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Abu Dhabi's Masdar plan takes shape

inside:

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Night view of Masdar City's flagship development – the Masdar institute – under construction.

Innovations in PV installation technology

PART 1: CELL MANUFACTURERS CONTINUE TO DRIVE DOWN THE COST OF MANUFACTURING AND BOOST EFFICIENCY OF THEIR PRODUCTS. BUT IT'S FOR NOTHING IF **INSTALLATION COSTS** AND **PERIPHERAL DEVICES THAT HARVEST USEABLE ENERGY FROM THE CELLS** NEGATE THE MANUFACTURING COST SAVINGS, AND ADD TO THE PRICE FOR THE END USER. JOYCE LAIRD LOOKS AT WHAT IS BEING DONE ON THE USER END TO MOVE PV CLOSER TO A UNIVERSAL REALITY- ONE THAT MEETS ALL DEMANDS AT A REASONABLE COST.

New devices for all installations

Innovations in harvesting

Many peripheral devices are being developed that boost the efficiency of PV systems. **National Semiconductor** is well known for semiconductor technology and IC devices and their Renewable Energy Group, based in Santa Clara, CA is taking IC technology into photovoltaics.

"We do this by employing distributed electronics into the PV systems to provide higher harvesting performance," Ralf Muenster, director of the renewable energy group says. "We are agnostic to the underlying technology. The goal is to fix some of the shortcomings of all photovoltaic systems," he adds.

The shortcoming with the basic inverter technology is that even the smallest mismatch has a very disproportionate impact on the energy harvest. It has been found that as little as 1.5% shade can cause a 17% loss of output. And a major issue that causes 10% malfunction can reduce the whole system output by 50% or more.

SolarMagic from National Semiconductor is a small device with just two inputs and two outputs which can be retrofitted into existing installations or installed along with new installations behind panels. It takes whatever is being delivered by the panels, whether 100% or 50% energy output and converts it to the optimum current to the inverter. "We typically recoup about 50%-60% of the power that would otherwise be lost," Muenster says.

He notes that ultimately the best solution will be to put the ICs board inside the junction box that's already on the back of the panel. The company is currently working with panel manufacturers on this so expect to see some fully integrated solutions to come out in 2010. But, until that is available, SolarMagic can help overcome impairment issues.

"We are not out there to compete. We offer our science to all panel manufacturers. We teach them how to create the PCB and integrate it reliably so when it's put into a junction box it will last 25 years. We provide the electronics know-how and our solution fits everywhere from residential and commercial to utility plants.".

Another power harvesting innovation comes from **Solar Edge** based in Herzelia, Israel. They developed a three-fold architecture that consists of *PowerBoxes* performing module-level MPPT (maximum power point tracking), a highly-reliable inverter, and a web portal for module-level monitoring and fault detection. The *PowerBox* is embedded into each module by the module manufacturers instead of the junction box. It can also be retrofitted by PV installers onto c-Si, thin film and CPV modules.

"Photovoltaic systems are highly ineffective. There has been a lot of innovation in improving the cells themselves, but not from the total system point of view," Lior Handelsman, vice president of product strategy & business development, says. "If the whole PVA is connected to one inverter the inverter can't optimise the energy harvesting from each individual module. This causes an energy loss of between 2% to 25%."

Solar Edge have developed a different way to harvest power from PV systems. The company has moved the power harvesting to each individual module. Instead of feeding the whole string into one large inverter, Solar Edge has developed a small chip that goes into the junction box that is on the back of every module.

This leaves the inverter only transforming DC to AC current for final grid connection. "The power is matched to the inverter and we know exactly how each cell is functioning. A cell that has issues for any reason does not drag down the performance of the whole string," Handelsman says. "Also, because of this, while any inverter can be used, it does open the

*Borrego takes customers all the way through feasibility analysis to design and system installation (**courtesy of Borrego Solar Systems, Inc**).*

option to use a simple, less costly inverter, while gaining from 2% to 25% more energy output. Our technology supports any type of PV modules up to 100 volt."

Fixturing

You can't have solar power without some way to mount it. Probably one of the most foremost companies looking at this aspect is **Schletter Inc.**, headquartered in Germany. The company provides racking fixtures for everything from residential rooftops to large ground mounts, including custom installations. They are currently creating more modular products to give integrators "turnkey" racking solutions for solar projects.

