Integrating Solar for the Uninitiated

Or, How to Integrate Solar When You Haven't Done It Before

With wind farms and solar (photovoltaic, or PV) arrays dotting the countryside, it is becoming more evident that alternative and renewable energy sources are gaining viability. So how do you implement these systems on your home when you have no idea where to start?

The universal answer is to conserve first. Wind and solar are used to generate power, but there is still a sizable investment required for equipment and storage. Solar water heating is similar, but easier on the wallet. To get the biggest impact from your investment, the first rule is to upgrade the thermal envelope. For an existing home, have a home energy rater (HERS rater) audit your home and explain where the best improvements can be made. For the a new build, specify materials and methods in accordance with Energy Star or National Green Building Program Silver or better requirements. If you have the budget, advance to Passive House standards. The concept here is to minimize the amount of power you will need to condition the inside air, supply hot water, and generate sufficient light as needed.

The next step is to look at equipment. Even with a net zero design (meaning that the building has a low energy requirement that can be satisfied by renewable energy sources to offset any demand from the grid,) wise choices are needed for heating/ventilation/air conditioning as well as hot water. Very efficient systems utilizing heat pump technology are advancing for cold climate applications. Geothermal systems have proven effective, but installation costs are high enough to need help from tax and utility rebates.

With the demand for power reduced in an existing home or new building project, it is time to look at renewable energy sources. It is possible that advancing methods and systems for residential construction can bring all-electric homes into focus. However, even off-the-grid homes have backup systems that cannot be ignored. Pellet stoves for heating and propane-fueled generators will still have a role in an all-electric house.

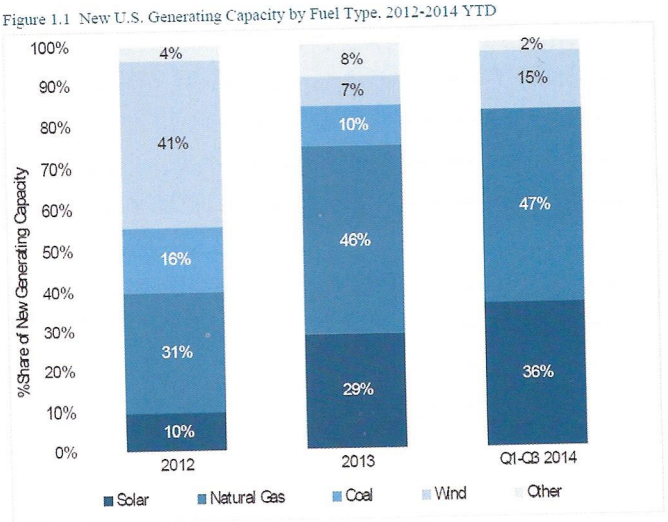
The Solar Energy Industry Association tracks installations and market conditions for solar applications. Indications are that the number of residential installations will exceed commercial installations this year. Their report, **"U.S. Solar Market Insights"** is available on their website, **seia.org/research-resources/solar-market-insight-report-2014-q3**. The report includes some interesting detail, but two key statements grabbed my attention.

1. "Our model shows weighted national residential system costs at $3.60/Wdc in the third quarter (2014), representing a 3.8 percent decrease quarter-over-quarter. Best-in-class installers are achieving lower costs by leaning on high installation volumes that allow the purchase of hardware directly from manufacturers and by amortizing overhead costs over a larger installation base."

2. "Supply chain, customer acquisition, installation labor, overhead and margin, which together constitute the category of 'soft costs,' continue to dominate project costs... Customer acquisition costs are typically anywhere between $0.35/Wdc and $0.50/Wdc."

Another valuable resource for those researching solar applications is the **SunShot Initiative** of the U.S. Department of Energy (**energy.gov/eere/sunshot/sunshot-initiative**.) The SunShot Initiative aims to bring the cost of solar down to $0.06 per kWh by 2020, primarily by reducing the soft costs of solar – installation labor, financing programs, permitting and inspection, and costs relating to marketing, site assessments, and customer meetings.

