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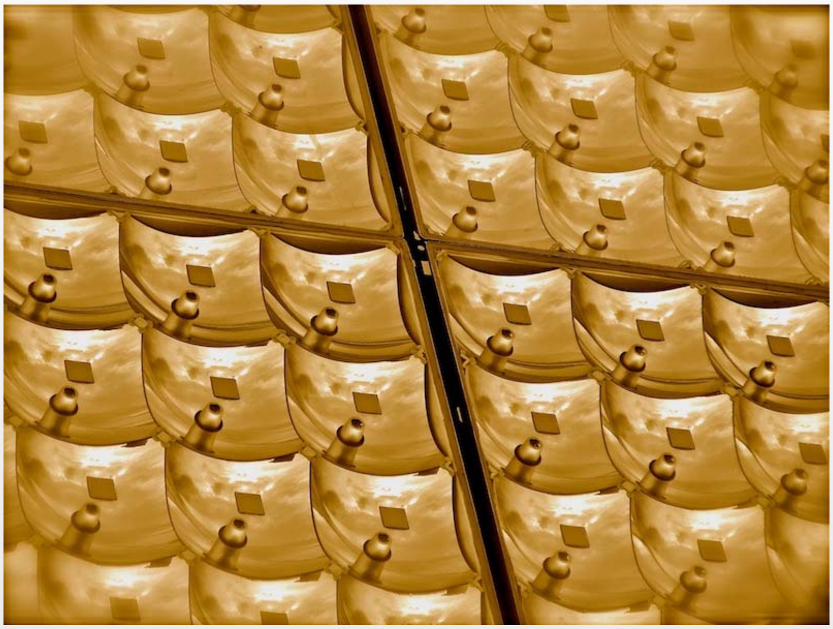

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Jun 4, 2014 | Geoffrey S. Kinsey | 0 Comments

Concentrator photovoltaics tipping point?

CPV-10 conference finds concentrator photovoltaics industry sector on the cusp of triple-digit megawatt relevance

Some 250 academics and technologists from 23 countries gathered in Albuquerque, NM, at the recent 10th International Conference on Concentrator Photovoltaic Systems (CPV-10) to discuss the state of CPV technology and deployment. Since its inception in 2002, the "CPV-x" conference series has operated as a nonprofit, with the aim of maintaining an intimate, collegial feel and a focus more on technology development than on marketing.

That intimate feel has become easier to maintain of late, as price declines in conventional PV modules, along with the shutdowns of several prominent CPV companies, have made it look like concentrator photovoltaics might never shake its epithet as the industry with a "zero-billion-dollar market." However, several trends in evidence suggest that CPV may be on track to finally make a real impact this decade.

The first promising indicator has to do with scale. As can be seen in Figure 1, the only way to get CPV to even show up on a plot of overall PV capacity is to use a 1000x multiplier on the scale. One would have to go back to 1996 to find a time when conventional PV was installing in such low volumes (a time when modules still cost $6/W). Thanks to large projects going into the ground in China (Suncore) and South Africa (Soitec Solar), 2014 will be the year that CPV finally crosses the 100 MW/year installed generating capacity threshold. Such scale should deliver economies to a number of system components, including multijunction cells and the multi-axis trackers used in high-concentration designs.

Figure 1: Annual installed capacity of CPV vs. "conventional" PV.

The second indicator is the fading influence of venture capital. Although it's hard to look a gift horse in the mouth, this trend should emerge as a positive for the industry. As several VC-backed startups have completed their familiar boom-hype-bust cycle and faded from view, the CPV companies that remain (and several new ones emerging) tend to be branches of large engineering firms. Such firms have a better understanding of, and patience for, the kind of diligent engineering required to commercialize PV technology. An example of this level of long-view focused persistence came during the keynote address of Hansjörg Lerchenmüller, senior vice president of product strategy for Soitec Solar, who chronicled his company's accrual of field experience (five years and counting) that led to a strong Munich

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Re-backed warranty package that, in turn, has enabled financing of Soitec's 44MW project nearing completion in South Africa.

A question asked by many in the solar industry is: "Do we really need CPV?" Despite the sector's growing pains, I believe the answer is "yes." With 40%-efficiency cells already in volume production, CPV modules have demonstrated efficiencies topping 33% *in operating conditions* (where the cell temperature can be 65°C or more). One problem that continues to plague CPV is the difficulty in making apples-to-apples comparisons with competing PV technologies. While performance under standard test conditions (STC) is the most familiar metric, measuring a CPV module under STC is both tricky and somewhat silly. The standard test conditions were originally devised to make indoor measurement easier, but CPV modules operate even further away from these conditions than flat-plate modules. In addition to the higher operating temperature, few solar simulators can reproduce the collimated light that is the direct component of sunlight and that most concentrating optics require, so an STC comparison, when it is done at all, is usually done by extrapolation. That said, an operating efficiency of 33-34% on a CPV module can be extrapolated to a STC efficiency of an even more impressive 35-36%. Comparable numbers for a mc-Si module, for example, might be 14% and 16%, respectively.

In sunny locales, a CPV module produces substantially more energy per day than a comparable flat-plate c-Si module (Figure 2). The energy dividend of a CPV module reaches its peak in the summer months, nicely matching a typical load profile in the southwest U.S.

Figure 2: Predicted energy production comparison of a multicrystalline silicon module (h_{STC}=17%, operating temperature 20°C above ambient, global normal irradiance) versus a CPV module (h_{STC}=36%, , operating temperature 40°

C above ambient, direct normal irradiance) in Albuquerque, NM. The ratio of the two energy densities is given on the right-hand axis.

For example, a CPV module is predicted to produce 60% more energy over the course of a year in Albuquerque than a standard flat-plate module. This dividend comes despite the fact that a crystalline-silicon module makes use of the diffuse component of sunlight. Such a boost in energy yield substantially increases the net present value of a PV installation, as it exceeds today's 30-50% cost premium of a CPV installation over a single-axis flat-plate installation.

For a world racing to deploy PV rapidly enough to help mitigate the worst effects of climate change, the higher energy densities offered by CPV remain a compelling clean energy alternative.

Geoffrey S. Kinsey served as the chairperson of the recent CPV-10 conference. He is the former Director of Photovoltaic Technologies at Fraunhofer Center for Sustainable Energy Systems (CSE), Boston, MA. Kinsey's work included R&D on advanced photovoltaic materials, increased energy output, and durability, as well as low-cost plug-and-play PV, in support of the U.S. Department of Energy's SunShot Initiative. He previously served as senior director of R&D at Amonix, where he led optimization of utility-scale solar power generators using III-V multijunction cells. Prior to his stint at Amonix, Kinsey spent seven years at Boeing-Spectrolab in R&D of high-efficiency multijunction cells. He received his BS from Yale University in 1992 and his PhD in solid-state electronics from the University of Texas at Austin in 2001. He has two patents issued and seven pending and more than 80 publications in the optoelectronics field.

PHOTO/TREATMENT BY TOM CHEYNEY

Sources: CPV-10, Suncore, Soitec, PV-Tech, IEEE, Cleantechnica, Canadian Solar, SolarCurator

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