“How racking-systems, power electronics, and inverters interact with each other more efficiently and how these innovations can improve overall performance and lower costs are critical to the future of the solar industry.” Alan King, Canadian Solar

Getting a grip on solar costs

Photo: Solaria trackers are designed around the optimal shape of the panel so it all becomes one structural element, says Solaria Corporation
New solutions for the installation and mounting of solar PV systems are making a significant impact on driving down balance of system costs, as Joyce Laird reports.
When it comes to driving down solar PV system balance of system (BOS) costs, a key focus is on cutting material, shipping and labor expenses. Innovative developments in panel edging and rack-mounting are doing just that.

Having started out as a system installation company, American firm Westinghouse Solar soon realised it was extremely challenging to source all the pieces and parts to maintain inventory for piece-part installation – and make a profit in the process. Gary Mull, the company’s vice president of marketing, says a good analogy is like buying a car and the next day a bunch of boxes arrive in your driveway and you need to hire some mechanics to assemble it.

“We realised there was a need to optimise this, so we set out to design a new technology that totally integrated solar panels with racking, wiring and grounding directly into the solar panel itself,” Mull says.

Westinghouse claims to be the first to have introduces a groove around the solar frame that allows a panel to be mounted with integrated backing directly to the roof itself. Mull says the company’s Instant Connect system eliminates the need for separate racking, grounding and wiring. “You simply mount, connect and you’re done,” he says.

“Focusing on BOS, there are tangents beyond just the installation time. There is training and a level of knowledge and comfort and quality that installers want to maintain. So making the whole process simpler, reduces barriers. Quality levels are maintained, system reliability is enhanced because the less there is to install, the less can go wrong in the assembly process.”

Snap change

Not ready for an all-in-one solution? Companies like SnapNrack offer alternative options. Its product is one of the more unique innovations in panel mounting. According to the company’s Chris Oestreich, the SnapNrack product originated from a group of engineers previously working for one of the nation’s largest PV system integrators, specifically to drive down installation labor costs. Today the solution is open to all installers.

“We worked with a variety of installers very closely to see what they liked, what they didn’t like. We had the installers right there with us during development and product iterations until we came up with exactly what they wanted,” Oestreich says. “It not only had to be easy and fast to use, it absolutely had to work with all types of solar panels, including new types with integrated micro-inverters.”

Almost all racking systems need clamps that are different sizes depending on what modules are being installed, Oestreich explains. “We developed universal clamps that work with any thickness of modules which immediately reduces the need to have multiple products in inventory. We have a solution for every type of roof, and every solar module. All that is needed for installation is SnapN-

Making the whole process simpler reduces barriers. Quality levels are maintained, system reliability is enhanced ... the less to install, the less can go wrong in assembly.”

Gary Mull, Westinghouse Solar

PanelClaw ground mount solution. Photo courtesy of PanelClaw North America, Inc.
Getting certified: the Intertek factor

Somebody has to make sure all of the innovations discussed in the main feature meet electrical, safety and structural criteria. That’s where the independent certification laboratories come in. Headquartered in the UK, with divisions in more than 100 countries, Intertek is one of the largest independent test facilities around.

Working directly with regulatory bodies to keep up with industry trends, allows Intertek to provide a broad range of expertise and the most comprehensive integrated testing, certification and consulting services in the industry. One noticeable trend, says Sunny Rai, Intertek’s regional vice president, is a lot of partnering in the area of racking, mounting and peripheral electronics for solar. And certainly, more testing is being done on full or at least partly integrated components of systems, rather than single edging or new rack-mounting products alone, he says.

“We started doing evaluations of racking and mounting systems because of accidents that had taken place with grounding issues in rackings and mountings. The industry got together and actually wrote a guideline for all racking and mounting systems which is now becoming UL standard 2703,” he says.

“The biggest trend we are seeing in the industry today, is to take all the guesswork out of installation and make it as modular as possible so every installation is exactly the same,” he continues. “Many new systems being designed are made to interlock in a way that is not just a benefit from the installation area as far as loading, snow loading and wind loading, and dynamic loads, but also provide proper grounding without the need to provide specialised workmanship. They snap together in a way to ensure proper grounding. We’ve been testing quite a few of those.”