Figure 1.1 New U.S. Generating Capacity by Fuel Type, 2012-2014 YTD



Source: GTM Research (solar data), FERC (non-solar data)

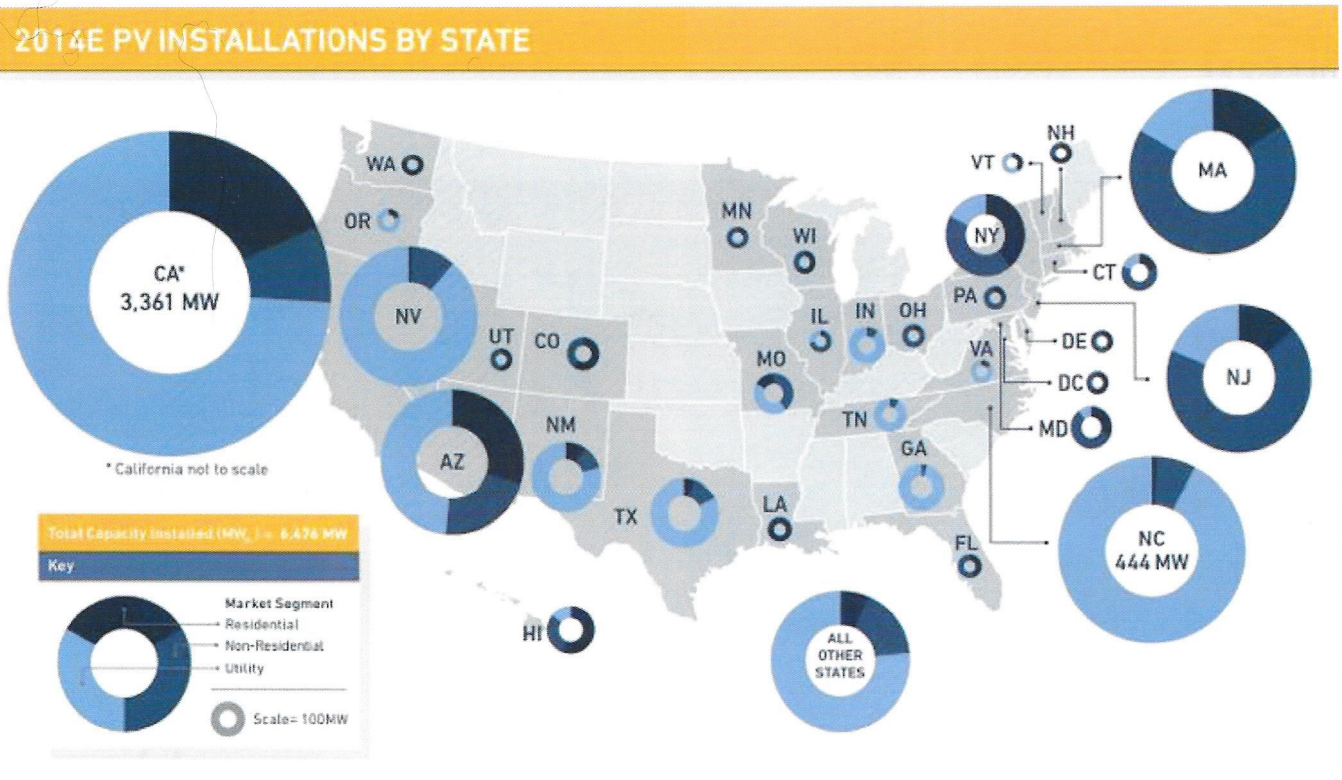
Quickly, I find myself needing to lean on some experts for the answers to questions that will help us all understand how to integrate solar into new home building projects. My first call was to fellow Build Green NH council member, Dan Clapp of Revision Energy (**revisionenergy.com**.)

