of 40-200 in/lbs. These torque wrenches are designed to reach 1/4" and 3/8" drive fasteners in obstructed areas as its 90 tooth ratcheting head allows for a mere 4° arc swing. Built in Dallas, TX, the PROTO Precision 90 Micrometer Torque Wrenches meet stringent industrial specifications and are calibrated for reliable accuracy.

Drive Size: 1/4" and 3/8"

Torque: 40 to 200in/lbs

Weight: 2.7lbs (1.22kg)

www.protoindustrial.com



Tension & Torque tools for Wind Turbines

- Bolt Tensioning Systems
- Torque Wrench Systems
- Nut Runners (Torque Multipliers)

Micro-MAX
The compact, lightweight tensioner pump



Type CX
Ultralight, high-speed torque wrench



www.ith.com • sales@ith.com • (815) 363-4900



Chicago Pneumatic Tool Co.

Product: Titan Hydraulic Torque Wrenches

Description: Titan's hydraulic torque wrenches are powerful, accurate, durable, robust, and efficient. They are cycle tested under load and then calibrated and certified with trace ability.

Power System: Hydraulic (powered by electric or pneumatic)

Drive Size: 1/2" to 3 1/2" square drive, 7/8" to 6 1/8" hex drive

Torque: 197 to 43,000 ft/lbs; 267 to 59,308Nm

Weight: 5.65lbs to 120lbs (2.56kg to 64.3kg)

www.cp.com

2019

ENERGY STORAGE BUYERS GUIDE



Image provided by:
NEC Energy Solutions /// www.neces.com

DIRECTORY

BATTERIES

- AGM
- All Iron Flow
- Lead Acid
- Li-Ion
- NiCd/NiMh
- Redox Flow

BATTERY ENERGY STORAGE SYSTEMS (BESS)

BATTERY MANAGEMENT SYSTEMS

BATTERY TESTING, INSPECTION, SAFETY

CAPACITORS

CHARGING TECHNOLOGY & DEVICES

COMPONENTS

CONTROLLERS

COOLING | THERMAL MANAGEMENT

CRYOGENIC ENERGY STORAGE

ELECTRICAL ENERGY STORAGE

ENERGY STORAGE METERING

ENERGY STORAGE SYSTEMS

- Commercial
- Grid-Connected
- Off-Grid
- Residential

ENGINEERING CONSULTANT

EPC SERVICES

FUEL CELLS

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INVERTERS

MECHANICAL ENERGY STORAGE

POWER ELECTRONICS FOR STORAGE SYSTEMS

PROTECTIVE RELAY

SOFTWARE SUPPLIER

STORAGE PRODUCTS AND SERVICES

TESTING | CERTIFICATION

THERMAL ENERGY STORAGE

TOOLS

VALVES & SYSTEM COMPONENTS

WIRE & CABLE

OTHER

- Education

Batteries - AGM



Battery Systems

Battery Systems has over 50 locations in the United States providing their customers with service and sales on battery and charger brands like Centennial, US Battery, Trojan, Odyssey, Optima, Noco, Lester, and more.

www.batterysystems.net



Leoch Battery Corp.

Leoch's new LC and LRC Series offer high performance in partial-state-of-charge (PSOC) applications and a long deep cycle life up to 4000 cycles @ 60% DoD. These energy efficient, high capacity AGM batteries use Advanced Carbon Technology for enhanced performance and longevity. The LC and LRC Series are suitable for use in off-grid photovoltaic (PV) systems, peak load shifting energy storage systems, load tracking energy storage systems, and a variety of other applications.

www.leoch.us



Sun Xtender Batteries

PVX-4050HT is the newest member of Sun Xtender Deep Cycle AGM Batteries in the renewable energy product line. This is an L-16 battery size, a 6V option used in both grid-tied and off-grid renewable energy storage systems. PVX-4050HT has a high capacity in the 6V renewable energy battery series. Sun Xtender has designed high density plates specifically for renewable energy applications, reducing impedance and improving charge acceptance for efficiency, reliability, power, and extended life. Sun Xtender exclusively manufactures Deep Cycle AGM (Absorbent Glass Mat) sealed batteries. These batteries never require watering and pose no risk of spilling. Sun Xtender batteries ship Hazmat Exempt and are 100% recyclable. Sun Xtender batteries are manufactured in the USA by Concorde Battery Corporation and built to the same demanding standards required by the aerospace industry.

www.sunxtender.com

Batteries - All Iron Flow



ESS Inc.

ESS Inc.'s 50kW/400kWh Energy Warehouse (EW) iron flow battery is a long-duration (4+ hours) energy storage system providing energy and power solutions for C&I, utility, and microgrid/off grid applications. The EW is capable of up to 8 continuous hours of energy delivery with a 20+ year operating life and no capacity degradation. Composed of iron, salt, and water for its electrolyte, the EW is a safe, long-lasting solution with a low levelized cost of storage per kWh.

www.essinc.com

Batteries - Lead Acid



Crown Battery Manufacturing

CROWN1 batteries are engineered and optimized for deep-cycling in renewable energy applications. They are 98% recyclable. Crown's process incorporates recycled lead and plastic, along with green energy from solar panels, wind turbines, and geothermal cooling. To ensure quality, every CROWN1 battery is manufactured at the company's ISO 9001:2015-certified headquarters in Fremont, Ohio, USA. CROWN1 maintenance-free batteries are built using robotic assembly, the industry's heaviest plates, and more active material. This allows for more chemical reactions, enhancing performance and lifespan. Proprietary cast-on-strap systems deliver 100X the precision of manual welding, for improved longevity and reliability. CROWN1 offers 6-, 8-, and 12-volt models with 33-390Ah (20-hour rating) capacities.

www.crownbattery.com



EnerSys

EnerSys provides stored energy solutions for industrial applications. They manufacture and distribute reserve power and motive power batteries, battery chargers, power equipment, battery accessories, and outdoor equipment enclosure solutions to customers worldwide.

www.enersys.com



Genorex

Genorex has developed a VRLA Smart Battery with an integrated battery management system designed to work with uninterruptible power supplies (UPS) or other stationary applications. Integrated into the Smart Battery is Genorex's integrated Battery Management and Care System (iBACS), which allows users to control performance of each individual battery. Genorex offers an 8-year warranty on the 10-year design life of each battery as long as its iBACS system is installed and used correctly. Other key features of the Smart Battery include measurement data that can be determined without contact, so even a 100% insulated system still allows access to measured data. This means historical battery monitoring data is collected at all times. The battery improves the performance of lead-acid batteries in UPS systems by 20%, closing the capacity gap in performance with lithium batteries, while delivering reliability and safety. The company says it will seamlessly replace 7Ah batteries in most applications.

www.genorex.de



GS Battery USA

GS Battery (U.S.A.) Inc. is an American subsidiary of GS Yuasa Corporation in Japan, a manufacturer of motorcycle and standby storage batteries. Their advanced Nano-carbon VRLA batteries (SLR) are especially designed for PV use and deliver 5,000@DoD 70% cycle performance. Over 19 years of life has been proved by IEC61427. They offer batteries with rack system from 12kWh to upper size and provide flexible system design, safety, and reliability at an economical cost.

www.gsbattery.com/renewable

Narada



Narada

Narada, established in 1994, is a battery manufacturer and global battery supplier of Lead Acid and Li-Ion Industrial batteries. Narada provides long-cycle life OPzV, REXC (Lead Carbon) VRLA series batteries, and LiFePO4 lithium battery systems, packaged with advanced intelligent battery management system technology. Narada offers solutions from large-scale, up to MW, containerized energy storage systems (ESS), to residential solutions.

www.mpinarada.com



Newmax Battery

Newnan Battery's thixotropic nano carbon GEL technology provides for a true maintenance-free GEL battery. Their enhanced AGM VRLA battery is an energy storage and power backup solution.

