BUILDING AMERICA TOP INNOVATIONS HALL OF FAME PROFILE

INNOVATIONS CATEGORY:

2. House-as-a-System Solutions
2.1 New Homes with Whole-House Packages

High-Performance with Solar Electric Reduced Peak Demand:

Premier Homes, Rancho Cordoba, CA

The 95 homes in Premier Gardens are equipped with photovoltaic panels that take advantage of solar energy to offset peak power loads during the hottest part of the day.

Building America's solar electric home projects have demonstrated the ability to reduce peak demand by 75%. In addition to substantial energy savings, this can have major impacts such as reducing rolling black-outs in resource-constrained, high-growth markets.

BUILDING AMERICA TOP INNOVATIONS

Recognizing Top Innovations in Building Science – The U.S. Department of Energy's Building America program was started in 1995 to provide research and development to the residential new construction and remodeling industry. As a national center for world-class research, Building America funds integrated research in market-ready technology solutions through collaborative partnerships between building and remodeling industry leaders, nationally recognized building scientists, and the national laboratories. Building America Top Innovation Awards recognize those projects that have had a profound or transforming impact on the new and retrofit housing industries on the road to high-performance homes.

As the housing market continues to evolve toward zero net-energy ready homes, Building America research has provided essential guidance for integrating renewable energy systems with high-performance homes and showing how they align with utility peak-demand reduction interests.

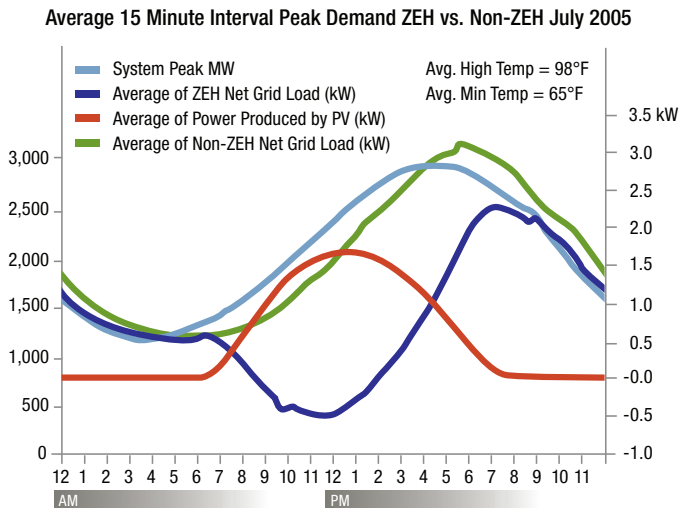
Solar photovoltaic technology is an attractive option for utilities because they can reduce reliance on fossil-fuel energy. More significantly, it reduces peak demand because systems produce the most power on sunny summer afternoons coincident with the highest demand for air conditioning.

Photovoltaic systems have been a part of several research projects conducted by the U.S. Department of Energy's Building America program. In 2007, Building America published a best practice guide for builders, *Solar Thermal & Photovoltaic Systems* (Baechler et al. 2007), with case studies featuring 13 of these projects. One case study involved Premier Homes, which worked with the Building America team ConSol and the Sacramento Municipal Utility District (SMUD) on a large solar home project in Sacramento, California, called Premier Gardens. Consol developed an energy-efficiency package including solar photovoltaic panels to generate electricity (see sidebar on back side) and SMUD monitored electricity use.

Premier Gardens was one of two energy-efficient neighborhoods that were built side by side in Rancho Cordoba, California, in 2004. The two sets of homes were nearly identical in size and price, and both exceeded the California Title 24 energy cooling requirements by as much as 30%. However, only the 95 homes at Premier Gardens had the energy efficiency and solar upgrade package. SMUD monitoring data for 2005 revealed that the Premier Gardens homes drew an average of 13% less power from the grid than the 98 homes in the other neighborhood over the course of the year. The more impressive finding is that peak energy demand for Premier Gardens homes was 75% lower than for the neighboring homes during the area's hottest July on record. This is significant because reducing peak energy demand can help reduce the likelihood of rolling black-outs when summer temperatures soar. It's also attractive for customers who pay more for electricity during peak demand times.

