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The Current Disruptive State of Photovoltaics

by Ben Bunker



Editor's Note: Renewable energies often been regarded as a distant cousin to high performance construction. They're situated, after all, on different sides of the meter, with renewables supplying energy, and good buildings reducing demand. Serious practitioners have always understood the relationship between the two, and the good sense of spending money on improving the building before investing in renewables. Until now.

The possibilities of installing photovoltaic systems in distributed locations is now on everyone's radar. Building owners who would not have considered installing PV a few years ago, are now doing so in droves. And, much to the consternation of many home performance people, these systems are sometimes installed on buildings that could use some work to improve their energy efficiency. It's an old tension between supply-side and demand-side energy management, and one which Ben is well qualified to discuss.

Public awareness of the residential photovoltaic industry has skyrocketed in recent years due to impressive marketing campaigns, technological advances, and third-party financing models that are making solar more obtainable than ever to the average homeowner. The energy-efficiency industry on the other hand, while also enjoying high public awareness, is relatively mature and driven by comparatively incremental innovation. In a race for the hearts, minds, and pocketbooks of the American consumer, we have to ask if energy efficiency is in danger of losing its historical position in the residential market. In this article, I'll analyze a few trends that may begin to answer this question, and I'll seek to cut through the hype. And in the end, my conclusion will be that the nature of the relationship between photovoltaics and energy-efficiency should be viewed as collaborative, not adversarial.

In 2014, the U.S. solar photovoltaic (PV) industry installed a record 6.2 Gigawatts (GW) of capacity across the country—enough to power 100,000 homes (1). Much of this growth occurred in the residential

market where a combination of the falling cost of PV and new third-party financing models like power-purchase agreements, leases and solar loans made solar more affordable than ever to the average consumer. These new financing models were the primary reason that, for the first time ever, more than half a GW of residential solar PV was installed in 2014 without any state or utility incentives.

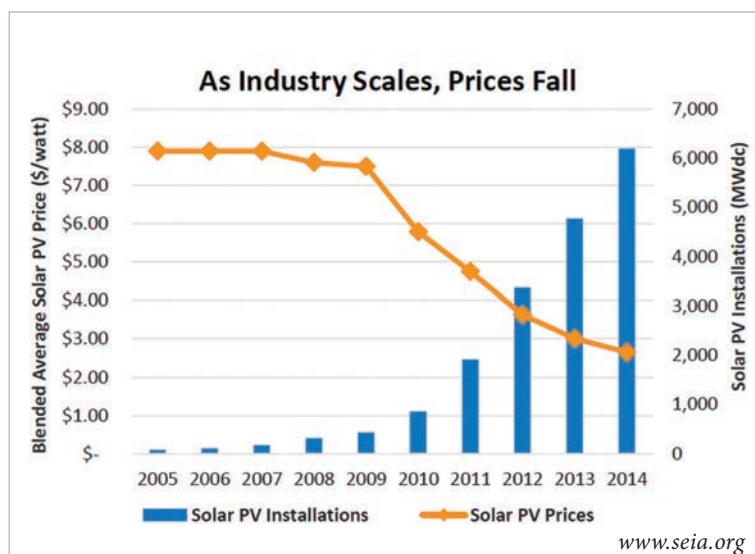
At first glance, the rapid expansion of the solar into the residential market may appear to pose a threat to established energy efficiency programs and initiatives. There are a number of scenarios worth considering.

- What if builders chose to install solar panels rather than including additional energy efficiency measures in their homes?
- What if states and local jurisdictions looking to achieve net-zero in the residential sector allowed builders to trade off efficiency upgrades with solar PV?
- What if homeowners looking lower their energy bills saw solar as a more cost effective option than a whole-home energy retrofit?

With all this uncertainty, it seems fair to ask: how disruptive will the rapid expansion of residential solar be in the new home construction and existing retrofit markets?