www.newmaxbattery.co.kr



Rolls Battery Engineering

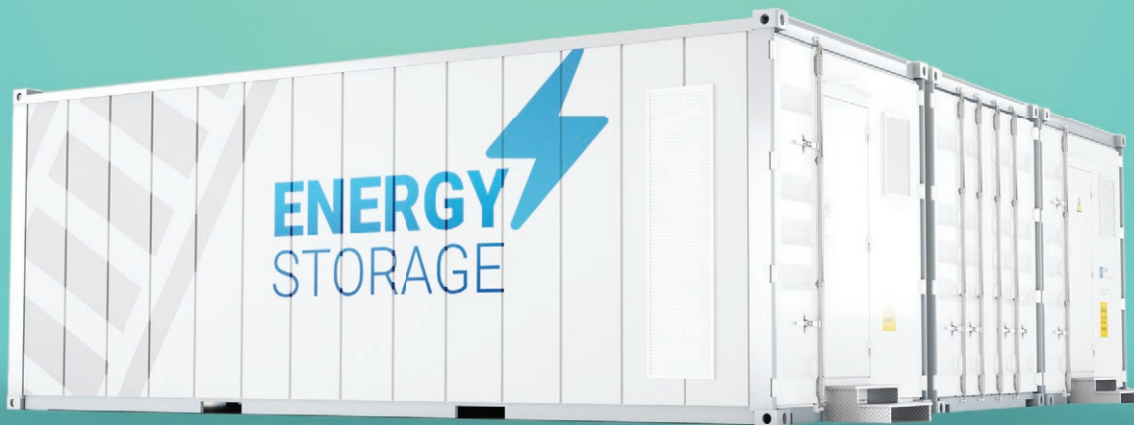
Designed to deliver reliable energy storage in residential and commercial off-grid and backup applications, Rolls 4000 Series 6 volt S6 L16-HC flooded deep cycle battery (428 AH capacity) offers durable, high-quality construction and high cycle life in the L16 case size, backed by a 3-year full replacement manufacturer warranty.

www.rollsbattery.com

THERMAL MANAGEMENT SOLUTIONS

for Energy Storage Systems

Help prevent thermal runaway & optimize ESS performance with Circulating Liquid Cooling from **HOTSTART**



HELP PREVENT THERMAL
RUNAWAY AND FIRE RISK



MAINTAIN PERFORMANCE
IN VARIOUS
ENVIRONMENTS



MAXIMIZE CHARGING
AND DISCHARGING
CYCLES



INCREASE OVERALL
BATTERY LIFE



cleanenergy.hotstart.com



Tydrolyte, LLC

Tydrolyte is a novel, safe, and high performing electrolyte solution for automotive, motive, and stationary storage lead battery manufacturers. Tydrolyte is a drop-in replacement for toxic sulfuric acid in lead batteries that improves performance by extending battery life through lower water loss and corrosion, as well as increasing efficiency and charge acceptance. It can be easily adopted by lead battery manufacturers without additional capital expenses or production technology.

www.tydrolyte.com



Zhongzhou Kanglida Electronic Power, Co. Ltd.

Kanglida has 4 series; 2v, 4v, 6v, and 12v batteries with capacity from 0.8ah to 3000ah. Kanglida provides sealed lead acid batteries, gel batteries, and maintenance-free batteries. Kanglida batteries are primarily used for solar systems, wind power systems, UPS, telecommunications, alarm systems, and lighting systems, among others. Kanglida batteries come with a one-year warranty from the date of purchase. Kanglida also offers OEM service.

en.kanglida-battery.com



Imperium3

Imperium3 is a global consortium of expertise in battery cell technology, LIB production, and raw material supply chain solutions. Imperium3 begins with patented lithium ion technology, which delivers increased capacity, long life cycle, high voltage, and improved safety, at a low cost of ownership and green manufacturing. With this technology as its foundation, Imperium3 has set out to deliver LIB production in the US and achieve 1GW per hour output by 2020.

www.im3.com



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 the stable, high-quality chemistry, Lithium Werks' U-Charge family of 12V, 24V, and 36V modules have an extended cycle life and float life, suited for energy storage markets such as renewables and UPS. Through this 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. The lithium iron phosphate batteries are fast-charging and safe energy storage solutions.

www.lithiumwerks.com



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



Durr MEGTEC, LLC

Durr MEGTEC is a global turnkey supplier of custom single-side or simultaneous two-side coating lines, drying systems, and environmental solutions. Durr MEGTEC has developed solutions for applications in lithium-ion battery electrodes, fuel cells, advanced composites, battery separators, solar films, membranes, clean room processes, and others. Its GigaCoater wide-web coating line for lithium-ion battery electrodes provides high-volume production of battery electrodes, with each GigaCoater capable of producing up to 3GWhr of electrode capacity per year on average. Durr MEGTEC has also developed an easy-to-use laboratory coating line designed for short production runs. In addition, they offer a complete range of pollution control equipment consisting of oxidizers, solvent recovery systems, and distillation and purification systems.

www.durr-megtec.com



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

POWER.PLANT.





CROWN
RENEWABLE POWER
BATTERIES





When you're going off-grid you become the power plant.

And when you need a battery to provide your power needs, depend on the best: **Crown Battery**. Thick energy-dense plates. Heavy-duty construction. More active lead materials. Proven low-maintenance performance. It all adds up to one **World Class Battery. Crown.**

CONTACT US FOR DETAILS: +1.419.334.7181 / commercial@crownbattery.com / www.crownbattery.com

Batteries - Redox Flow



VRB Energy

VRB Energy's vanadium redox battery (VRB) systems store energy in liquid electrolyte in a patented process based on the reduction and oxidation of ionic forms of the element vanadium. This is a repeatable process that 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

Battery Energy Storage Systems (BESS)



Atlantic Clean Energy Supply

ACES' Battery Energy Storage System (BESS) is a commercial PCS system offered in 30kW/50kW/100kW/150kW or larger. They also provide a variety of affordable batteries, including lead-acid, AGM, Gel, and Li-ion. They can also provide less than 10kWh on/off-grid system solutions.

www.atlanticces.com



MGX Renewables

MGX Renewables has created a modular Energy Storage System designed to deliver backup power in the range of 5kW to 100kW over extended periods of time. With the advantage of rechargeable zinc-air fuel cell technology, the system can be configured to support a wide range of discharge power, recharge power, and duty cycle requirements. An independent Battery Management System enables the system to be configured for any AC/DC, load/source environment.

www.mgxrenewables.com



NantEnergy

Zinc-Air batteries provide resiliency and reliability to wireless communication networks (telecom towers, Central Office, and Data Centers/Fiber hubs), backup power, and voltage/frequency regulation for utilities, and new electricity generation for rural/island locations. The batteries use electricity generated from solar panels in the charge process to convert zinc oxide to zinc and oxygen, with the zinc serving as a storage form of energy.

www.nantenergy.com

NEC



NEC Energy Solutions

NEC Energy Solutions, headquartered in Westborough Massachusetts USA, designs, manufactures, and integrates smart energy storage solutions for the electric grid and other applications with critical power needs. With over 700MW of energy storage installed, contracted, or awarded, NEC Energy Solutions provides megawatt-scale energy storage and proprietary software control systems that support the operation of the grid, while enabling more wind and solar generation to be installed.

www.neces.com

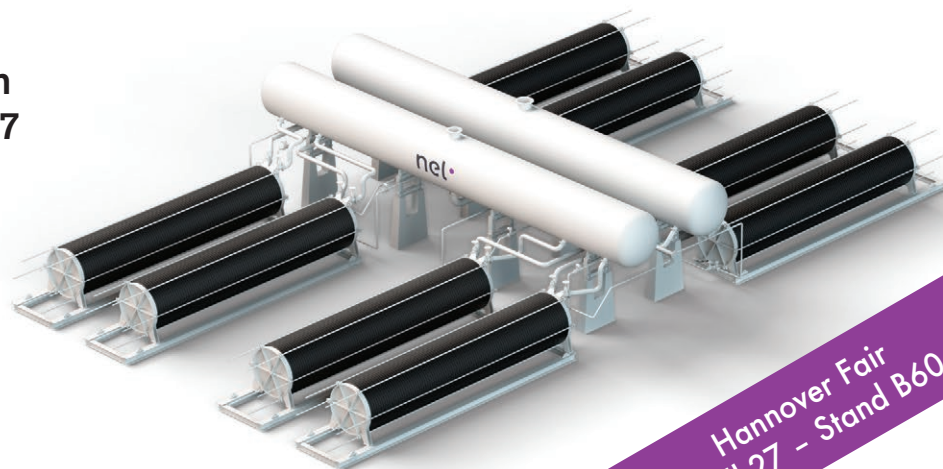


THE STORAGE REVOLUTION

Stop curtailing excess power. Nel Hydrogen electrolyzers will help save lost energy, balance electric output and increase your bottom line.