Weight worries

Rai says that weight is another issue, but while some solutions work, such as those that eliminate rack-mounting entirely, others run into challenges. “Some designs have used non-metallic materials when trying to go lightweight. There are safety issues,” he says. “When using some polymeric materials that could potentially burn, they have to make sure it meets the fire class rating for the roofing material and the uniform building code to conform with the roofing and fire requirement as the entire roof, including the modules and racking.”

To safeguard against bad results before getting to the test stages, smart companies bring their design concepts to Intertek to get a preliminary design review and make sure they are in compliance with all the standards that are applicable to the materials and designs. “Once they get our feedback and make any changes that might be needed in the product, then they can go back and create the final product and submit a complete sample to us,” Rai says.

Intertek’s light soaking chamber is used to test PV modules and racking and ground mount systems for performance under simulated real-world conditions. Photo courtesy of Intertek Group, plc.

real saving is in the reduction time spent in installation.”

Meantime, if focusing on flat commercial rooftops and ground mounts, PanelClaw North America, Inc. has an answer. Headquartered in North Andover, MA, the company specialises in one thing and one thing only; lowering installation and lifecycle cost for flat roof commercial and ground mount solar installations. It does this with a family of mounting solutions, carrying names derived from the Ursidae family (species of bear).

“When we entered the commercial flat roof space, we realised that to lower the lifecycle cost, we needed to work with the entire solar chain. We asked them what problems they had that could be solved with better racking,” says Constantino Nicolaou, the company’s president and CEO.

Based on the feedback, the first thing the company did was develop a product with just three components and two nuts and bolts - the Polar Bear system for commercial rooftops. “Then we integrated concrete ballast into our system and launched the Grizzly Bear product,” Nicolaou says.

After looking closely into current codes and standards, the company realised there was no standard for racking, he continues. “We started talking to UL, and helped develop codes and standards. We were the first company in North America to have every single one of our products, not only listed, but certified to

Feature article
UL2703,” he says. “The end result is that the entire industry now gets to save two to six cents per watt on grounding.” PanelClaw was also the first racking company in the world to open an Intertek certified (see box) satellite test laboratory for UL2703, he adds.

Moving from commercial rooftops, the company’s Panda Bear system was developed specifically for ground mount in landfills and ground fills. “We will soon be launching a fixed-tilt penetrating system called the Sun Bear,” Nicolaou says. “This product has a design unlike any other fixed tilt product on the market.”

**Strategic edge**

The large solar manufacturers certainly see the benefits of simplifying installation using systems like those already mentioned. Indeed, many are partnering with component suppliers that can help deliver fully integrated systems. “How racking-systems, power electronics, and inverters interact with each other more efficiently and how these innovations can reduce grounding, wiring, cabling and installation costs to improve overall performance and lower costs are critical to the future of the solar industry,” says Alan King, General Manager of US Operations for module manufacturer Canadian Solar.

He stresses: “When I talk about lower cost, I don’t necessarily mean lower purchase pricing, but overall cost because of better performing products. Lower levelised cost of electricity over the life of the system. I think that is critical.”

The company works closely with companies developing power electronics, he says. “We only work with those that will back their product for the time length we want, which in our case is 25 years,” he says. “We control the integration of products into our panels so we can say to our customer that the panel and all of the integrated electronics are fully backed by Canadian Solar.”

The firm was the first panel manufacturer to integrate the Zep mounting system two years ago. Its NewEdge panel uses the technology to reduce installation cost. Today, other module manufacturers are also integrating the Zep system and branding their easy mount modules under various names. “We continue to work with Zep to refine it,” says King. “We just incorporated it into our newly introduced AC panels for residential and commercial installations.”

Similarly, China’s Hanwha Solar also invests in and partners with promising companies it thinks can add value to its solar chain. One such strategic partners is US company tenKsolar®. Its OptiMax Wave
combines PV modules, light-smart reflectors, inverters and light weight racking into a single integrated system for easy and fast design and installation. The completely integrated system also features parallel wiring, minimal ballast and no roof penetration for reduced overall balance of system cost.

Dr. Chris Eberspacher, CTO, Hanwha Solar One and president Hanwha Solar says the main challenge for all PV is uniform illumination. “These modules go against some of the common assumptions about how a PV panel should be designed. TenK looked at how they could get a better energy output from any common solar module and teamed up with 3M to use a type of high tech optical reflector to reflect more light onto those modules.”