Industry Hot Spots

Partnerships between major production builders and solar PV installers are forming that have the potential to significantly increase the market penetration of solar in the new home construction market. Much of this activity originated in the mid-2000s in the California market through \$400 million in funding made available through the New Solar Homes Partnership (NSHP). The NSHP aimed to deploy 1,750 MW of residential solar through rebates administered by three major investor owned utilities in the state (Pacific Gas & Electric, Southern California Edison, and San Diego Gas & Electric). As of Spring 2015, the NSHP has almost reached its goal, however, the future for solar in the new home industry will likely be driven by third-party financing models, not state or utility rebate programs (2).



Builders including KB Home, Richmond American Homes, Lennar, Standard Pacific, and Pulte are all seeing success in California partnering with companies like SunPower and SolarCity to offer solar to their customers. Solar installers are offering a compelling business proposition: through solar leasing programs administered by the installation companies, builders can now offer solar PV to their homebuyers without incurring any additional costs themselves. In other words, builders are now able to market solar equipped homes to homebuyers without charging a price premium. Even more attractive is that from the homebuyer's perspective, there is little impact on the home buying process beyond signing a separate agreement with the solar installer.

This model is beginning to spread to other states with high solar potential and/or favorable solar policies like Arizona, Colorado, Maryland, New Jersey, Oregon, Texas, and Florida. Consider that in 2014, the five builders mentioned above closed on over 54,000 homes nationwide and you begin to see the potential for this type of model to become a significant driver for increasing the penetration of solar in the new home market. Indeed, SolarCity already has partnerships in place with more than 30 homebuilders across the country including major production builders like Taylor Morrison, Toll Brothers, and Shea Homes (3).

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The rapid expansion of residential solar may pose more of a direct challenge to home performance professionals offering whole-home energy efficiency retrofits. Homeowners who are interested primarily in lowering their utility bills may see solar as a better option than a deep energy efficiency retrofit.

In an article for Green Building Advisor, Martin Holladay compares the relative cost effectiveness of a deep energy retrofit and a solar PV installation paid in full by a homeowner. Holladay looks for the tipping point at which solar makes more financial sense than efficiency upgrades. He concludes that the current price of installed PV should guide these decisions. Assuming that the cost of installing a 1-kW array is \$7,000, energy efficiency upgrades should only be pursued if a \$7,000 investment will yield more savings than the energy generated by 1-kW array installed in the location in question (5).

As the cost of installed solar continues to drop, this math will increasingly favor solar and this does not account for situations in which homeowners choose a zero-down solar loan or lease rather than paying for the system in full at the time of purchase.

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Can We Have Photovoltaics AND Efficiency?

The growth in popularity of solar PV among home builders should not be viewed as a direct challenge to existing utility-implemented energy efficiency programs targeting the new construction market.

Energy efficiency programs usually score highly on utility cost-effectiveness tests and have a proven track record of delivering savings with a high return-on-investment (ROI). Programs like EPA's ENERGY STAR Certified Homes Program continue to issue tens of thousands of certifications each year to homes nationwide, even in areas without strong utility support.

In fact, over 80,000 homes earned the ENERGY STAR in 2014, bringing the total number of homes certified through that program close to 1.6 million. Some large production builders like Meritage Homes, Beazer Homes, and KB Home have even committed to having all of their homes earn the ENERGY STAR.

Direct tradeoffs between efficiency and solar may arise in the future as building codes move towards increasingly flexible models in an effort to eventually achieve the goal of net zero energy in the residential sector. The 2015 International Energy Conservation Code includes a new compliance alternative in which builders can meet code requirements by achieving a particular Energy Rating Index (ERI). One example of an ERI that is already in widespread use is the RESNET Home Energy Rating System, which is used to rate one-third of all new homes (4). Now that builders can be awarded points towards achieving an ERI score by installing solar, they may opt to install PV rather than pursue deeper more extensive energy efficiency improvements, especially in situations in which a solar installer provides third-party financing for the installation that reduces or eliminates direct costs to the builder.