"The ability of solar to level out air conditioning-driven peak demand makes it a desirable investment for utilities and for consumers."

Bruce Baccei, ConSol



In July 2005, outdoor temperatures reached 98°F and air conditioners ran full force, yet the solar-equipped homes' net electricity demand (dark blue) actually dropped during the hottest part of the day. The red line shows the average power being produced by the solar systems in Premier Gardens. In contrast, the power demand of the neighboring, energy-efficient community (green) and the average system demand (light blue) rose steadily during the day.

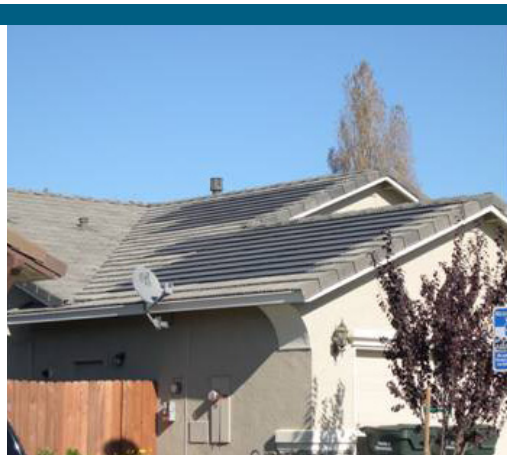
Overall, the solar panels produced about 10% more power than expected. Each home's 2.2-kW photovoltaic system produced about 3,330 kWh during the 12 months studied, about half the average consumption of each household (7,007 kWh). Premier Homes chose to install photovoltaic tiles that are similar in dimension to cement roof tiles. The PV tiles lay on the roof shingle-fashion to blend with the roofing.

The entire energy efficiency package, including solar tiles, cost $10,000 to $15,000, but financial incentives from SMUD helped keep the solar systems cost-effective for homebuyers. SMUD contributed about $7,000 per home toward the cost of each PV system. Premier Homes offset the remaining cost by including fewer high-end aesthetic features, such as granite countertops, so the homes would sell at a price comparable to the neighboring homes.

Premier Homes offered photovoltaics as a standard feature on several developments after Premier Gardens was completed. SMUD continues to conduct research and demonstration projects for energy efficiency.

Lessons Learned

- "The first step in designing a near zero-energy home is to significantly reduce the home's overall energy use. This enables the home builder to install a smaller, less expensive PV system to meet the home's electrical needs," said Rob Hammon of ConSol.
- SMUD learned that west-facing systems contributed more to peak-demand reduction, which has helped shape their future solar electric incentive programs.



Premier Homes chose photovoltaic tiles that lay on the roof shingle-fashion and blend in with the concrete roofing tiles.

KEY ENERGY-EFFICIENCY MEASURES

Envelope:

- Attic: R-38 insulation
- Walls: R-13 batt insulation, plus 1-inch rigid foam exterior sheathing insulation
- Windows: Vinyl-framed, spectrally selective (U=0.33-0.37, SHGC=0.32-0.35)

HVAC:

- Furnace: 0.91 AFUE gas
- Air conditioner: SEER 14
- Ducts: R-4 insulation, duct-blaster tested, buried in attic insulation

Components:

- Photovoltaic system: 2.2-kW GE Energy AC
- Water heater: Tankless, on-demand
- Lighting: 100% CFLs

REFERENCES

Baechler MC, TL Gilbride, KA Ruiz, HE Steward, and PM Love. 2007. *Building America Best Practices Series, Volume 6: High-Performance Home Technologies: Solar Thermal & Photovoltaic Systems*. NREL/TP-550-41085; PNNL-16362, Prepared by Pacific Northwest National Laboratory for the U.S. Department of Energy. http://apps1.eere.energy.gov/buildings/publications/pdfs/building_america/41085.pdf

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