"Many Schletter racks are delivered up to 70% pre-assembled," Sven Kuenzel, senior sales manager says for the new US plant based in Tucson, AZ. "Structurally, it is becoming more of a 'plug-and-play' product. That gets the mounting time way down. The labour is where all cost reduction has to happen. There comes a point where fixturing can't get any lower in manufactured cost, and the same goes for the solar cell manufacturers. It is the installation where the cost can be addressed. Make everything faster to install and more reliable," he says.

When talking about the solar market in general, Sharp does it all; complete PV manufacturing from si-PV to CIGS. Ron Kenedi, vice president, **Sharp Solar Energy Solutions Group**, Huntington Beach, CA, says that while not an installer, Sharp is doing things to help installers.

"We are making our frames easier to use in terms of commercial system installations and we are also offering a complete system for residential called *OnEnergy*, which includes the framed solar modules and the inverter. It is delivered on site ready to go so the contractor just installs it," Kenedi says.

Sharp's *OnEnergy* solar system features UL-listed, rail-by-rail integrated grounding, eliminating the need for connecting a ground wire from module to module throughout the entire array. It has pre-cut, pre-drilled racks, fewer rails and mounting hardware and requires less ground lugs and copper wiring. This reduces overall system costs by cutting installation time.

"On the utility scale side we are working very closely with contractors to design the best systems for our thin film modules. We've come up with new ways to install, which eliminate concrete. A special machine punches the rack into the ground and then it just installs the modules," Kenedi says.

System Integrators at all levels

System integrators have the unique position of viewing what is happening in the industry as a whole, and how it affects the overall progression of full solar power utilisation. All take customers from feasibility analysis to design and system installation.

Borrego Solar Systems, Inc. headquartered in Lowell, MA is one such integrator. "We focus on commercial buildings and municipalities such schools, and we are technology agnostic. We need to be free to take advantage of the best solution for every project," Ike Hall, ceo, says.

Hall notes that he sees the power conversion area as the fastest growing new technology. "Many companies are coming up with ever better ways to make power conversion smarter. Probably one of the most exciting things we've seen is transmitting the performance data over the power lines rather than installing a separate data-com, which is very difficult," he says.

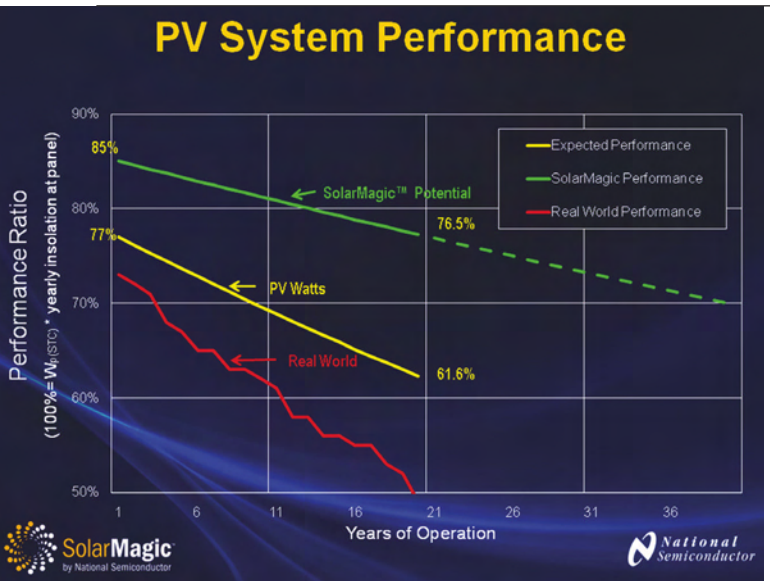
"Typically all customers are looking for a good return," Hall adds. "If we can't deliver this, then it's not going to work. After that, the second thing we do is try to mitigate the risk for the customer. We need to ensure that this whole system and all of it's parts is going to perform for 25 years."

To address this, Borrego favours mature technology and real balance sheets, whether cell manufacturers or the latest in peripheral system devices. Investors are not willing to take financial risks with a VC backed company that is not fully warranted.

"We feel as the market matures, more emphasis will be on buying power rather than buying systems. Ultimately we want to be a full energy service area to all markets," Hall says.

Innovateus Solar LLC is another world wide distributor of PV products that works directly with companies for commercial rooftop installations.

Finding the right fit for the right use is the company's foremost goal. The first it looks at is the type of roof. Second, the geographical location. This dictates what type of solar panels would work best and what type of fixturing.