A similar scenario is already playing out in California where a proposal under consideration would amend the state's Title 24 energy code to allow solar PV systems of approximately 2 kilowatts to serve as a tradeoff for high performance walls and high performance attics in new homes. The energy and economic impacts of this proposal are still unclear but debates over the relative cost effectiveness of energy efficiency and solar PV are sure to continue as more states adopt the ERI model or something similar.

The Current Pressure Points

There is certainly a point at which efficiency upgrades are not the most economical way to lower a homeowner's utility bill, however, efficiency still delivers something solar cannot: comfort and health. There is no amount of solar that can fix common issues like hot and cold spots or uneven temperatures from room to room that are the

reason that many homeowners contact home performance contractors in the first place. And high-performing homes are increasingly recognized as healthier due to better moisture control and reduced intrusion of pollutants. From this perspective, solar and efficiency should be viewed as complementary tools for achieving the goal of comfortable and healthy homes with low utility bills.

Ideally every solar installation should include air sealing and insulation measures as well as high ROI upgrades like efficient lighting. These efficiency upgrades would subsequently reduce the size of the array needed to power the home. A few years ago SolarCity attempted to do just that but found it impossible to standardize retrofit work at scale. They have since shifted to relying on a simulation engine that uses data analytics to identify potential efficiency upgrades and then connects consumers to local contractors who can perform the work. (6)

It is worth noting that solar still faces a major short term hurdle when the Federal Investment Tax Credit steps down from 30 percent to 10 percent after 2016. Research from Green Tech Media indicates that, based on an analysis of 20 state markets, only 3 states will have distributed solar generation costs below grid electricity prices after the ITC is lowered. It seems clear that there are certain markets in which the economics for solar may no longer be favorable, which in turn will reduce the availability of solar to consumers.

What I Expect in the Future

Solar PV is already having a significant impact on the new home construction and existing home retrofit market, but the growth of solar does not herald the end times for the energy efficiency industry. Efficiency will continue to be popular option for new home builders, and there is little evidence to suggest that the growth of PV will result in reduced availability of rebates and incentives for energy efficiency from utilities. Solar and efficiency may soon both be regarded as options for code compliance through energy modeling, although efficiency will likely continue to be the preferred option for the time being because efficiency is already part of many builders' construction practices.

Energy efficiency and solar PV seek to solve the same homeowner pain points like rising utility bills, but they approach these issues in different ways. The advantages of each approach are amplified when they are implemented together. For example, the most cost effective way to achieve a net-zero energy home is by implementing efficiency first and then installing solar, rather than simply installing a large solar array to cover the home's entire energy needs. Even if a homebuilder or homeowner opted to install a larger array, the home would suffer from comfort issues unless it featured some level of energy efficiency. In the existing home retrofit market in particular, this means that home performance contractors may need to emphasize the benefits of comfort and/or consider identifying a solar trade ally.

In the end, energy efficiency and solar PV should be viewed as complementary approaches to transforming markets and creating a sustainable future. They are not participants in a zero sum game.

Links to resources:

- 1 <http://www.seia.org/research-resources/solar-market-insight-report-2014-q4>
- 2 <http://www.greentechmedia.com/articles/read/Signs-of-the-California-Solar-Initiatives-Coming-End>
- 3 <http://www.greentechmedia.com/articles/read/SunPower-KB-Home-and-the-CSI-Driving-New-Solar-Home-Growth-Surge>
- 4 http://www.builderonline.com/building/code/2015-iecc-what-you-need-to-know_o
- 5 <http://www.greenbuildingadvisor.com/blogs/dept/musings/energy-efficiency-retrofits-insulation-or-solar-power>
- 6 <http://theenergycollective.com/stephenlacey/243716/has-solarcity-created-amazon-1-click-energy-efficiency>
- 7 <http://www.greentechmedia.com/articles/read/What-Happens-When-the-ITC-Expires>



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