

# **Installed cost of solar photovoltaic systems in the US declined significantly in 2010 and 2011**

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The installed cost of solar photovoltaic (PV) power systems in the United States fell substantially in 2010 and into the first half of 2011, according to the latest edition of an annual PV cost tracking report released by the Department of Energy's Lawrence Berkeley National Laboratory (Berkeley Lab).

The average installed cost of residential and commercial PV systems completed in 2010 fell by roughly 17 percent from the year before, and by an additional 11 percent within the first six months of 2011. These recent installed cost reductions are attributable, in part, to dramatic reductions in the price of PV modules. Galen Barbose of Berkeley Lab's Environmental Energy Technologies Division and co-author of the report explains: "Wholesale PV module prices have fallen precipitously since about 2008, and those upstream cost reductions have made their way through to consumers."

The report indicates that non-module costs—such as installation labor, marketing, overhead, inverters, and the balance of systems—also fell for residential and commercial PV systems in 2010. "The drop in non-module costs is especially important," notes report co-author and Berkeley Lab scientist Ryan Wiser, "as those are the costs that can be most readily influenced by solar policies aimed at accelerating deployment and removing market barriers, as opposed to research and development programs that are also aimed at reducing module costs."

According to the report, average non-module costs for residential and commercial systems declined by roughly 18 percent from 2009 to 2010.

Turning to utility-sector PV, costs varied over a wide range for systems installed in 2010, with the cost of systems greater than 5,000 kilowatts (kW) ranging from \$2.90 per Watt (W) to \$6.20/W, reflecting differences in project size and system configuration, as well as the unique characteristics of certain individual projects. Consistent with continued cost reductions, current benchmarks for the installed cost of prototypical, large utility-scale PV projects generally range from \$3.80/W to \$4.40/W.

The market for solar PV systems in the United States has grown rapidly over the past decade, as national, state and local governments offered various incentives to expand the solar market and accelerate cost reductions. The study—the fourth in Berkeley Lab's "Tracking the Sun" report series—describes trends in the installed cost of PV in the United States, and examined more than 115,000 residential, commercial and utility-sector PV systems installed between 1998 and 2010 across 42 states, representing roughly 78 percent of all grid-connected PV capacity installed in the United States. Naïm Darghouth, also with Berkeley Lab, explains that "the study is intended to provide policy makers and industry observers with a reliable and detailed set of historical benchmarks for tracking and understanding past trends in the installed cost of PV."

## **Costs Differ by Region and by Size and Type of System**

The study also highlights differences in installed costs by region and by system size and installation type. Comparing across U.S. states, for example, the average cost of PV systems installed in 2010 and less than

10 kilowatts (kW) in size ranged from \$6.30/W to \$8.40/W depending on the state. The report also found that residential PV systems installed on new homes had significantly lower average installed costs than those installed as retrofits to existing homes.

Based on these data and on installed cost data from the sizable German and Japanese PV markets, the authors suggest that PV costs may be driven lower through large-scale deployment programs, but that other factors are also important in achieving cost reductions.

The report also shows that PV installed costs exhibit significant economies of scale. Among systems installed in 2010, those smaller than 2 kW averaged \$9.80/W, while large commercial systems >1,000 kW averaged \$5.20/W; partial-year data for 2011 suggests that average costs declined even further in 2011. Large utility-sector systems installed in 2010 registered even lower costs, with a number of systems in the \$3.00/W to \$4.00/W range.

## **Cost Declines for PV System Owners in 2010 Were Partially Offset by Falling Incentives**

The average size of direct cash incentives provided through state and utility PV incentive programs has declined steadily since their peak in 2002. The dollar-per-Watt benefit of the federal investment tax credit (ITC) and Treasury grant in lieu of the ITC, which are based on a percentage of installed cost, also fell in 2010 as a result of the drop in average installed costs.

The reduced value of federal, state, and utility incentives in 2010 partially offset the decline in installed costs. Therefore, while pre-incentive installed costs fell by \$1.00/W and \$1.50/W for residential and commercial PV in 2010, respectively, the decline in "net" (or post-

incentive) installed costs fell by \$0.40/W for residential PV and by \$0.80/W for commercial PV.

**More information:** The report "Tracking the Sun IV: An Historical Summary of the Installed Cost of Photovoltaics in the United States from 1998 to 2010," by Galen Barbose, Naïm Darghouth, and Ryan Wisner, may be downloaded from

[eetd.lbl.gov/ea/emp/reports/lbnl-5047e.pdf](http://eetd.lbl.gov/ea/emp/reports/lbnl-5047e.pdf)

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