

Solar/PV roundtable

PES is proud to present our first roundtable interview, in which the great and good of the solar/PV community debate and discuss the burning issues of the moment. We're delighted to have secured access to some of the sector's foremost thinkers, and are sure you'll be engaged and illuminated by what they've got to say.

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PES: Can you discuss the outlook for the solar/PV energy industry and how it will impact on your organisation in the future?

Carsten Busch: As one of the world's leading engineering companies, we help our customers to use electrical power efficiently, to increase industrial productivity and to lower environmental impact in a sustainable way. ABB has been working for many years to offer products and solutions to reduce the environmental impact of energy systems. ABB manufactures and supplies a broad range of high quality products for the solar power market, suitable for the smallest residential building applications, right up to large power plants.

Photovoltaic technology is particularly benefiting from the use of robots which bring unmatched precision and the highest production efficiency. ABB offers the complete range of industrial robots and robot applications for solar module and cell manufacturing plants, as well as for medium and high voltage grid connection in order to increase production efficiency, and quality output as well as to reduce TCO. On the other hand, ABB's offering for the photovoltaic industry includes solar inverters, components for module tracking systems, low voltage components and accessories.

Evelyn Butler: Given positive outlooks forecasted for 2011 by both the European Photovoltaic Industry Association (EPIA) and the US Solar Energy Industry Association (SEIA), UL continues to see growth in the global industry both in terms of technology innovation and overall usage of solar. As such, UL continues to make investments in testing and certification capacity, increasing in staff and laboratory equipment qualified and capable to assist in bringing more solar to market sooner. UL currently has state-of-the-art dedicated PV testing facilities in the US (San Jose, California), China (Suzhou) and Germany (near Frankfurt) and plans to open two additional facilities in Japan (Ise) and India (Bangalore) later this year.

Rob DeLine: There are a couple notable trends shaping the future of the industry:

(1) The end markets for PV installations are big and now more broad-based, so the industry is more sustainable. Several countries are approaching or have crossed GW scale – France, Italy, and now the US. There are also many more in the 200-500MW range, which in aggregate add up to big numbers. Also, the three market segments, residential, commercial, and power plants are all healthy and growing.

(2) Costs have come down dramatically, both on PV modules and balance of systems costs, resulting in a level cost of electricity approaching 15c/kwh in many markets with average sun.

(3) The lightening-fast move of manufacturing to China (Japan through Germany to China). I cannot think of an industry that has moved to China faster.

Given these trends combined with our number one position as equipment supplier to the industry, we're bullish about the prospects of serving panel manufacturers integration and solution needs. We're experiencing record bookings for both our wafering and cell product lines. Moving forward, our goal is to leverage Applied's global infrastructure and core competency in nanomanufacturing and process integration to enable a "Factory of the Future" for c-Si manufacturing, delivering a more automated approach to increasing efficiency and driving lower cost per watt.

Justin Roux: Solar PV continues to be very enticing and there also seems to be plenty of room for consolidation of technology in the industry. The growth is exciting and for as much as it is fertile enough to keep producing new breakthroughs at a healthy rate, it is also producing marketable technologies. We are continuing to invest in new production capacity in solar solutions.

PES: Do you believe that the promise of solar/PV power as a replacement for current power plants is achievable?

Paula Mints: In my assessment, solar (flat plate, CPV and CSP) will contribute, perhaps significantly to global energy needs, however, other energy technologies will continue to contribute with solar technologies as part of the solution, competing with these other technologies, and also competing within the sector – that is, flat plate with CPV and CSP, and thin films with c-Si.

Evelyn Butler: UL is technology neutral when it comes to which renewable energies are best for different climates and geographies and we do see renewable energy sources as viable and sustainable in the overall power portfolio. Each country or region will have to determine, based upon what is most suitable for their climate and geography, what is most economical, efficient and sustainable when choosing amongst solar, wind, biofuels, biogas, hydrogen, fuel cells, storage and other options. Where UL has seen most commercialised product activity in the last ten years has been in solar and wind.

Rob DeLine: Solar PV can't begin to replace current power plants until an economical storage technology can help transform an intermittent generation source. However, solar PV can and will be a critical and sizable part of most countries' integrated energy solution, particularly in the face of increasing environmental pressures. Solar PV is affordable, scalable and is a manufactured energy, which means that the cost will continue to decline over time. What many do not realise is that during peak times, if we use natural gas as an industry benchmark, solar PV is already price competitive in many places around the world. In the US, at \$3.00/Wp installed, the power generated by a solar farm is already crossing over in Hawaii, California, New York, and Texas. More and more places will crossover as the cost of solar PV inevitably declines, and the fuel costs for natural gas trends upwards.