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NR Electric

As an integrated energy storage system provider, NR Electric offers a Battery Energy Storage System (BESS) solution with high safety, reliability, and flexibility. NR's PCS, certified by UL, G59, and TUV, is able to connect any battery type or energy medium such as Lithium-ion, Lead-acid, Sodium sulfur, Vanadium redox, and Zinc-bromine. Proprietary control algorithms with utility grade BESS controller and energy management software enables a variety of energy storage applications and optimize system efficiency and performance.

www.nrec.com



Solar Turbines

A Caterpillar Company

Solar Turbines

Designed specifically for industrial service, the Solar Energy Storage is a compact product that features high storage density that can be integrated into new or existing facilities. The Solar Energy Storage system is a complete system solution with an integrated fire detection and suppression system and a 2 x 100% HVAC system for a wide ambient range installation. Plug and play design features are incorporated throughout, minimizing installation and commissioning time.

www.solarturbines.com

Battery Management Systems



Nuvation Energy

Developed in consultation with battery manufacturers and energy storage system integrators, Nuvation BMS is a configurable battery management system that meets the demanding requirements of today's energy storage systems. In addition to providing precise cell balancing and robust communications with power conversion systems, this utility-grade BMS includes intelligent stack management features that are typically found only in custom-developed controllers.

www.nuvationenergy.com



Storage Battery Systems

The EqualLink Battery Management System from SBS actively manages batteries to increase reliability and extend life. EqualLink monitors the voltage, internal resistance, and temperature of each battery in a stationary battery system. Through a patented balancing process, EqualLink actively regulates the float charging current of each battery, ensuring all batteries charge at the optimal voltage. Easy to set up and configure, EqualLink is designed for many battery applications.

www.sbsbattery.com

Battery Testing, Inspection, Safety



The Knowledge. The Equipment. The Solution.

Advanced Test Equipment Rentals

Advanced Test Equipment Rentals (ATEC) supplies a large selection of power supplies, loads, grid simulators, precision power analyzers, variable transformers, battery test systems, and electrical test and measurement equipment for the energy storage industry. ATEC is an A2LA ISO 17025 accredited for calibration company providing a high level of reliability, friendly and knowledgeable service, and next day deliveries.

www.atecorp.com



DNV GL

DNV GL's global energy storage experts work with manufacturers, utilities, project developers, communities, and regulators to identify, evaluate, test, and certify systems that will integrate seamlessly with today's grid. Through their dedicated labs and expertise around the world, they have created a combination of analytical and testing experience to help find energy storage solutions.

www.dnvgl.com/storage

Capacitors



Cornell Dubilier Electronics

Next generation inverter designs for renewable energy demand reliable DC link capacitors with higher capacitance values, voltage, and current ratings. Available in new case sizes and ratings, Cornell Dubilier's Type 947D power film capacitors offer high bulk energy storage, ripple filtering, and life expectancy for wind and solar power inverter designs, as well as electric vehicle applications. Clients can select from hundreds of standard catalog listings, or connect with CDE engineers to develop special designs to their requirements.

www.cde.com

Charging Technology and Devices



SolarEdge

Based on patent-pending technology, SolarEdge's inverter-integrated EV charger charges by supplementing grid power with PV power via a single inverter. Offering a solar boost mode, SolarEdge's Level 2 EV charger offers charging 6x faster than a standard Level 1 charger. SolarEdge's HD-Wave inverter with an integrated EV charger provides management and monitoring of solar production, while enabling EV charging from a single inverter and dashboard.

www.solaredge.com/us

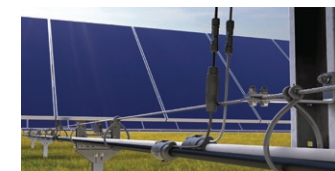
Components



Mersen

With the continuous growth of demands for DC battery-related applications such as Energy Storage facilities and Electric Vehicles, comes the need for better operation management and fault clearing of such loads. Mersen offers a wide range of DC overcurrent protection solutions based upon incumbent technology (DC fuse) enhanced by two new disruptive hybrid devices. These three product families are designed to safely clear both high and low DC fault currents for today's demanding DC systems.

ep.mersen.com



Shoals Technologies Group

The BLA is a component harness which makes use of the Shoals In-Line fuse and wire welding manufacturing process, and offers a site that is free of DC string combiners. All of the load is combined in the large conductors that typically run between the string combiner and the inverter. There is no need to trench for DC feeders or hang string combiner boxes. And when booted with BAC connector, the entire array is plug-and-play, plug into the panel strings, plug into the inverter.

www.shoals.com

Worried about power outages?

Take power into your own hands with the all-in-one smart home battery solution.

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Controllers



Eaton

Eaton's Power Xpert Energy Optimizer controller helps simplify and expedite deployment of complex microgrid and energy storage systems. Designed for critical applications, the solution is engineered to help customers deploy stand-alone power systems using existing and new assets with the adaptability to easily meet future needs. The system provides a modular, scalable approach to microgrid control in military, campus, utility, healthcare, commercial, community, and other applications.

www.eaton.com



Morningstar Corporation

Combining the surge and power capabilities of a low-frequency inverter with the agility and compactness of a high-frequency design, the MultiWave inverter/charger delivers power with less weight, achieves peak efficiency in excess of 95% across a wide load range, and is fast enough for use in uninterrupted power supply (UPS) applications. It offers off-grid, UPS, and Solar Priority modes, open MODBUS communications, and automated generator control. It is passively cooled with no fans, and provides full power to 40°C. An ultra-wide input voltage and frequency range and sine wave smoothing and power factor correction helps clean up "dirty" AC power. The new weight class allows one person mounting and it allows for easy commissioning via its built-in meter.

www.morningstarcorp.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). 5-year warranty, CE and RoHS compliant.

www.phocos.com

Cryogenic Energy Storage



Highview Power

Highview Power's cryogenic energy storage technology delivers, clean, reliable, and affordable long-duration energy storage. It is an energy storage solution that can deliver anywhere from 4 to over 12 hours of energy, when, where, and how it's needed most. The long-duration systems are scalable with no size limitations and no geographic constraints.

www.highviewpower.com

UltraFLEX™

Bringing the Power to you

No other solution delivers the ultra-reliability and ultra-sustainability of the UltraFlex system and brings you the power to dramatically reduce diesel consumption, CO₂ footprint, and maintenance costs.

- Reliable and robust for the toughest off-grid locations and renewable applications
- Scalable and versatile for single and three phase operations
- Adaptable for existing or new solar arrays
- Recyclable product with a positive end-of-life value

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Electrical Energy Storage



SIBA FUSES, LLC

SIBA FUSES has introduced PV fuses and developed special wind farm SSK fuses for Switch-Fuse combination, providing minimal breaking current at low dissipation and can be used on transformers rated up to 3150KVA. Their energy storage fuses feature a high breaking capacity specifically designed to meet stringent energy storage requirements.

www.siba-fuses.us

Energy Storage Metering



Continental Control Systems

Continental Control Systems provides economical and high accuracy measurement of electrical production and consumption, and has designed a new meter module for mass production, customizable for OEM metering design-in. The WattNode Meter Module is a bidirectional networked energy meter offering energy measurement parameters such as energy (kW), power (kWh), voltage, current, demand, kVAR, kVARh, power factor, frequency, etc. These energy values are communicated using the Modbus RTU communication protocol over RS-485. Revenue-grade accuracy is obtainable using the CCS Accu-CT family of current transformers, (Class 0.6 or Class 0.3 accuracy), otherwise the meter module utilizes any externally mounted or PCB mounted 0.333 Vac current transformers. Available as single and three phase modules, the meter is externally (instrument) powered from 12 to 24Vac or 6 to 24Vdc.

www.ctlsys.com



meteocontrol North America, Inc.