TenK uses a low cost, thick structure where the reflector and the module are fixed relative to each other. This allows the reflector to boost the energy and power output of the module. It has effectively redesigned the way a module is wired and how the cells are connected within the module to incorporate redundancy in parallel connections. This allows the module to work well in a non-uniform enhanced illumination state.

“The next step was to add embedded electronics for DC to DC conversion so an optimised power stream could drive low cost inverters with a fixed DC output,” says Eberspacher. “Basically, when completely configured, it is an advanced spectroscopic reflector which reflects light which is useful for the solar cell, and transmits light which is not useful so that the module doesn’t get any warmer than necessary in order to maximise its sunlight to electricity conversion. This streamlines the module structure and the connection to one another so

“It costs about $20 each to make and install an aluminium frame on a large solar panel...We figured out how to completely eliminate that frame, which eliminated the first cost of structure.”

Daniel Shugar, Solaria
the modules can be more efficient and have a low wind profile... it just fits without any ballast or added weight to flat commercial rooftops.”

Another Chinese company forming such strategic partnerships is UpSolar. Headquartered in Shanghai, the firm has a global reach, including divisions in Europe, the USA, Middle East and Africa. While panel manufacturing is its core business, it maintains alliances with providers of distributed power electronics, framing, racking and mounting products so it can offer full turnkey solutions to customers, says the company’s CTO Stephane Dufrenne. “There are many things that can be done to reduce the balance of system cost,” Dufrenne says. The company offers Zep Solar integrated frames with our modules, which reduce both time and cost of installation, and in a bid to further increase system performance, it has formed alliances with DC optimiser and micro-inverters companies.

“Our AC module, or ACM, is a prime example of the innovation we regularly incorporate into our products through strategic partnership with industry leaders like Enphase Energy and Zep Solar. The ACM with a micro-inverter attached into the ZEP frame is a game changer of the whole residential roof-top PV segment,” Dufrenne says. “Building these relationships while maintaining a focus on our R&D capabilities allow us to consistently improve performance and reduce costs at both the module and system levels.”

Frameless

Back in the US, Daniel Shugar, CEO of Solaria similarly says by making the trackers part of the panels themselves and integrating the electronics, the firm has been able to reduce the entire cost of system. “It brings about lower cost and higher efficiency,” he says. “It costs about $20 each to make and install an aluminum frame on a large solar panel. Aluminum is a commodity so it’s impossible...
to reduce in cost. You buy alu-
minum by what it sells for on 
the market. So we figured out 
how to completely eliminate 
that frame, which eliminated 
the first cost of structure.”

He continues: “Also, 
because frames are quite 
heavy and wide, it reduces 
shipping cost. It also elimi-
nates the need for grounding 
because conductive materials 
are eliminated. Frames also 
tend to trap dirt which affects 
panel performance, So hav-
ing it frameless also gets more 
energy out of the panels over 
the times of the year. It adds 
up to a lot in savings.”

Solaria solar panels attach 
with clips that hold securely, 
he explains. The trackers are 
designed around the opti-
mal shape of the panel so it all 
becomes one structural ele-
ment. According to Shugar 
this also speeds up installa-
tion time because the simple 
clip has a top down attach-
ment and eliminates all the 
screws, nuts and bolts of stan-
dard installations. Moreover, 
the clips are only three to four 
inches in size and only four 
are used per panel.

“Our technology integrates 
the lens into the cover glass. 
It’s a very cost effective way 
to do it and reduces the cost 
of solar cell material for our 
buying by 60%. The byprod-
uct of doing that, is that the 
glass on our panel is thicker 
than any standard panel,” he 
says. “That glass strength is a 
square function of thickness. 
If the glass is twice as thick, 
it make it 4 times as strong. 
With this type of strength, it 
doesn’t need the reinforce-
ment of a frame. The clips 
work fine and it passes all 
tests and certifications with 
flaying colors.”

Solaria’s horizontal tracker 
rotates ±60 degrees to enable 
it to produces a lot more 
energy and each row operates 
independently, eliminating 
the need for any mechani-
cal device in the middle of an 
array field.

Nor is it necessary to level 
the land either to get East/ 
West direction for the site. 
“Our installations can go with 
the natural terrain. This also 
reduces construction cost, and 
eliminates many environmen-
tal concerns,” Shugar says.

OptiMax Wave combines PV modules, light-smart reflectors, inverters 
and light weight racking into a single integrated system for easy and 
fast design and installation. Photo: Hanwha SolarOne Co., Ltd.