PES: What do you see as the most important market segments for the near future: residential, commercial, or utility scale projects?

Paula Mints: In terms of the grid connected market, residential (single and multi family) commercial (small, medium, large and multi-megawatt) and utility owned applications will all be important to solar's future, with different technologies more or less competitive depending on the application and the needs of the users. For example, (and purely as an example), areas with

DNI of >6 tend to make CPV more competitive, large areas of flat land, particularly when utilities are involved in the U.S. and storage is a desired attribute of the system tend to favour CSP, where system cost is important (and it always is) inexpensive c-Si tends to win. With higher efficiency as a technology choice, c-Si and specifically one or two manufacturers have an edge – however, low profile preferences of consumers and large areas where land and/or roof space is not an issue can favour thin films. For off-grid applications, habitation (water pumping, remote homes and village grids, et al) will likely continue to see the strongest demand.

Evelyn Butler: All of these markets have their significance in the adoption of solar. UL works with many companies in all the mentioned areas and continues to provide each with the proper attention. Depending upon the country and the incentives / subsidies provided, there seems to be an initial focus in gaining mainstream acceptance of solar amongst the residential users; however, due to what is perceived to be a high investment to install solar, commercial and utility scale projects are the new focus in taking better advantage of those government subsidies and at a larger scale for performance and efficiency. UL has observed this in Germany, Japan, Spain, the US and Italy.

Rob DeLine: Residential, commercial and utility power plants each represent about a third of total worldwide installations. For the near future, utility power plants is the most important segment because it's the quickest way to achieve scale and will always represent the lowest total cost of deployment. Compare the cost of a single 10MW ground-mount project versus the cost of 2,500 4KW residential rooftop projects – single project overhead versus 2,500 project overhead; single design versus 2,500 customised designed and 2,500 truck rolls. For me, utility scale is a no-brainer.

PES: What are the obstacles to the development of solar/PV energy?

Paula Mints: The obstacles are the same as they have always been, all installations have a high upfront capital cost, and someone has to pay the bill, so, incentives are required for the grid connected application and someone has to pay for these too. It does not seem to matter that all energy technologies enjoy subsidies (tax, incentives, etc) at some point in the chain of development – solar seems to get all pressure in this regard.

Carsten Busch: Political willingness to support solar! Nuclear energy becomes the biggest threat in the long term...

Evelyn Butler: The solar industry does not have a broad supply-chain of products available to use interchangeably within a PV module without there being a critical effect on the safety, performance or long-term efficiency of the product. For example, there do not exist both US, national and international standards for all types of components – such as connectors, junction boxes, wire and cable, polymerics, etc. specifically for PV use. There may be a US standards (ANSI/UL standard) in some cases, or an IEC or EN standard in others, but a common standard under which manufacturers can have the appropriate components and subcomponents assessed for multiple target markets can cause costly delays in certifying the overall PV modules as well as new PV technologies and systems.

As the supply chain diversifies with more choices for manufacturers, improves its focus on developing PV specific materials and components, and matures with more and more innovation, so will the quality and performance of the modules. This will present a more 'plug and play' environment for PV module manufacturer and quicker product development periods.

Rob DeLine: Key obstacles are pretty clear: lack of scale, lack of policy, lack of capital---particularly given the global economic crisis of late. Bottom line: it has been a tumultuous year for the

industry but what many don't realise, is that except for Spain, solar PV installations in EVERY other country actually grew in 2009, representing a 60% growth year on year. As far as a crystal ball goes, I believe PV installations could exceed 10GW this year, and fully installed costs will dip below \$3.00/Wp, and scores of countries will make substantive progress on their clean energy strategies. I'm optimistic, and I think everyone involved would agree that it's pretty remarkable to be at the front edge of an explosive industry, and better yet, an industry that will in fact change the way the world gets its energy.

Justin Roux: For solar installation technologies to experience an uptake that matches their potential (and for Europe to hit its 2020 target), they will have to appeal more to the "man-in-the-street", meaning that the installation price will need to come down. Finished metal prices (silicon and copper) are driven high, not by the price of extraction or the cost of manufacture, but by the activity of futures traders. This needs as much, if not more attention than has been given to the recent subsidies debates. In short, solar energy is a route towards saving our future – solutions should drive finance and politics; it should not be the other way about.

PES: How can we accelerate the pace of change?

Evelyn Butler: Manufacturers need to be aware of the relationship and dependency between their product development and commercialisation timelines, the design and market access requirements for products and the standards for safety, performance, efficiency, durability and reliability including the overall certification process. Certification organisations can support manufacturers in early stages of product development, providing insight into product safety and performance considerations prior to designs being finalised. This provides the manufacturer with increased confidence in submitting their products for evaluation to the appropriate standards as well as better expectations of performance under test. Third-party testing and certification organisations can help accelerate the overall acceptance and availability of products in the market place through such early product development involvement.