The powerful blue'Log X-series is a feature rich tool set accessible locally or remotely. Their adaptive dataloggers have expandable functionality for a shifting regulatory and technological future. They have a compact design with easy to setup FTP push function and cost savings due to modular system design. They can be connected to allow multiple options in plant design such as major monitoring platforms and inverter brands. Only one datalogger is needed for collecting data from up to 100 devices and integrated remote access gives transparency in troubleshooting.

www.meteocontrol.com

Energy Storage Systems



ElectrIQ Power

The ElectrIQ PowerPod is a fully-integrated energy storage, management, and monitoring system that includes safe lithium-ion batteries and a hybrid solar/battery inverter controlled by intelligent software. The attractive design minimizes wiring and space requirements while enabling battery capacity to scale up to meet almost any home or light commercial need.

www.electriqpower.com



Go Electric

Go Electric provides microgrid solutions delivering energy resiliency to its customers. Its proprietary energy storage system, LYNC DR, delivers uninterrupted power to facilities and integrates DERs into a resilient microgrid through AutoLYNC, GoE's patented microgrid controller. In addition to its resiliency offering, LYNC DR lowers facility energy costs and earns revenue through utility and ISO market participation.

www.goelectricinc.com



MK Battery

MK Battery delivers the reliability and sustainability of the UltraFlex energy storage system and provides the power to dramatically reduce diesel consumption, CO2 footprint, and maintenance costs. The system combines ultracapacitor and battery chemistries in a single electrolyte, creating a maintenance-free hybrid cell with high efficiency, performance, and long lifetime throughput. It is reliable and robust for tough, off-grid locations and renewable applications, while scalable and versatile for single and three phase operations. The UltraFlex system is adaptable for existing or new solar arrays and recyclable with a positive end-of-life value. A combination of high power, fast response, deep cycling, remote monitoring, temperature tolerance, and robust chemistry makes UltraFlex suitable for on-grid, off-grid, or weak grid energy storage applications.

www.mkbattery.com

Energy Storage Systems - Commercial



Canadian Energy

Canadian Energy provides batteries, stored energy solutions, DC power solutions, and renewable energy solutions all across Canada and all over the world.

www.cdnrg.com



Dynapower Company

The new BTM-125EHV is a fully-integrated behind the meter energy storage system that combines Dynapower's new, high efficiency UL 1741 SA certified MPS-125 EHV inverter with Li-ion batteries in a temperature-controlled NEMA 3R-rated battery enclosure. The compact fully integrated system is easily deployed with a forklift on a concrete pad, crushed stone or on the ground. The system features Dynamic Transfer which in the event of grid disturbance seamlessly switches a facility from grid-tied to battery backup power. Available in 2, 4, and 6-hour configurations. Multiple BTM-125EHV systems can be paralleled together to meet the energy storage sizing needs of any behind the meter installation. The BTM is capable of interoperation with solar, wind and diesel gen sets. Available with Black Start and direct release fire suppression system.

www.dynapower.com



SimpliPhi Power

PHI High Voltage stacks feature modular battery building blocks that can be sized, scaled, and installed without heavy equipment. When a building, facility, or campus requires multiple voltage, capacity, and power output parameters at different locations, PHI High Voltage can be customized and optimized for each unique use case. SimpliPhi's safe LFP chemistry also eliminates the need for complex, expensive, and bulky cooling equipment reducing system cost, footprint, and any parasitic loads.

www.simpliphipower.com



Sinexcel

Sinexcel, Inc.

The pre-engineered container BESS, driven by SINEXCEL, with standard electric room benefited from modular CPUC/HECO listed PCS, offers ample space for different batteries and flexible configuration in AC power and voltage. NEMA3R rating cabinet and available in 10ft, 20ft, or 40ft CCS certified shipping containers with built-in transformer, switches, fire system, and local controls, this BESS is designed for PnP and savings on installation time and cost for the community and C&I user. DC coupled PV connection is also available.

www.sinexcel.us

Energy Storage Systems - Grid-Connected



nel

number one by nature™

Nel Hydrogen

Nel Hydrogen provides Alkaline and Proton Exchange Membrain (PEM) electrolysers and electrolyser plants, built-to-scale to store excess electricity from renewable energy sources as hydrogen. This technology allows energy suppliers stable and flexible delivery of electricity. When required, New Hydrogen also integrates equipment components from other global suppliers into a customized Nel solution.

www.nelhydrogen.com



RES (Renewable Energy Systems)

RES is an international renewable energy company that has delivered 270MW/328MWh of energy storage projects across the globe since 2010. A technology agnostic approach is applied in the design and build of every battery storage facility. Their Energy Management System software, RESolve, encompasses the full life-cycle of energy storage solutions, from day-one analytics and in-house engineering, to construction and long-term management.

www.res-group.com

Sargent & Lundy



Sargent & Lundy

For more than 125 years, Sargent & Lundy has provided broad-scope services on battery energy storage projects, including engineering, consulting, construction support, and EPC services. Their experience spans the spectrum of markets, applications, interconnection requirements, and technology types. Clients include utilities, developers, financial institutions/lenders, constructors, and manufacturers.

www.sargentlundy.com

socomec Innovative Power Solutions



Socomec, Inc.

Socomec offers their 33kW to 1MW On-grid Storage Solution certified UL 9540 (US Standard for Energy Storage Systems). This solution includes: bidirectional power converters (UL 1741 SA), batteries, AC distribution cabinet, and string battery coupling panel (SBCP). A solution for industrial and commercial applications, this compact system enables peak shaving, load shifting, and photovoltaic self-consumption.

www.socomec.us

Energy Storage Systems - Off-Grid

Discover® Innovative Battery Solutions



Discover Battery

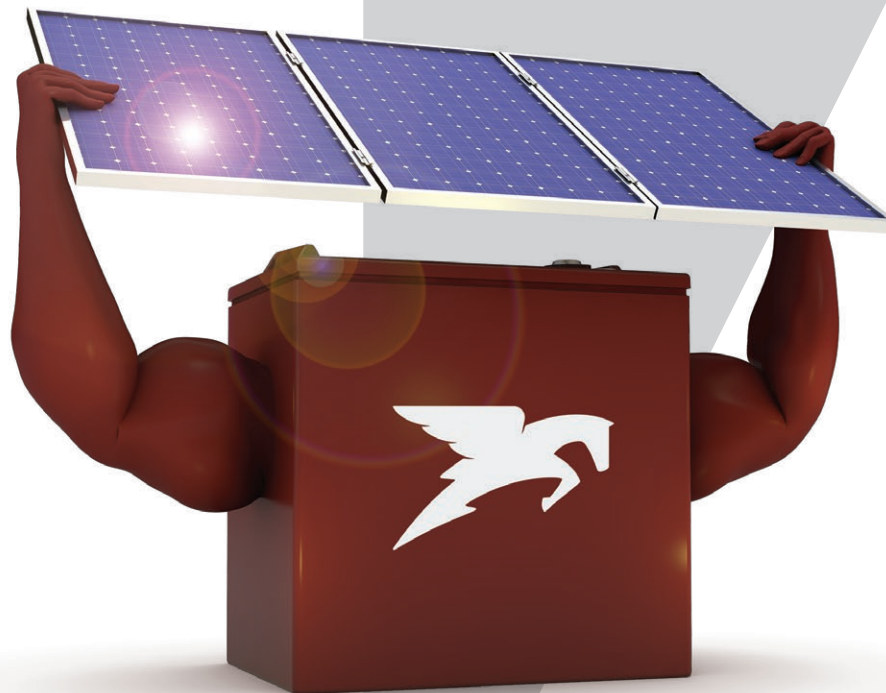
Discover Battery's Advanced Energy System LiFePO4 batteries offer a low per kWh cost of energy storage. Deep cycling, fast recharge, >95% round-trip efficiency, 1C continuous charge/discharge, 5C peak current, and a 10-year warranty combined with zero maintenance provide performance and total cost of ownership savings.

www.discoveraes.com



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.