National Semiconductor provides devices that maximise PV system energy harvest by employing distributed electronics ***(courtesy of National Semiconductor, Renewable Energy Group).***

"If the roof is an architectural metal one, we would start out recommending thin film products, like those from **Uni Solar**. It's thin film and flexible and easily applied to metal," Thomas Justin Kanczuzewski, executive vice president, says. "If it is white reflective like a TPO or PVC we suggest a product like **Solyndra**. For maximum power in limited space on a sturdy roof, we'd recommend a high efficiency crystalline panel. Both price and quality are big definers."

Charley Farmer, vice president of design for **Meridian Solar, Inc**. believes that the most interesting technology he has seen this year are the PV modules manufactured by the Solyndra company. "What I find fascinating is that Solyndra created a completely different form factor that solved the traditional problems faced by CIGS PV modules. In commercial installations with very large span roofs like warehouses with TPO (thermoplastic polyolefins) roofing, owners definitely do not want their roof penetrated in any way. Also, they can't carry as much weight as smaller commercial roofs. The Solyndra system is extremely light weight – about 3 lbs. per sq. ft., where a traditional ballast system could be 10lbs-20lbs. And it installs by snapping together like Lego, with no roof penetration. We are pretty excited about this product."

The second most interesting technology Farmer says is the rise of the individual inverters, as well as the latest in DC-DC converters, including National Semiconductor's *SolarMagic* and *Enphase* micro-inverters. "I think you will see these companies grabbing more of a market share. We have used the *Enphase* technology on about 15% of our installs to date."

Click through

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How to handle defective PV cells and wafers – http://tinyurl.com/ofsd3s

Solar PV Innovation: the new buzz – http://tinyurl.com/y9usf9x

As for the market itself, Farmer has a strong opinion on regulation. "A significant number of solar systems are being installed without using a licensed structural engineer, to sign off on the fact that the building can withstand the additional load put on that building. The US currently has no national requirements, which can be dangerous. For example at Meridian we hire an independent structural engineer to do our own analysis on every project to make sure that public safety is never at risk by installing a specific system."

Installation Partnering

Pristine Eco Systems, based in East Hampton, NY, USA is strictly focused on installations. Greg Darvin, owner, says that with his construction background he partnered with a licensed electrician. Because of such dual expertise in electric and construction, Pristine takes a very holistic view of solar: "We set a realistic goal. We go through every power usage avenue the customer currently uses before recommending a solar array. It not only needs to be aesthetically good, but it needs to be fixtured properly, and there are a lot of structural things that need to be taken into consideration."

> "There comes a point where fixturing can't get any lower in manufactured cost, and the same goes for the solar cell manufacturers. It is the installation where the cost can be addressed." - *Sven Kuenzel, Schletter Inc.*

Like many other integrators and installers, Darvin believes that the biggest problem with the industry is lack of regulation. Taking the USA as an example, the only form of certification is *NABCEP (North American Board of Certified Energy Practitioners)*. Pristine is one of the approximately 800 companies in the USA that are NABCEP certified. "We need a Federal board and individual state boards. There really are none at this point other than general energy, which doesn't address the unique needs of solar. It need solar-specific expertise to ensure things are being done right," Darvin says.

Pro-Tech Energy Solutions LLC and the **Whitman Company**, both located in NJ, USA, are another successful solar installation partnership.

John Drexinger, president of Pro-Tech says that since his partnership with Whitman, the companies have built over 11 MW of solar in New Jersey. "Having a partner that is expert in construction and physical engineering is critical. It is extremely important to have experts in all facets of a project, not only the power side," he says.

Barry Skoultchi and Carey Ruetsch (Whitman's president and director respectively) agree that partnering with Pro-Tech creates a very well rounded offering to commercial and industrial companies that decide to go the solar route. "Whitman has been in business for over 25 years as a multi-disciplined engineering firm. We are their main engineering support for Pro-Tech on the design side for structural engineering on the rooftops," Ruetsch says.

One thing that the Pro-Tech/Whitman alliance does that is slightly different than other installers is perform audits using different solar panel brands in different geographical locations. "You can't stick to any one technology.

You don't know 'best fit' until you do site evaluations to find it. We check out everything available. When the customer is putting up money, they need to trust you," Drexinger says.

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Future Concepts

Cool Earth based in Livermore, CA, USA has one of the most unique concepts in utility level solar generation to date - solar balloons. The company didn't start out to develop a solar balloon concentrator, only to experiment with the lowest cost ways to effectively capture protons and make electricity. It simply evolved.

"The balloon is the concentrator. The whole front of the balloon surface is clear plastic while the inside surface is aluminum coated," Rob Lamkin, CEO, says.

