Photo courtesy of Marco Miller.

The 4,032 Sanyo 190-watt solar panels greet the morning sun as it rises over the rooftops of the Rodney Strong Vineyard, Sonoma County, Calif.

Vineyard Produces *More Than Wine*

By Rob Haddock

Some of the juice being produced at Rodney Strong Vineyards in Sonoma County, Calif., is not from the grape but has been kissed by the sun.

Visitors to the winery and its tasting room may be unaware that the same sun that ripens the grapes that produce Strong's award-winning wines, such as Symmetry, now is helping generate much of the power that lights their tour and provides refrigeration for the vineyard facilities.

Capturing the California sunshine's abundant energy is a new 766,080-watt photovoltaic (PV) power-generation system recently installed by PowerLight Corp. of Berkeley, Calif., on the metal panel rooftops of the vineyard's barrel-aging warehouses. The system will save the county from burning fossil fuel and prevent 8,872 tons (8048 metric tons) of carbon dioxide from being poured into the environment during the next 40 years.

"Solar electrical systems have never been more suitable to our industry," says Tom Klein, Rodney Strong's chief executive officer. "The combination of solar technology improvements along with customary flat-surfaced winery storage areas and their sunny locations have made renewable energy more commercially viable."

More power per square foot

PVs are dichotomized by two technologies—thin film and crystalline. The thin film, while less expensive in some applications, produces less than half the power of the proven and well-established crystalline technology, hence the latter is preferred for limited rooftop space, according to Marco Miller, project manager for PowerLight.

"There was a time when thin-film technology was thought to be the rising star of the PV industry, but after a couple decades of floundering improvement and less than equal performance, the technology has been abandoned in favor of more reliable crystalline cells by all but one producer domestically," he says.

"When space is at a premium, the highest output per square foot of available rooftop is a primary consideration. Sanyo currently produces the highest-output crystalline module for its size. It produces 190 watts of power and its compact 36¾x53½-inch (933x1359–mm) size conserves rooftop space. A thin-film system on these roofs would have produced only about 40 percent of this power using the same available space."

The Strong rooftops afforded 100,000 square feet (9290 m^2) of space. Not all of it was usable, but about 55 percent of the space now is covered by the PV modules.

One reason for some loss in available rooftop space is that layout of the modules is carefully planned to avoid shading from parapets, rooftop equipment, and domed skylights that would diminish the output of photoelectric cells. Between each row of panels, a space also is left open for foot traffic. This layout pattern makes every module in the system accessible and eliminates the need for installers or maintenance personnel to walk on any cells.

Careful planning speeds installation

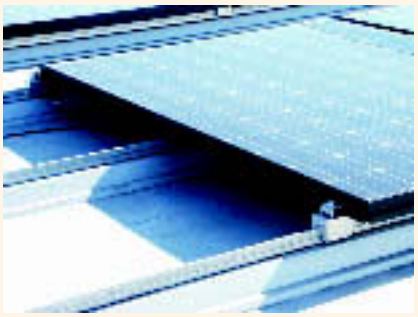
Planning for the system began in April 2003 with careful consideration given to initial costs, state and federal rebates, power production levels, investment payback estimates, and construction logistics. By September, the winery and PowerLight agreed on a plan and entered a contract for the work. About eight weeks later, design was complete, concrete equipment pads were poured, and solar modules were delivered to the project. Once materials were onsite, the entire system was in place in less than five weeks—in time to celebrate Christmas with power produced by the sun.

A chief concern was how the PV modules could be attached to the standing seam roof systems without jeopardizing material and weathertightness warranties. The answer was found with S-5!™ attachment technology for standing seam metal roofing. The custom clamp was designed by S-5! of Colorado Springs, Colo., to PowerLight's requirements for the project. The patented design of the attachment clamp

About 55 percent of the total roof surface is covered by P V modules producing 766,000 watts of DC power. *Photo courtesy of Marco Miller.*

Walk space is left between each row of panels for service and trouble shooting access. The standing seam metal roof is durable enough to support occasional foot traffic.

Each Sanyo panel has four attachment points using S-5-U clamps custom made for the system.



The combination of PV panels linked by the S-5! clamp atop a metal standing seam roof makes a perfect sustainable, energy-producing system with a 40-year service life.

Photos by R. M. Haddock.

and attendant round-point setscrews enabled the entire installation without a single penetration through the Galvalume® steel roof's surface, even though there were more than 10,000 individual attachment points.

The PV modules were preloaded to the roof, distributed, and installed in only 10 days. Installers I.C.E. Builders Inc., Anaheim, Calif., achieved production rates of almost 800 panels per day. According to Tyge Nason, superintendent on the project, this is faster than any other system he has installed. Mark Shervin, an electrician for Absolute Power Systems, Santa Clarita, Calif., adds that the specially designed S-5! clamps also made the installation of the electrical chases easier.

Power-Generation Equation

The system consists of PV panels from Sanyo (Model HIP-190BA2), each of which produces 190 watts of DC power—considered one of the most powerful units on the market today, with power conversions by Xantrex Technology. The 4,032 Sanyo panels use mono- and poly-crystalline technology to translate the sun's rays into DC power.

The power modules are connected in strings of eight units (in series), then run through a chase at the ridge area to combiner boxes containing 504 fuses—one for each string of units. Power then is wired through a disconnect switch and into an inverter (three required on this job) to translate the DC power into 208-volt AC power, which then is bumped up to 480-volt three-phase for consumption by the vineyard.

The system also is grid connected, meaning any excess power produced by the array will be fed back into the utility grid and sold to the local utility, which avoids still more burning of fossil fuels and helps with system payback to Strong. Once the power conversion is complete, the system will provide about 680,000 watts of AC power.