TRILLIUM™ TROJAN INTELLIGENT LITHIUM

Learn more about Trojan's products including our new Lithium Ion solutions for renewable energy applications.

trojanbattery.com

Energy Storage Systems - Residential

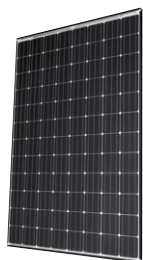


Fortress Power

Fortress Power engineers announce the new eVault 16.5kWh 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 power up to 8 stacks in parallel (132kWh). Competitively priced, the eVault battery also provides a 10-year warranty and 6,000 cycles.

www.fortresspower.com

Panasonic



Panasonic

Panasonic's HIT modules introduced high-efficiency solar panels to the world in 1997. Add their intelligent battery storage solutions to 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.

na.panasonic.com/us/solar



Sullivan Solar Power

Sullivan Solar Power is a turnkey solar power and energy storage installation firm servicing Southern California, specializing in the LG Chem RESU battery. Using only IBEW certified electricians, Sullivan Solar Power offers residential solar with battery integration, and develops, and manages over 500 energy storage systems in the region.

www.sullivansolarpower.com

Engineering Consultant



POWER Engineers

POWER Engineers provides technical expertise in energy storage and renewables interconnection and integration, system studies, site selection support, distributed generation, substation protection and control, and microgrid engineering and design. They also support the non-technical needs of storage programs, such as financial and economic analysis, and program management. This ranges all the way from tendering to project execution, resulting in cost-effective and reliable projects.

www.powereng.com



Taney Engineering

Taney Engineering provides site development services including zoning and entitlements feasibility studies, grading plans, street plans and profiles, hydrology studies, aerial mapping, ground support services, A.L.T.A. surveys, boundary and topographical surveys, and construction staking. Their drainage (hydrology/hydraulic) services include hydrologic modeling, channel and storm drain design, storm drain hydraulic modeling, flood control, masterplanning, sedimentation and erosion modeling, storm-water detention/retention basin design, FEMA flood plain delineation, and letters of map revisions, conditional letters of map revisions, flood plain and open channel hydraulic modeling, as well as hydraulic design of bridges and culverts.

www.taneycorp.com

EPC Services



Blattner Energy, Inc.

Blattner Energy is a diversified engineering, procurement, and construction (EPC) contractor providing construction solutions for the power delivery industry and expertise in renewable energy. Blattner provides complete EPC services for utility-scale energy storage projects, and PV, CPV, and CSP solar projects as well as wind energy projects. Blattner has installed more than 35GW of renewable energy in North America. Their project management skills and self-performance allow them to deliver high levels of safety, quality, schedule, and productivity.

www.blattnerenergy.com



Mott MacDonald

Grid-connected battery storage projects are becoming commercially viable for many applications: reducing system and peak demand, providing standby power, improving frequency response, and more. Mott MacDonald has the full range of skills required to plan, engineer, implement, and manage commercially successful battery storage projects across a wide range of applications. Grid-connected battery storage projects are becoming commercially viable for many applications: reducing system and peak demand, providing standby power, improving frequency response, and more.

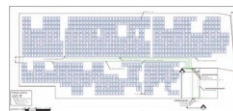
www.mottmac.com



SaltX Technology

SaltX Technology, a nanocoated energy storage salt supplier, is opening its pilot energy storage plant (1MW/10MWh) in Berlin, Germany. SaltX is looking to develop large scale installations in the US for steam supply to steam networks or combined heat and power (CHP) plants. In collaboration with local engineering companies, SaltX is looking to realize new large scale thermal energy storage plants. Nanocoated salts are suitable for longer term large scale storage and deliver steam at up to 950°F.

www.saltxtechnology.com



SepiSolar

SepiSolar is a national solar-plus-storage design and engineering company. They offer complete permit-ready plan sets and PE stamps for residential, commercial, agricultural, and utility solar projects for all 50 states. They also provide feasibility studies, site surveys, and processing services for interconnection applications, incentive programs (SGIP, SREC, SMART, etc), and other technical and administrative services.

www.sepisolar.com



Trimark Associates, Inc.

Trimark is a reseller of NEC's distributed storage solution (DSS) – a pre-configured, fully integrated energy storage platform empowering the delivery of advanced energy services at the grid edge. The NEC DSS reduces enterprise energy costs by optimizing how and when energy is supplied from the grid. By combining Trimark's Vantage control platform with DSS, owners can align multiple generation sources, control charge and discharge events, track power characteristics at the point of interconnection, trend asset performance for predictive maintenance, and automatically produce and distribute scheduled reports. The combined DSS platforms support smoother intermittent distributed renewable generation and shaving of peak demand.

www.trimarkassoc.com

Fuel Cells



GenCell Energy

GenCell Energy develops hydrogen-based alkaline fuel cells that generate reliable, zero-emission, and cost-efficient off-grid and backup power. Their G5 long-duration UPS provides smooth uninterrupted power to backup processes for any duration from seconds to 48 hours. Their G5rx provides immediate backup with extended run-time for utility sub-stations. Their A5 Primary Power Supply is a tailored solution for off-grid/poor grid telecom using a revolutionary process to extract hydrogen from ammonia.

www.gencellenergy.com

Hybrid Systems



Hybrid Energy Storage Solutions, Ltd.

HESStec is a technological solution provider, creating hybrid energy storage solutions (HESS), optimized in economic terms thanks to the integration of several energy storage technologies, enhanced power electronics, and patented energy management algorithms in exclusive, flexible hardware and software platforms. This specialization in enabling technologies allows them to offer cost-effective energy storage solutions that can be integrated at different levels of the electrical grid.

www.hesstec.net

Inverters



Analytic Systems

The IPSi Series of Intelligent Pure Sinewave Inverters are designed specifically for running computers and other sensitive AC loads in rugged mobile and other off-grid environments. Models are available for 110V or 220V AC Out at 50 or 60Hz (user selectable), and to operate from 11-15, 20-45 or 40-80V DC In to cover all standard DC battery voltages from 12V to 64V nominal (includes 72V Rail).

www.analyticsystems.com



Darfon America Corp.

Darfon's H5001 hybrid inverter is versatile enough to be used off-grid, grid-tied, or even as a string inverter. It handles loads up to 5.5kW off-grid and 7kW grid-tied. To facilitate a smooth installation process, the H5001 is transformerless and has a built-in distribution box that includes breakers, disconnect switches, and generator support circuitry. The Darfon H5001 supports a wide range of applications, including off-grid, self-consumption, net-metering, backup, and time-of-use optimization.

www.darfonsolar.com



Dynapower Company

Dynapower's all new air-cooled CPS-1500 and CPS-3000 utility-scale energy storage inverters are offered in both indoor and outdoor configurations and are UL 1741 SA certified. The Gen 4 CPS have been optimized to reduce the cost of utility-scale energy storage installations. Featuring a highly-efficient three-level topology, Dynapower's Gen 4 CPS inverters are designed for four-quadrant energy storage applications in both grid-tied and microgrid applications. They feature Dynapower's Dynamic Transfer and Black Start technologies. Multiple CPS units can be paralleled together to meet the sizing needs of any energy storage installation. Dynapower can supply either standalone CPS inverters or complete fully-integrated energy storage systems featuring CPS inverters. Standalone CPS inverters can also be supplied with MV transformers to easily integrate customer supplied battery systems into any network.

www.dynapower.com



Fronius

Fronius introduces the Fronius Smart Solution, the first adaptive system design. The Fronius Smart Solution, for residential and commercial systems, adapts to PV needs with shade mitigation, NEC compliance, high performance, and monitoring while keeping the number of components low and the installation easy. The Fronius Smart Solution consists of the Fronius Rapid Shutdown Box, a Fronius SnapInverter, the Fronius Smart Meter, and the Fronius Solar.web monitoring portal.

www.fronius.us/pv

Narada®

Energy Storage Solutions for Grid, Off-Grid, Micro-Grid and Home Energy



When you need long term reliable batteries, Narada RexC-series Lead Carbon, Intensive Cycling series and Li-Ion batteries deliver. Engineered and manufactured in state of the art facilities, Narada provides solutions to meet your renewable power energy storage needs.

