

# Price Premium Analysis of a Multi-State Dataset of Solar Homes

## Host-owned rooftop solar adds significant value to U.S. homes across 8 states

*Ben Hoen & Ryan Wiser, Lawrence Berkeley National Laboratory; Sandra Adomatis, Adomatis Appraisal Services; Thomas Jackson, Real Property Analytics/Texas A&M University; Joshua Graff-Zivin, University of California at San Diego; Mark Thayer, San Diego State University; Geoffrey T. Klise, Sandia National Laboratories*

### Overview

Homes with solar photovoltaic (PV) systems have proliferated in the United States recently, reaching more than half a million in 2014, in part due to plummeting PV costs and innovative financing options. The U.S. Department of Energy estimates that achieving its SunShot PV price-reduction targets could result in 108 gigawatts of residential rooftop PV installed by 2050—equivalent to 30 million U.S. PV homes. As PV systems become an increasingly common feature of U.S. homes, the ability to value these homes appropriately will become increasingly important. At the same time, capturing the value of PV to homes will be important for facilitating a robust residential PV market.

Appraisers, real estate agents, and other property valuers have made strides toward valuing PV homes, and several limited studies have suggested the presence of PV home premiums, but gaps remain in understanding these premiums for housing markets nationwide. To help fill these gaps, researchers from Lawrence Berkeley National Laboratory (LBNL) and their collaborators from other institutions conducted the most comprehensive PV home premium analysis to date. The study more than doubles the number of PV home sales previously analyzed, examines transactions in eight states, and spans the years 2002–2013. The results impart confidence that PV consistently adds value across a variety of states, housing and PV markets, and home types.

### Data and Methods

The study used data on PV homes from LBNL's *Tracking the Sun* report series with corresponding real estate information and information on similar non-PV homes. These data span the years 2002–2013 and eight states: California, Connecticut, Florida, Massachusetts, Maryland, North Carolina, New York, and Pennsylvania. The PV and non-PV homes were matched, resulting in a dataset of 18,871 non-PV homes (including 6,036 newly built homes) and 3,951 PV homes (including 1,444 newly built homes). All PV systems in this dataset were homeowner owned rather than leased. The sample included homes no more expensive than \$900,000.

These data were analyzed using hedonic (regression) pricing models to account for various home/site, neighborhood, and market characteristics. A number of models were estimated and compared, ensuring the results were robust to data and model specification. Contributory-value estimates also were generated for comparison based on net cost (PV cost after federal, state, and utility incentives), gross cost (PV cost before incentives), and income (value of energy savings from PV systems).

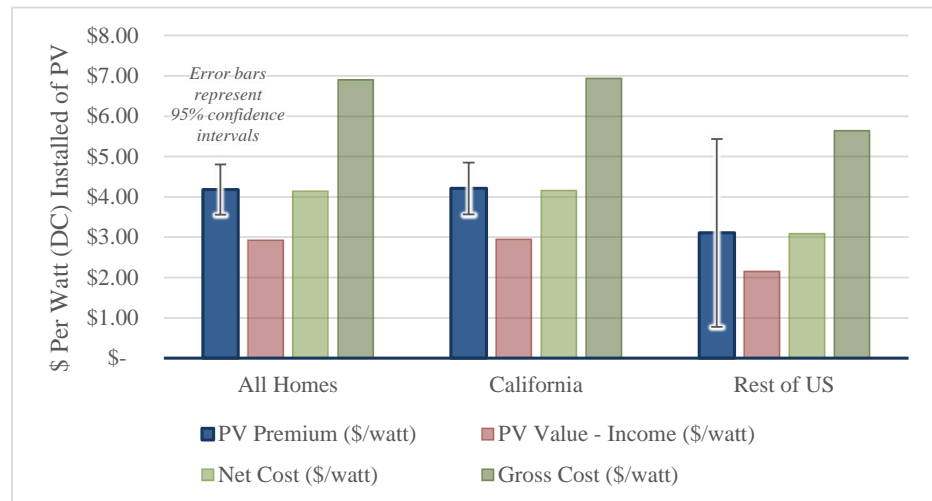
This fact sheet summarizes the full report: Hoen, B., S. Adomatis, T. Jackson, J. Graff-Zivin, M. Thayer, G.T. Klise, and R. Wiser. 2014. *Selling into the Sun: Price Premium Analysis of a Multi-State Dataset of Solar Homes*. Berkeley, CA: Lawrence Berkeley National Laboratory. The full report, along with a summary slide deck and data file, is available [here](#) or via [emp.lbl.gov/reports](http://emp.lbl.gov/reports).

The research was supported by funding from the U.S. Department of Energy SunShot Initiative. The SunShot Initiative is a collaborative national effort that aggressively drives innovation to make solar energy fully cost-competitive with traditional energy sources before the end of the decade. Through SunShot, DOE supports efforts by private companies, universities, and national laboratories to drive down the cost of solar electricity to \$0.06 per kilowatt-hour. Learn more at [www.energy.gov/sunshot](http://www.energy.gov/sunshot)



## Results and Conclusions

- Home buyers consistently have been willing to pay more for a property with PV across a variety of states, housing and PV markets, and home types.
- Premiums for PV homes are \$1.10/watt larger in California than outside of California, but this difference is not statistically significant, and it seems to reflect the net cost of PV systems in each area (Figure 1). Moreover, the findings should provide greater confidence that PV adds substantial value to non-California homes.



**Figure 1: All-homes and location-based PV home premium results compared with contributory-value estimates**

- Net cost estimates—which account for federal, state, and utility incentives—seem to be the best proxy for market premiums. Income estimates using the PV Value® algorithm are consistently lower than market premiums, possibly due in part to the sensitivity of this method to electricity-rate assumptions.
- PV premiums remained fairly consistent even as PV gross costs decreased dramatically over the study period, suggesting that net cost, rather than gross cost, is the dominant market signal.
- In contrast to previous studies, this study found only a small and non-statistically significant difference between PV premiums for new and existing homes, likely because this study includes many more sales and recent sales while excluding very-high-priced homes.
- A “green cachet” might exist for PV homes; that is, buyers might be willing to pay a certain amount for having any size of PV system on their homes and then some increment more depending on the size of the system.
- The market appears to depreciate PV systems in their first 10 years at a rate exceeding the rate of PV efficiency losses. The study data do not allow analysis of depreciation into the second decade of PV systems’ operation—this is an area for future research.
- This study focuses only on homes with host-owned PV systems, not those with leased PV systems. Future analysis should focus on leased systems, as they are a growing portion of the PV home market.

For more information on the Electricity Markets & Policy Group, visit us at [www.emp.lbl.gov](http://www.emp.lbl.gov)

For all of our downloadable publications, visit <http://emp.lbl.gov/reports>