ROB: Assuming an average New Hampshire home has a good thermal envelope and high efficiency lighting and mechanical equipment, how large of a PV solar array would we need to install?

DAN: This is a hard number to pinpoint since there are many variables. If you do not heat your home with electricity (ground or air source hp,) we can use an average of 600 kilowatt hours per month, or 7,200 kwh per year. Assuming we have a south facing orientation (160-230 degrees) and good solar access (>80 percent annual), a 6.0-6.50 kw array, consisting of 22-24 modules or 375-400 square feet, will provide 100 percent of the homes demand over 12 months using net metering.

ROB: What is the cost ($/watt) to install that array?

DAN: The cost is dependent on location, roof pitch and type, and design and size of the array. The range is $3.50 to $4 per watt, so a 6 to



The SunShot Initiative is working with the National Renewable Energy Laboratory (NREL) to develop low-cost, high-efficiency photovoltaic (PV) technologies. NREL has documented the progress and published the graphic depicting the falling price of utility-scale projects.

6.5 kw array at $3.75 per watt ranges from $22,500 to $24,375 gross cost, or $12,000 to $13,312 net cost after New Hampshire state rebate and 30 percent Federal Tax Credit.

ROB: In our climate, is solar gain reliable all year long? Assuming the answer is no, how does one manage the peaks and valleys to meet the normal demands of the household? What are the trade-offs of 100 percent off-the-grid versus net metering?

DAN: Overall, New Hampshire has a great climate for solar due to good sun and colder ambient temperatures. That said, we do lose our solar resource during the winter months, with solar production dropping around 50 percent when compared to the summer months. This can be managed through net metering, allowing us to size the array using supply vs. demand on an annual basis, providing the homeowner with the most cost effective system. Off grid arrays incorporate battery storage, increasing the array size, cost, and maintenance, but provide true independence from the grid.

ROB: How will integration of PV and hot water solar panels impact the design of the house? Are roof mounted systems the best?

DAN: In my opinion, the design approach of the home should simply come down to efficiency of space, a tight thermal envelope and proper passive solar gain. This will open up the opportunity for solar PV and/or thermal to contribute a higher percentage of the home's energy demands. PV arrays can now offset both base load and space heating loads, assuming the homeowner chooses air or ground source heat pumps. Solar thermal systems can offset a large percentage of space heating needs as long as we have low temperature radiant distribution, and domestic hot water needs can be met with either solar thermal or heat pump hot water tanks. So we look at specific site conditions (azimuth, pitch, shading), available roof space, roof type such as standing seam, and anticipated energy demands prior to coming up with a design.

ROB: What are the life expectancies of the system's components? How much maintenance is required?

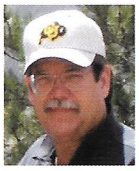
DAN: We expect 20 years plus out of a solar thermal system and 30 plus year out of a GTPV array. The modules come with a standard 10 year workmanship and 25 year production warranty. The inverters range from a 10-25 year warranty. Overall, since there are no moving parts, very little maintenance is needed on a GTPV array.

ROB: What level of participation will the homeowner need to manage? Is an annual service agreement with the installer necessary?

DAN: We feel the homeowner should not have to manage the systems, and we design our systems with this in mind as well as performance and longevity. A solar thermal system should have preventative maintenance performed every 3-5 years, while a GTPV array's performance can be monitored remotely. Overall we do not set up service contracts. If there is an issue we service all manufacturers' warranties on the equipment we install and do a good job at choosing the equipment we install.

Below are some additional resources for New Hampshire folks.

- Energy Star programs: Go to **NHSaves.com**. – Links to each of the NH Utilities is at the bottom of the home page.
- Liberty Utilities – **liberty-utilities.com/east/electricity/net_metering**
- PSNH – **psnh.com/RenewableEnergy/For-Home/Net-Metering.aspx**



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