ISO9001/14001/TL9000 Certified Quality
Backed by Industry Leading Warranties

Narada...Reliable Battery Solutions

www.mpinarada.com - email : info@mpinarada.com - MPI Narada - Newton, MA
Tel: 800-982-4339



Growatt New Energy Technology

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 has a compact design and is easy to install. With its three MPPTs, the system configuration is easy and flexible, fitting different rooftops. It is compliant with UI1741 SA and CA Rule 21. With Growatt OSS (Online Smart Service) it is convenient for customers to monitor and maintain the PV system from their mobile devices.

www.growatt-america.com



SMA America

SMA is now taking orders for its DC coupled storage solution. This storage solution is built for new PV plants, and can be used to retrofit existing plants for operators who want the benefits of solar-plus-storage. The DC coupled storage solution consists of SMA's Sunny Central EV-US inverters with a DC coupling ready option and up to six 500kW DC-DC Converters. In many utility-scale applications, DC coupling can offer significant operating cost and efficiency advantages over AC coupled systems.

www.sma-america.com

Mechanical Energy Storage



Max Boegl Wind AG

The Water Battery is a large-scale storage system that combines renewables with a modern pumped-storage hydro power plant. This concept is flexible and can switch between generating and storing electricity within 30 seconds, which makes it possible to make short-term adjustments to the demands of the electricity market. The storage concept uses the tower base of the wind turbines as water storage facilities with a storage capacity of 70MW hours.

www.mbrenewables.com

Power Electronics for Storage Systems



Chroma Systems Solutions, Inc.

Chroma is a global provider of power conversion test instrumentation and automated systems including Battery Test Systems, AC/DC Power Sources, Electronic Loads, Power Meters, and ATE for diverse bench-top, R&D and design verification of EV/PHEV, Solar, LED, Battery, Medical, and Power Supply applications.

www.chromausa.com



Ideal Power, Inc.

The Stabiliti Series is Ideal Power's latest 30 kilowatt power conversion system for project developers and system integrators seeking to efficiently connect distributed energy resources to the grid and reduce demand charges. The grid-resilient Stabiliti Series is available in two versions: dual port AC-DC bi-directional and multi-port AC-DC-DC bi-directional. Both products are microgrid-enabled with multi-port conversion technologies and are fully certified to the latest UL 1741 SA Smart Inverter standard, creating energy resilience and reducing reliance on backup generators.

www.idealpower.com

Protective Relay



Day Ahead Instrumentation, LLC

For Distributed Energy Resources connected to the grid at low voltage and required to be installed with protective relays, DAI provides turn-key solutions to meet all utilities' requirements. UL 508A listed, powered by SEL and NEO Virtus Engineering.

www.day-ahead.com

Software Supplier



ABB

ABB announces the global launch of its new ABB Ability e-mesh solution. This software solution provides power grid operators an integrated single and unified view of their distributed energy resources (DERs) such as microgrids, battery energy storage systems (BESS), and renewable power generation. ABB Ability e-mesh solution is a comprehensive cloud-based offering that enables utilities, industries, independent power producers, and operators to make smart, fast, and effective business decisions by monitoring and controlling their sites and fleets remotely. It also enables in-depth data analytics and provides service options. The increased visibility across all assets enables better control, optimized investment cost and better operational efficiency.

www.abb.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



Sighten

Sighten's powerful toolset helps hundreds of companies accelerate their solar and storage sales. Sighten includes project design, automated shading analysis, financing options, customized proposals, and seamless agreement e-signing. All subscriptions come with unlimited users, proposals, and contracts for a flat, low monthly fee, making Sighten a solution for solar companies of all sizes.

www.sighten.io

Storage Products & Services



Destin Power

The All-in-One for 100kW PCS and 220kWh battery is provided as an integrated product of PCS, LiB, and switch gear. It can be configured for the various needs of energy storage application fields like peak cut and renewable energy connections. They work closely with clients through turnkey based ESS projects. This product is easy to install and maintain. Its round-trip efficiency is 91.5% by applying Hybrid SiC IGBT. The turnkey ESS is also available with large 20ft or 40ft containers.

www.destin.co.kr



Nexceris

Li-ion Tamer is a gas detection technology developed specifically for lithium-ion batteries. It improves the safety of energy storage systems by providing early warning of a single cell failure within a battery. The technology detects gasses vented from damaged cells before they enter thermal runaway and allows the time necessary to mitigate battery fires. The product is designed to be installed on battery racks to help prevent fires by providing detection that will save lives, capital, and protect a company's brand. Li-ion Tamer is a Nexceris product.

www.nexceris.com

Testing | Certification



Kinectrics

Kinectrics' new GRIDSIM Power Laboratory is an independent facility in Toronto, Canada aimed at testing smart grid systems, renewable generation equipment, and medium voltage power systems over a wide range of voltages and frequencies and at power levels up to 12MVA. They perform the evaluation, testing, certification, and standards solutions energy storage products require in support of safe renewable power integration with the grid. The lab will be able to perform testing to UL 1741 SA and associated source requirement documents, CSA C22.2 No. 107.1 and IEC 62109. Their laboratory gives energy storage products a simple, fast, and efficient path to new markets with full type-test certifications across industries, made possible with large-scale grid simulation capabilities.

www.kinectrics.com



Ingeteam

Ingeteam

Ingeteam's turnkey storage inverter station is a UL 9540 and UL 1741 SA compliant MV solution. Comprising one, two, or three bidirectional battery central inverters for both grid-connected and stand-alone systems, it combines Ingeteam's overall expertise in the power conversion field (+54GW supplied worldwide), plant control technology, and monitoring solutions. With a flexible design, Ingeteam's storage inverter offers a high-power density in a single power block, providing different configurable operating modes. It is available in two different series, 1000Vdc and 1500Vdc (610kVA to 1,640kVA), and features advanced battery control technology which extends the maximum life of the storage system. Ingeteam also supplies the Power Plant Controller and SCADA systems, as well as commissioning and O&M services.

www.ingeteam.com



Rhombus Energy Solutions

Rhombus Energy's Power Converter Systems enable batteries to be optimally used by converting power from AC to DC to charge batteries, and from DC to AC to use the energy stored in the batteries. Every Energy Storage System (ESS), depending on type of batteries, operates at different voltage ranges and charge/discharge rates. Rhombus Power Converters are an essential and core part of an ESS, and are tuned to optimize each ESS.

www.rhombusenergy.com

Thermal Energy Storage



Ice Energy

Ice Energy's Ice Bear 20 is a compact, home-optimized, solar-compatible A/C system that uses both traditional A/C technology as well as integrated thermal energy storage. The Ice Bear 20 compressor can cool the home like a conventional A/C unit, or store energy by freezing water in the ice tank to later provide up to four hours of cooling to an entire home.

www.ice-energy.com

Tools



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

Valves and System Components



GEMU Valves, Inc.

In the GEMU CleanStar SmartLine range, the valve body through which the process medium flows are available with connection sizes (1/2" to 1 1/4") and with flare and metric spigots for butt-welding availability in transparent (PP-R) and grey (PP-H) materials. Low cost polypropylene (PP) materials meet necessary resistance and purity requirements, especially during the development of new plant and processes.

www.gemu.com

Wire & Cable



Service Wire, Co.

