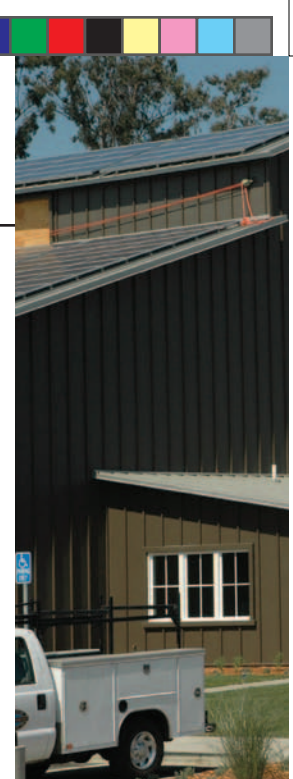


# A PERFECT MARRIAGE

THIN FILM OR  
CRYSTALLINE  
ARRAYS WITH  
STANDING-SEAM  
METAL ROOFS

BY ROB HADDOCK



**THE CONCEPT OF** mingling photovoltaic arrays with standing-seam metal roofing is growing—and for good reasons. Rising energy costs and environmental concerns about fossil fuels make renewable energy sources a bipartisan issue politically, and, in many cases, integration of power generation into building design just makes good sense. Although the economies are not yet attractive enough to make the concept work on its own merit, government incentives are priming the pump (more so in some states than others).

A 30-year power source on a 30-year roof without any surface penetration couples the most sustainable roof system available today with alternative electrical power generation. When it comes to roof types, a decision for PV power generation actually is driving roof design toward metal. Unlike built-up or membrane roofs that require replacement before the usable life of the PV expires, a standing-seam metal roof has a life expectancy consistent with that of crystalline PV modules.



Crystalline systems are mounted by one of two methods: direct attachment or on a racking system, as typified by this installation at the Merryvale Winery in California. With a racking system, continuous rails are attached to the seams, and the PV panels are in turn attached to the rails. The electrical connections are made with quick-connect type leads on the underside of the panels. The Sharp panels used here are said to have the most output for their size, maximizing power generation given roof area constraints.







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## [ BUILDING GREEN ]



### THE TWO CHOICES

PVs are dichotomized by two technologies—thin film (amorphous silicon) and crystalline. Both can be integrated with standing seam, and each has advantages and disadvantages.

A fellow named Stan Ovshinsky pioneered the amorphous/thin-film concept in 1978. In the 80s and 90s this technology was thought to be the rising star of the PV industry, but after numerous disappointments, only one manufacturer domestically still embraces this technology; all others having returned to the more traditional crystalline methods. The one left—Uni-Solar—has a lot invested, having spent some \$100 million (more or less) on a production facility in Auburn Hills, Mich., before Belgium-based Bekaert (Uni-Solar owner at the time and fifth benefactor) sold the company. Said Françoise Vanthemsche of

**PVs are dichotomized by two technologies—thin film and crystalline.**

the Belgian company, “We would have had to invest for years and years before we could have hoped for a return.” The company now is owned by Rochester Hills, Mich.-based ECD Ovonic, a company guided by Ovshinsky. Contrary to the dooming prophecies of Bekaert, Uni-Solar now has plans to double and redouble its production capabilities in the next few years.

When rooftop space is at a premium and the environment provides bright sunshine, crystalline PV is the obvious choice instead of thin film, producing up to double the power within the same space. It is said thin-film technologies are improving and several films that are more efficient will be in production later this year.



The first crystalline cell dates back to 1941. Although the technology was used in space exploration in the late 50s and throughout the 60s, the efficiencies were low and costs were high. Over the years, both aspects of mono- and poly-crystalline have improved dramatically. The per-watt cost “on the street” of crystalline cells has fallen from \$1,785 in 1955 to \$30 in 1973 to under \$3 today. There are a number of companies who make crystalline modules today. The larger ones are Siemens (now Shell Solar) Munich, Germany; Sharp Corp., Osaka, Japan; BP Solar, Frederick, Md.; Sanyo, Osaka; and Kyocera, Kyoto, Japan. (Note that three of these are Japanese companies. Japan has been an industry leader since the 60s.) Several of these companies have production in the United States. Because of recent world events, the demand for PVs has soared and all production facilities are operating at or near capacity with ambitious expansion plans.

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in recent years. High roof-surface temperatures cause heightened cooling loads, burning still more fossil fuel and putting even greater demand on over-taxed electrical grids. California,

where brownouts were a regular occurrence a few years ago, quickly became the catalyst for focusing attention on the virtues of cool roofing. Because metal roofing has high reflectivity, its benefits as a cool roofing alternative are well established.