Dr. Petri Konttinen: We need to give all new renewable energy technologies a fair chance. We need to acknowledge that fossil and nuclear power generation has been subsidised for decades directly and indirectly – even now in EU more than all the renewables are receiving together. Power plants becoming end-of-life need to be replaced with the best locally suited renewables, and the smart grids need to be developed to accommodate the distributed energy generation from many small sources instead of one big polluting plant. Legislation and building code frameworks need to be modified to allow fast throughput of renewable energy installations, and certain rate of certification should be taken for buildings to make fully integrated solar energy as common as doors and windows are today.

PES: How are governments and the energy industry encouraging innovation?

Evelyn Butler: Governments and industry are making significant contributions to research and development in improving and creating new technologies to improve the cost of ownership and to improve cell efficiency overall. In addition, until there is larger scale, efficient use of solar, such incentives and support is necessary until cost parity is achieved. For instance, in 2009, the US Department of Energy has dedicated hundreds of millions of US dollars to different stages of development to encourage innovation of new products, research and development of new technologies and to clear market barriers so that more solar can be installed sooner. UL is a partner in such a US DOE grant effort, under the Solar America Initiative, called the Solar America Board for Codes and

Standards (SolarABCs) whose mission to assist with clarifying and accelerating the standards and codes development processes so that there is more understanding and involvement in industry.

PES: Do you believe that thin film technology will eventually make crystalline solar panels obsolete or do both technologies have a place in the future of solar power?

Paula Mints: Right now inexpensive c-Si is making it very difficult for thin films to compete. All flat plate technologies (CIGS, CdTe, a-Si including tandem junction, single and multi c-Si) have a place in the competitive environment that all solar technologies face.

Evelyn Butler: We believe that both technologies have a place in the future of solar that will prove to be application or end-user specific. Both technologies have trade-offs when it comes to cost/watt and efficiency. Large scale installations of one technology may be more cost-effective, yet requires more modules due to lower efficiency. In addition, depending upon the use, such as integrated into building design and facade, there may also be a higher cost, yet a lower energy efficiency yield. Again, the project developer who is determining what the main purpose and usage, as well as the appropriate incentives that may apply, will have to be diligent in calculating the results of the trade-offs.

Rob DeLine: c-Si and thin film technology will continue to co-exist as the industry evolves, with c-Si being a far more efficient option for space constrained areas, and thin film being the most cost effective approach for large-area, utility scale applications. That said, c-Si is clearly the entrenched technology and those hoping to unseat it will need disruptive innovation and a plan to get to GW scale quickly. Also, we can't forget the importance of bankability in this equation; if new thin film technologies are predicated on large installations, then project financing and field data becomes integral.

PES: Do you think the public accepts a rapid expansion of solar/PV power?

Paula Mints: I think that the trend is away from conventional energy sources, but, it is an expensive change. The industrial revolution was expensive too. Look at it this way, the pony express used to be the way the U.S. delivered its mail, that and stage coaches. Then, along came the railroads and the telegraph and the pony express was displaced by different modes of delivery. It was an expensive change. The globe is not going through what could be termed an energy revolution and it will be expensive and take time to change old habits and implement new technologies. Along the way, some things will be displaced and replaced by new technologies and skills.

Rob DeLine: Recent polling done in June (conducted by Applied) unveiled that 67 per cent of Americans would be willing to pay more for their monthly utility bill if their utility company increased its use of renewable energy and 49 per cent of consumers polled would be willing to pay \$5 or more each month for an increased amount of renewable energy – a 14 per cent increase from the results of Applied Materials' 2009 survey.

As we know however, it's not as easy as that – a number of factors need to be in place to create an environment where PV can flourish. There is a notable absence of advocacy and subsequently projects here in the US. Establishing a robust renewable industry in the US is going to require focus on three clear policy goals: increasing the total amount of clean energy generation, incentivising local manufacturing, and creating a stable business climate where the rules and regulations are predictable over time.

PES: Chinese companies seem to lower their module prices severely in order to gain market share. What are your thoughts on this aggressive stance?

As in other commodities, unrealistic pricing will cause the markets to cannibalise their customers

Paula Mints: Aggressive pricing for share is not new to the PV industry – which was unprofitable on the manufacturing side up until 2004 – it is also not new to any other industry. It is an entry and competitive strategy. It does make for a difficult competitive landscape for many manufacturers.

Carsten Busch: Chinese PV companies will gain clearly become market lead for PC cell and module production worldwide, because of aggressive price and government incentives. Nevertheless European and NA companies can be competitive mainly regarding high quality image, reduced transport cost and local brand.