ServiceSolar PV wire meets current UL 4703 requirements. It can be used in both grounded and ungrounded solar arrays and is designed to withstand heat, cold, and moisture while meeting US and Canadian standards for safety. ServiceSolar PV wire is available in all industry colors, and comes in 600/1kV XLP/USA-2 or RHH/RHW-2, and in 600V with EnviroPlus (LSZH) Jacket.

www.servicewire.com


Other - Education




University of British Columbia


UBC Master of Engineering Leadership (MEL) is a hybrid degree that expands technical knowledge and business skills in 12 months. UBC hybrid graduate degrees enable practicing professionals to upgrade their technical knowledge through UBC Faculty of Applied Science courses while gaining fundamental business and management skills through UBC Sauder School of Business courses.


www.mel.ubc.ca





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- Power converter for distributed energy resources in grid or island mode
- Resiliency designed multi-point communications to remote equipment
- Integrated isolation transformer
- Wide input voltage range
- Direct air-cooled

VectorStat® Integrated Site Controller Includes:

- Feature rich, distributed architecture with industrial grade encryption
- Software platform and databases with industry proven open-source modules
- Persistent key value and time based database which runs on VectorStation™ hardware or VectorCloud™
- Open to customer-designed "applets" for customized applications
- Includes MODBUS, CAN, USB, RS-485 interfaces
- VectorStat® nodes can be connected to disparate equipment and included in network
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April 16th-18th, 2019 - Phoenix, AZ

esacon.energystorage-events.org

ESA's Annual Energy Storage Conference and Expo is the energy storage industry's premiere event. The conference features world-class speakers, including nationally recognized leaders in energy, politics, and business; exhibitors; and educational sessions, all focused on fostering the energy storage industry. In 2018, ESA's Annual Energy Storage Conference and Expo hosted nearly 1,900 attendees, and 130 leading industry speakers. The event also featured several new additions to the conference, including the Microgrid Exchange, the Storage+Solar Showcase, and the ESA News Desk on the exhibit hall floor, which will all return in 2019. With more than 25 insightful education sessions, workshops, and site tours to Phoenix-area energy projects, ESA Annual Conference is the must-attend event for energy storage education and a vital platform to make key networking connections.

show in print

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



Microgrid-enabled switchgear

Hive is designed and engineered to provide facilities with critical energy reliability and resiliency when experiencing disturbances from the electric grid. By integrating all the control functionality up front and bringing all distributed energy resources (DERs) into a central connection point, Hive simplifies the design, engineering, installation, and commissioning for low- and medium-voltage microgrid systems. With Go Electric's patented microgrid controller, AutoLYNC, embedded in the switchgear, Hive incorporates a wide range of DERs, such as solar, wind, energy storage, and gensets. Making decisions by the millisecond, AutoLYNC ensures safe power delivery from any generation asset when isolated from the distribution grid. It monitors energy production in real time to constantly balance generation and load, responding instantly to intermittent fluctuations in solar or wind energy output. AutoLYNC senses each resource type and sets resource function based on customer priorities, including financial and energy security considerations.

Go Electric, Inc.

www.goelectricinc.com



DC-DC converters for solar plus storage

Dynapower offers a full-suite of UL-listed DC-DC converters specifically designed to optimize utility-scale solar plus storage installations for maximum energy production. DPS DC-DC converters are offered in 250kW, 375kW, and 500kW ratings. Up to eight units can be paralleled to create building blocks from 250kW to 4MW. DPS units are designed for interfacing battery energy storage with new and existing 1000V and 1500V central inverter-based PV power plants. Dynapower DPS units work with all central inverters, and are capable of operating in voltage, current, and power control modes with the capability of on-the-fly switching between modes. Additionally, advanced automatic excess PV energy recapture and time-shift of PV energy can be realized using the DPS in solar-plus-storage installations. Dynapower supplies both standalone DPS units or DPS units as part of fully-integrated energy storage systems in 2, 4, and 6 hour configurations.

Dynapower Company

www.dynapower.com



Bringing down the cost of DC-coupled solar + storage

Alencon Systems LLC's Bi-Directional Optimizer for Storage Systems, the BOSS, controls the charge and discharge of individual battery racks in both DC and AC coupled deployments and supports the integration of energy storage with 600V, 1000V, or 1500V PV strings. The BOSS features Alencon's Galvanically Isolated DC-DC conversion topology and is a rack level DC-DC converter so it assures optimal utilization of each battery rack in the cabinet. The BOSS also makes it easy to deploy DC-coupled Solar + Storage projects with string inverters. Available in two form factors; a 19-inch rack mounted unit which can be installed and integrated into a battery cabinet, and an outdoor rated, rail or wall mounted form factor which can be installed either inside or outside a battery cabinet, BOSS units also feature mechanical packaging with forced air cooling.

Alencon Systems, LLC

www.alenconsystems.com



Single and three-phase energy storage inverter

Sinexcel Inc. provides semi-integrated micro-grid and energy storage systems, based on its own ETL/CPUC/HECO listed modular storage inverter and solar-battery hybrid inverter from 30 to 500kw, and is compatible with various EMS and battery systems. Sinexcel 30Kw energy storage inverter is a small footprint energy storage solution for Demand Charge Management, back-up and PV self-supply, which could support 3 phases 480Vac/208Vac and single-phase in one unit, and could be used for large residential and commercial applications.

Sinexcel Inc.

www.sinexcel.us



Battery performance scorecard

Advances in battery technology are accelerating, and lithium chemistries lead the way. Energy densities are increasing, cell weights are decreasing, and battery lives are lengthening, all at a dramatic rate. Costs, too, have declined, and the number of profitable energy storage applications has risen. The 2018 Battery Performance Scorecard, which stems from DNV GL's experience in battery testing at its BEST Test & Commercialization Center in Rochester, New York, will provide confidence in the quickly growing battery market and provide a roadmap for battery buyers to manage and operate specific battery technologies and estimate warranties and replacement costs. DNV GL's 2,300 energy experts support customers around the globe in delivering a safe, reliable, efficient, and sustainable energy supply.

DNV GL

www.dnvgl.com/storage

WIND +

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2018 was a historic year as wind power surpassed **90,000 MW** installed and the AWEA WINDPOWER Conference grew **10%** making it the **largest show in 5 years**. The wind industry's powerful growth is poised to continue in 2019, with more than **37,700 MW** of wind capacity under construction or in advanced development.

WINDPOWER is where the industry comes together to plan for the future and keep this success story growing. This May, the biggest wind energy conference in the Western Hemisphere will head to the energy capital of world, where leaders from the wind industry and across energy sectors will gather to take the next steps forward to powering the future, together!

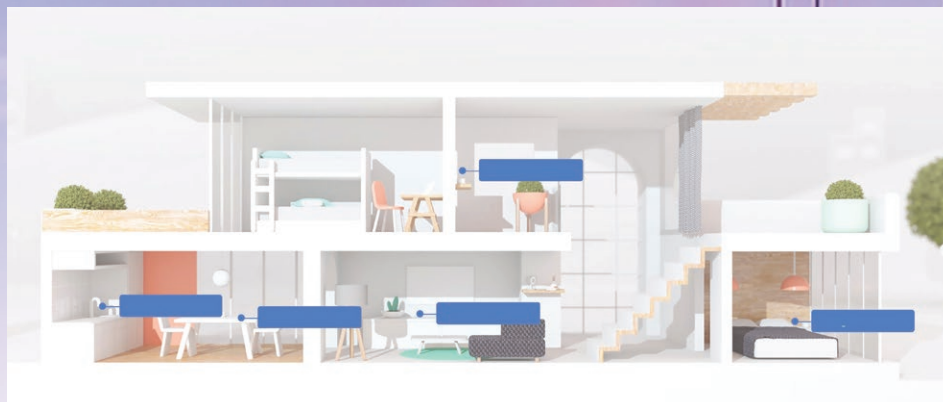
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Smart Homes Need Smart Consumers

by Bruno Sarda



WHAT'S POSSIBLE WHEN PEOPLE BETTER

understand their electricity—how it's made, how and when it's used? As it turns out, a lot.