When pointed toward the sun, this inflated balloon concentrates the light and focuses it to an internal PV solar cell that captures the photons and converts them into electricity. The inflated solar concentrator is 10 feet in diameter, but the actual solar cell material is only 8 inches across. The solar cell at the heart of the receiver is space-grade silicon or compound semiconductor material, such as that used in the **SolFocus** system.

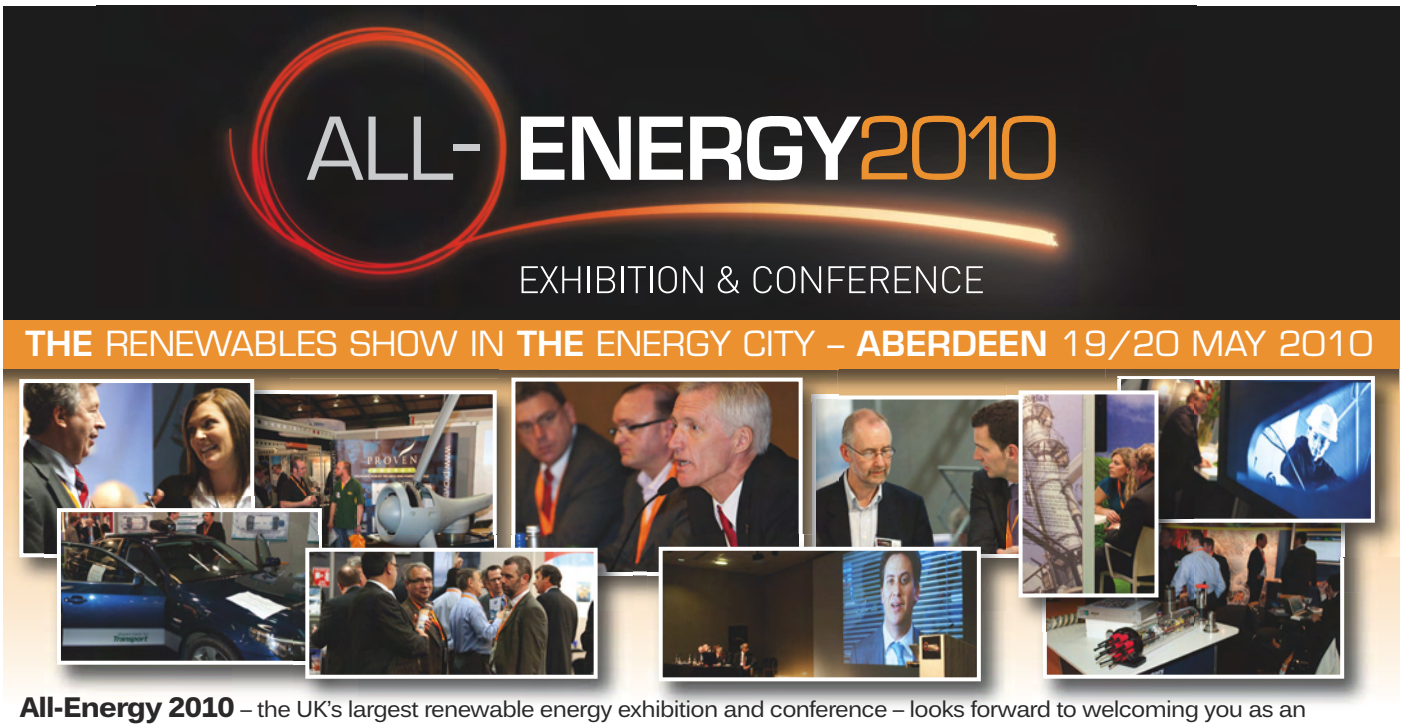
Cool Earth says it will be building its first commercial utility scale power plant next summer. Lamkin says that its first plant will be one or two MW (to prove the technology) with subsequent plants at the 10 MW level. "We are not looking at selling equipment. We will be selling power to directly to large utilities from our solar farms," he says *(see part two of this article in the March/April issue for installations on the distributed/commercial; as well as the utility side of PV solar).*

Wherever you look today, whether utility, commercial or residential, installation innovations are being developed to make solar power more cost efficient and safer to use. With both module, fixturing and device innovators bringing new products to the market, there is a lot to take advantage of when choosing the best fit for specific applications.

NB: Part two of this article in the March/April will focus on specific installations on the distributed/commercial; as well as the utility side of PV solar.

About the author:

Based in California, Joyce Laird has been writing for a wide range of industrial magazines for over a decade. Her extensive background in the semiconductor industry created a perfect transition to covering developments in photovoltaics.



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