Crystalline systems consist of individual aluminum-framed glass modules that are mounted mechanically just above the roof surface with an air space between the roof and PV. The combination of a crystalline PV over standing-seam roofing with this air space may prove to be the ultimate cool roof. The elevated crystalline PV modules cast the metal roof panel in shade and create a "stack-effect" air plenum, keeping both the roof and the PV cool, maximizing power generation efficiencies.

Thin films, on the other hand, are laminated onto a dark-colored, synthetic plastic sheet, which then is applied directly to the metal panel surface. While the dark-colored thin film raises metal roof temperatures by 40 or 50 degrees (4 or 10 C), the crystalline installation actually reduces rooftop temperatures by as much as 65 F (18 C), thereby also reducing the building's cooling load, according to recent research at Oak Ridge National Laboratory, Oak Ridge, Tenn.

### OTHER PROS AND CONS

An advantage of the thin film is that it is more productive in low-light situations, so early morning and late evening light, as well as overcast days, will translate into more usable power with thin film. But it produces less than half the power of the more traditional crystalline technology in a bright, sunny environment. Where a

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## [ BUILDING GREEN ]



The Rodney Strong Vineyard, Healdsburg, Calif., sports direct-mounted PV. Whether rack mounted or direct mounted, the crystalline panels sit several inches above the roof's surface, creating an air plenum and shading the roof's surface from direct sunlight. The cooling effect created helps the PV to operate with greater efficiency and also lowers the roof temperature, reducing building cooling costs.



rooftop application is considered, space usually is at a premium. In other words, the challenge is to produce as much power as possible on the limited space available.

Crystalline technology is the clear winner in this arena given a relatively sunny environment.

The compact size of crystalline pan-

els makes them a preference, according to Marco Miller, project manager for Berkeley, Calif.-based PowerLight Corp., perhaps the largest PV integrator in the country. "Sanyo currently produces the highest output crystalline module for its size. It produces 190 watts of power and its compact 36 3/4- by 53 1/2-inch [933-by 1359-mm] size conserves rooftop space. A thin-film system produces only about 40 percent of this power using the same available space—and for 80 percent of the cost."

A slight edge for the thin-film laminate is its lighter weight. The crystalline panels mentioned have a gross weight

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## [ BUILDING GREEN ]

of 2.66 pounds per square foot (13 kg per m<sup>2</sup>) while the thin film weighs more like 1.8 pounds per square foot (9 kg per m<sup>2</sup>). Installation density using crystalline does not usually net out at more than 2 pounds per square foot (10 kg per m<sup>2</sup>) when modules are arranged on a rooftop because crystalline normally is used in a

### Cost savings when mounting to metal as opposed to other alternatives can be up to several dollars per watt less expensive.

pattern that does not cover 100 percent of a roof's surface, leaving walk space between rows of modules.

Attachment of the two systems is varied, as well. The thin-film laminated sheet has

been adhered to the metal panel surfaces with various types of adhesives over the years. Attachment of the more unitized crystalline PV modules is typically done with S-5! clamps or other seam-clamping devices.

When it comes to availability, thin film is a winner over crystalline panel products. Skyrocketing costs of oil, increased government incentives globally and trouble in the Persian Gulf have led to a sharp increase in demand for PV systems, outpacing supply capabilities for crystalline production. While the glass panel producers of crystalline are anything but aggressive, the thin-film production facility owned by Uni-Solar is still looking for new business. Despite this, costs are similar—and in fact slightly favor crystalline. Large systems are going in place for under \$6 per watt, compared to about \$7 for thin film (varies by region and system size). With these kinds of costs coupled with state incentives (which are varied), an installed PV system can have a payback in as little as 5 to 10 years. (For more information about state incentives, visit [www.dsireusa.org](http://www.dsireusa.org).)

### SOLAR PLATFORMS

These figures, mind you, have to do with standing-seam metal panels, which are much more effective “solar platforms” than traditional roofing counterparts, like asphalt and single ply. Cost savings when mounting to metal as opposed to other alternatives can be up to several dollars per watt less expensive. Metal also makes more sense because it has a service life consistent with PVs. Crystalline PV typically enjoys a service life of 30 to 40 years, matching that of most standing-seam metal roofing.

Compatible service life, penetration free attachment, lower installation costs, cooler roofs, rising energy costs and increased environmental concerns all spell a bright, sunny future for PV integrated with standing-seam metal roofing. ■■

*Rob Haddock is president of the Metal Roof Advisory Group Ltd., Colorado Springs, Colo., and technical advisor for metalmag.*

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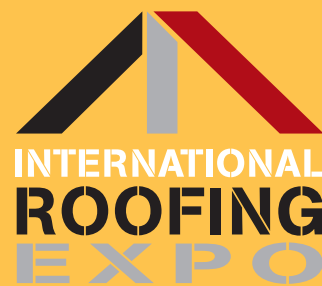
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