Justin Roux: If people are buying their own renewable energy capacity, from whatever source, then it's a good thing indeed. Claiming to support the growth of renewable energy and then complaining about anything that brings it to market is base hypocrisy. Let's think about a future filled with clean energy generation first and worry about market dynamics second. If China can produce high-quality solutions more cheaply than the West, then maybe the West should take note instead of complaining. If we all DON'T increase our efforts in clean-energy generation, then all nations will suffer together – so let's not take a "them-and-us" attitude in averting that situation.

PES: Let's say that tomorrow a new oil field is discovered that will provide us with ample fuel for the next 100 years. Will all the efforts into renewable go to waste?

Carsten Busch: No, because environmental issues like global warming will increase awareness for renewable energies.

Dr. Petri Konttinen: The waste would be with the new oil burned to the sky. The key issue here is not only for how long we have oil, but also what is it and other fossil fuels doing to our atmosphere. Eventually, it does not make any difference if there is enough oil left for 50 or 150 years. We are at the surge of oil peak: it came, it's here and it will be gone. The amount of primary energy used increased roughly ten-fold in the past century. Given the amount of increasing population combined to increased consumption per capita, this can't continue forever. Sure, we do not know which of the energy forms we will have in 100 years, but I'm pretty sure that sun will still be shining then. Maybe our grand-grand-children will look upon our current solar technologies as we look at the T-Ford compared to a state-of-the-art electric car, but the principle is still the same: We need energy which will take us from A to B safely, unpolluting and day-after-day.

Justin Roux: No. I think the wheels have started to turn. The exhaustion of fossil fuels is a 'when', not an 'if'. I think that the "price rape" that continues to rage on the commodities markets will continue to drive people to other solutions – that being the case, I think the trend of substitution from oil as a power source (in some sectors) has begun. As in other commodities, unrealistic pricing will cause the markets to cannibalise their customers. In terms of power generation from fossil fuels, history will look back on this as being a good thing.

PES: The Deepwater Horizon disaster should make us look to solar/PV power, and start a revolution in how we meet our energy needs. Do you agree with this statement – and do you believe it will happen?

Evelyn Butler: While UL regrets the resulting environmental

impact the Deepwater Horizon disaster has caused, the public, business, government, industry and environmental communities all need to support the research, development and growth of all types of viable power sources in balance with their effect on the environment.

PES: Which energy technologies will progress most in the next ten years?

Evelyn Butler: UL sees a strong focus on development of additional solar technologies which show a marked increase in the efficiency of energy conversion whether those are in different elemental configurations (CIGS vs. Cadmium Telluride, etc.), concentrated PV, solar thermal, etc. In addition, other products within a solar system such as the inverters, will also need to have a focus on continued high efficiency and reduction in overall cost to keep solar competitive overall with traditional sources of energy.

UL also recognises a surge in technology focus on wind and associated products are more regions where wind can perform well begin to see installations being implemented and finally be able to take advantage of that natural resource; however, due to the length of time needed to complete a wind farm project – often three or more years – this larger scale renewable energy effort cannot always take advantage of newer technologies without changes to project designs and may be subject to fluctuations in government subsidies and incentives. UL also sees increased development into larger-scale storage and batteries as more hybrid renewable energy technologies are used together or are dependent upon a storage solution to increase their overall energy yield.

Dr. Petri Konttinen: Well, we have utilised already most of the old renewables like hydro, so the biggest potential is within solar-based primal energies: PV, CSP, solar thermal heating and cooling, biomass, geothermal and wind, added with energy conversion by electric cars and fuel cells. All of these are going through a very rapid phase of development, although it may not seem so for the grand public. The only thing we can really compare this pace is the development of ITC in 1990s and 2000s. For example, how many did believe in 1990 that we would soon have a mobile phone with email and internet in our pocket? The energy revolution will take a bit longer due to the huge amount of infrastructure needed, but the development will be there.

PES: What are the challenges in commercialising new energy technologies?

Evelyn Butler: From a standards developers' perspective, new energy technologies typically need new compliance requirements to be developed. Such requirements are better developed in parallel with the product's development rather than after the fact, which may cause delays in introducing the product to the market. Currently, many manufacturers will engage their testing and certification partner after prototypes have been created. Depending upon the product involved and its construction, and without involvement during design stages, major changes in material or components of the product may be required for it to be compliant with an existing standard. Or appropriate requirements may not exist and time must be given for standards developers to conduct the appropriate amount of safety science research and develop the compliance requirements before testing can begin and certification granted.

Overall, new energy technologies tend to have a specific purpose and focus, such as for a specific site or user; therefore, the involvement in all the appropriate stakeholders through the commercialisation process is necessary to ensure the product's intended use and performance. ■