We're living in an exciting era of customization, where the end-customer has control over everything from their morning coffee order to shopping with just one click. Our hyper-connected, "one-touch" world depends on a fuel that we can't see, smell, or touch—electricity—yet the average consumer spends more time considering their toothpaste options than their electricity choice. But that's starting to change as new technology partnerships unlock a brand-new portal into consumer-facing electricity.

New technologies, when paired with an innovative electricity provider and an empowered customer, turn into personal energy efficiency command centers. With simple verbal commands, homeowners have the ability to turn up or down their lights and thermostat, inquire about their billing, check in on their energy usage, and more. Just like that, today's fuel—electricity—moves from ubiquitous and often overlooked, to tangible and relatable.

This new level of consciousness can have a major impact on consumer preferences and behaviors. When customers are armed with all of the information surrounding the products they engage with in their everyday life, their interest moves beyond cost and into social and environmental impact. This presents a huge opportunity to make a meaningful difference.

If all consumers became engaged with their power through smart technology, what would they demand from companies like us? Would they change their consumption depending on price? Might they request energy that's 100 percent renewable and reliable, or free power at night or on



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**Phoenix Convention
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esacon.energystorage-events.org

weekends (when they're most likely to be charging their EVs)? The answer to everything is yes. In Texas, where the vast majority of the population has access to retail electricity choice, consumers and businesses are taking control of their energy usage. That's because smart energy usage translates directly into savings—both economic and environmental.

The World Economic Forum reports that energy consumption contributes to roughly two-thirds of global greenhouse gas (GHG) emissions. This means that, in order to make a meaningful impact on climate change, we must transform the way that we produce and consume energy. One of the most economic and inclusive actions toward energy transformation is energy efficiency. A lot of press is given to renewable energy development and a new, clean, and modern infrastructure. But a sizeable portion of the solution is as easy as becoming better stewards of the resources we use.

Behavioral change en masse is typically slow moving. Today's tools take the effort and guess work out of living a sustainable energy lifestyle through automation. Smart home devices like thermostats and AI assistants simplify energy conservation by learning user habits and adjusting accordingly; you no longer have to remember whether or not you turned all the lights off when you left the house because your digital assistant knows when you leave for work, and can do it for you. By effectively expediting what could take years of consumer education in order to achieve one small change, the collective impact can be great.

For consumers that choose to be more deliberate about their electricity usage, devices can take the guesswork out of interpreting their energy data through a simple user interface. Armed with an intimate knowledge of their power, customers are able to customize the plans and solutions that best suit their lifestyle. After all, an EV owner's electricity profile will look very different from a retiree or a family with a number of young children—why should they all buy electricity in the same way? From enrolling in demand response programs that reward customers

for curtailing their usage when the grid is under stress, to selecting fixed-rate or time-of-use plans, having foundational knowledge of how much power you're using, and when, can unlock new possibilities.

The power sector is evolving to become increasingly decarbonized, decentralized, and customized. As a consumer, you should be taking full advantage of the new, modern era of power. There's potential where electricity meets technology, and all of it is for your benefit.

Bruno Sarda is Vice President of Sustainability for NRG Energy, a Fortune 500 company serving nearly 3 million residential and commercial customers through a portfolio of retail electricity brands. Sarda is also a faculty member and Senior Sustainability Scholar at Arizona State University, where he teaches sustainability leadership to graduate and executive students.

NRG Energy /// www.nrg.com

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MARCH

- 05-06 AWEA Wind Power on Capitol Hill 2019**
Washington Court Hotel – Washington, DC; www.awea.org
- 06 IREC Vision Summit 2019**
Washington, DC; www.irecvisionssummit.org
- 12-13 Solar Power Florida**
Bahia Mar Fort Lauderdale Beach – Ft. Lauderdale, FL; www.events.solar/florida
- 19-21 Solar Power Finance & Investment Summit**
Omni La Costa Resort & Spa – San Diego, CA;
infocastinc.com/event/solar-power-finance-investment/
- 25-28 NABCEP Continuing Education Conference**
Sheraton San Diego Hotel & Marina – San Diego, CA; www.nabcep.org
- 26 SolarWakeup Live!**
The Calderwood Pavilion at the BCA – Boston, MA; www.solarwakeuplive.com
- 26-28 AWEA Wind Project Siting and Environmental Compliance Conference 2019**
Hyatt Regency Hotel – Albuquerque, NM; www.awea.org
- 27-29 Progress Summit 2019**
Westin Hotel – Ottawa, ON; www.broadbentstitute.ca

APRIL

- 14-16 Solar Power Mountain West 2019**
Hyatt Regency Hotel – Aurora, CO; spm19.zohobackstage.com
- 16-18 ESA Energy Storage Annual Conference & Expo**
Phoenix Convention Center – Phoenix, AZ; esacon.energystorage-events.org
- 25-26 California Solar Power Expo**
Marriot San Diego Hotel & Marina – San Diego, CA; events.solar/expo

MAY

- 01-02 Midwest Solar Expo**
Radisson Blu Aqua – Minneapolis, MN; www.midwestsolarexpo.com
- 07-09 Oregon Solar Energy Conference**
Portland Crowne Plaza – Portland, OR; oregonsolarenergyconference.com
- 08-09 Solar Canada**
BMO Centre – Calgary, AB; www.solarcanadaconference.ca
- 15-16 International Solar Power & Technology Summit**
San Francisco, CA; <http://usa.solartech.global>
- 20-23 AWEA WINDPOWER 2019 Conference & Exhibition**
George R. Brown Convention Center – Houston, TX; www.awea.org

JUNE

- 05-06 37th West Coast Energy Management Congress (EMC)**
Santa Clara Convention Center – Santa Clara, CA; www.energyevent.com
- 21-23 The 30th Anniversary Energy Fair**
Custer, WI; www.midwestrenew.org

JULY

- 09-11 Intersolar North America**
Moscone Center – San Francisco, CA; www.intersolar.us

SEPTEMBER

- 10-11 Wind Resource & Project Energy Assessment Conference**
Hyatt Regency Lake Washington – Renton, WA; www.awea.org
- 23-26 Solar Power International 2019**
Salt Palace Convention Center – Salt Lake City, UT; www.solarpowerinternational.com
- 23-26 Energy Storage International**
Salt Palace Convention Center – Salt Lake City, UT; www.solarpowerinternational.com

OCTOBER

- 01-02 AWEA Wind Energy Finance & Investment Conference**
www.awea.org
- 22-23 AWEA Offshore WINDPOWER Conference and Exhibition**
Boston Park Plaza – Boston, MA; www.awea.org

Page	Company	Website
56	Abaris Training	www.abaris.com
34	Ace Clamp	www.aceclamp.com
62	AIMCO Corporation	www.aimco-global.com
42	American Earth Anchors	americanearthanchors.com
26	APA Solar Racking	apalternatives.com
15	Arconic	afshuck.net/solar
79	AWEA	www.windpowerexpo.org
5 & 39	Baja Carports	www.bajacarports.com
OBC	BayWa r.e. Wind, LLC	www.baywa-re.com
8	Continental Control Systems	www.ctlsys.com
68	Crown Battery	www.crownbattery.com
50	CTC Global	www.ctcglobal.com
11	DNV GL Energy USA, Inc.	www.dnvgl.com/energy
21	Dynapower	www.dynapower.com/ESG
57	Einpart LLC	www.einpart.com
10	Eko Instruments (USA) Inc	www.eko-usa.com
70	Electricq Power	electricqpower.com
80	Energy Storage Association	esacon.energystorage-events.org
9	GameChange Solar	gamechangesolar.com
59	Heico Fasteners	www.heico-group.com
67	HOTSTART	cleanenergy.hotstart.com
13	Ingeteam Energy	www.ingeteam.com
81	InterSolar North America	www.intersolar.us
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18	Sinexcel	www.sinexcel.us
20	SMARTTECH	smartechonline.com
44	Solar Canada	solarcanadaconference.ca
35	Solar Connections International	solarconnections.com
29	Solar Flexrack	solarflexrack.com/competitive
49	Solar Power Events	www.events.solar
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25	Soltec	soltec.com
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