



Courtesy: Solar Living Design

**PROJECT:** Ive—Benjamin residence  
**SYSTEM TYPE:** Residential grid-direct PV  
**INSTALLER:** Solar Living Design,  
[www.solarlivingdesign.com](http://www.solarlivingdesign.com)  
**DATE COMMISSIONED:** July 2008

**LOCATION:** Lakewood, Colorado,  
 39.7° N latitude

**AVERAGE DAILY SOLAR RESOURCE:**  
 5.5 peak sun-hours

**ARRAY CAPACITY:** 9.12 kW STC

**AVERAGE ESTIMATED ANNUAL PRODUCTION:**  
 12,901 AC kWh (per PVWatts)

**AVERAGE ANNUAL UTILITY  
 ELECTRICITY OFFSET:** 100%

**MODULES:** 48 Sanyo HIT Double bifacial,  
 190 W STC each

**INVERTERS:** Two Sunny Boy 5000U,  
 10 kW rated output

**ARRAY INSTALLATION:** Integrated awning  
 designed by Solar Living Design, 22° tilt

## Sun & Shade with a 9.12 kW PV Awning System

Besides plans for PV, Diana Ive and her husband Delmar Benjamin wanted a patio constructed to shade the large, south-facing deck and bank of southeast-facing windows, which admitted too much sun into the house during the summer months.

So when Diana stumbled across a rendering of a solar-electric awning over a walkway that used glass-on-glass modules, the wheels started turning. She sought out local

**Delmar agreed to design the sealed awning structure to support the modules, paying special attention to provide strategies for hiding the wiring and keeping the back of the array free from shading.**

PV installer Greg Koss of Solar Living Designs to see how the modules could be integrated into a patio structure. Koss found the modules: Sanyo's HIT series of bifacial modules, which generate energy from both sides of the module while allowing some light to pass through. But the question of how to best incorporate the modules into a shade structure was turned over to Delmar.

Famous in aviation circles for flying his Gee Bee racer, an airplane many called the "Widow Maker," Delmar had

lots of experience working and designing with aluminum after decades in the aviation industry. He agreed to design the awning structure to support the modules, paying special attention to strategies for hiding the wiring and keeping the back of the array free from shading.

"Delmar paid exceptionally close attention to detail," Koss says. "I can remember hanging one of the aluminum beams: Delmar checked the measurement, and it was 1/8 of an inch off. We pulled it, drilled new holes, and got it back up within 1/16 of an inch." In the end, it was this attention to detail that made everything slide into place perfectly, resulting in a beautifully constructed array.

After the PV installation was complete, simulated white marble porcelain tiles were laid on the patio deck below the array canopy. With their relatively high reflection value, they help bounce more of the sun's energy to the bottom of the modules. After laying the tile, says Koss, the array's output increased by about 6%.

—Justine Sanchez, with Greg Koss