Installation of the mammoth system (there are only a handful of systems this size in the United States) was completed at a cost of $5.61 per watt DC. Lending to such speedy and low cost installation was the fact that the mounting platforms for the array were standing seam metal roofs that already capped the existing barrel aging rooms. These pre-engineered metal buildings constructed of systems from Metallic Buildings and VP Buildings sport state-of-the-art 24-inch (610-mm) trapezoidal rib standing seam roof panels.

The system is monitored by a data-acquisition system (DAS) that constantly and electronically tracks the power output and transmits the information to PowerLight headquarters via modem or fiber optics. If power output becomes diminished (a rare occurrence), a technician can be dispatched to the site. He will look at the combiner boxes, and a fuse light will tell him which "string" to check for problems. He then can reference the as-built drawing to find the location of that string on the rooftop. Everything is surface-mounted for easy access. The panels are warranted for output by the manufacturer for 20 years but are expected to have a service life about double that.

Weighing the Options

Rodney Strong is a family-owned vineyard founded in 1959. Jim Magnus, facilities manager for the winery, began researching PVs about five years

Factoids

Photo by R. M. Haddock.

The vineyard's barrel-aging warehouse stores 40,000 barrels of wine. Each one contains 65 gallons.

- The photovoltaic power-generation system at Rodney Strong Vineyards, Sonoma County, Calif., is the largest system ever installed at a winery, the largest system in Sonoma County, and the largest that PowerLight has ever installed on a metal roof.
- At peak output, the generation system will produce enough electricity to power about 800 single-family homes.
- This system will pay back the owner's investment in about 10 years.
- The 8,872 tons (8048 metric tons) of carbon dioxide the system keeps out of the environment during the next 40 years is equivalent to removing 59 cars from the roadways each year or not driving 22 million miles (45 roundtrips to the moon). It takes 2,502 acres (1012 hectario) of trees to absorb 8,872 tons (8049 metric tons) of CO_2.

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ago. He chose PowerLight to manage the project because the company was the only system integrator around that had installed similar-sized systems in the past. "There are a lot of outfits jumping into this PV business. We didn't want to be a teething ring for some newcomer to the industry," Magnus says. He looks forward to energy savings from the new system, which will produce about 30 percent of the vineyard's power requirements.

PowerLight has been installing PV systems since 1991 and has additional offices in New Jersey and Hawaii. The company owns several patents for specialized PV systems designed for installation over flat membrane roofs. This is the largest project it has undertaken over a low-slope metal standing seam roof, and it is quite pleased with the outcome. "We're delighted that Rodney Strong is setting such a positive example for the wine industry by deploying reliable, environmentally responsible, and cost-effective solar power," says Dan Shugar, PowerLight's president.

Photo by R.M. Haddock

The December sun casts a long shadow. P.V. modules are carefully laid out so no cells are obscured by the adjacent parapet.

The concept of mingling PV arrays with standing seam metal roofing is growing—and for good reason. A 40-year power source on a 40-year roof without any surface penetration perhaps is the most sustainable roofing solution available today. Unlike sheet-membrane roofs that require replacement before the usable life of the PV expires, the standing seam metal roof has a life expectancy consistent with that of the crystalline modules.

This factored into decisions at the vineyard. Originally, Magnus was considering the installation on an existing EPDM roof system. PowerLight concluded, however, that the existing roof would need to be replaced with one more compatible with a PV system from both a mounting and service-life standpoint. Standing seam metal was a perfect fit.

The metal roof/crystalline PV combination also weighs less than 3½ pounds (1½ kg) net total per square foot of roof area. (Metal roof system ≤ 1.7 pounds [0.77 kg]; P.V. module ≤ 1.8 pounds [0.8 kg] net) As far as eco-friendly roofs are concerned, such a lightweight system can have tremendous cost impact when it comes to the design of the supporting structure and deck type. In comparison, another eco-friendly option of a vegetative roof can add (dead plus

live) loads of 15 to 100 pounds (7 to 45 kg) and costs up to $20 per foot plus solar modules. Metal, on the other hand affords environmental responsibility at a fraction of these figures—generally under $6 per square foot.

Other attributes of installing a PV system over metal include availability in terms of rooftop inventory. During the last decade, about 700 million square feet (65 million m^2) of low-slope standing seam metal and about the same amount of architectural profiles on steep applications have been installed annually. This means there are plenty of potential sites for PV arrays. Using the penetration-free S-5! attachment technology, it costs 60 cents to $1 per watt less to install PV arrays over metal as opposed to conventional membrane roofing. That can translate into as much $7 per square foot of roof area in cost savings.

The Ultimate Cool Roof

Environmental concerns with respect to roof temperatures have been a "hot" topic in recent years. High roof-surface temperatures cause heightened cooling loads, burning still more fossil fuel and putting even greater demand on overtaxed 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. The combination of a PV installation over standing seam roofing may prove to be the ultimate cool roof, saving Rodney Strong Vineyards significant cooling costs in the summer. Having PV modules raised several inches above the surface of a roof casts the metal roof panel in shade and creates an air plenum. The shading effect and movement of air through the plenum reduce rooftop temperatures by as much as 65 F (18C), reducing the building's cooling load, according to recent research at Oak Ridge National Laboratory, Oak Ridge, Tenn.

For More Information

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Rob M. Haddock, director of the Metal Roof Advisory Group Ltd., is a well-known expert and educator in the field of metal roofing technologies. He is a member of the National Roofing Contractors Association, ASTM, the Systems Builders Association, and the Metal Construction Association. Haddock also is a course author and faculty member for the Roofing Industry Educational Institute, the Roof Consultants Institute, and the University of Wisconsin School of Engineering.