

Nantucket Energy Office Case Studies: Residential Solar Photovoltaic (PV) Power

June 1, 2012

Ranney Residence:
26 Monomoy Rd.

ACTION:

Installed a 2.025-kilowatt solar PV system in December 2008 to generate electricity & reduce energy costs



About the building and household:

The Ranney residence is a single family, cape-style house built in 1978. The nine solar (PV) panels are mounted on a nearby 14'x16' adjacent shed, which was built on the property in 1980. The shed roof faces approximately 150 degrees magnetic (SSE). The Ranneys are year-round residents and currently live in their solar powered home 12 months per year.



Motivation:

“To save money and use less electricity from the grid.”

— H. Flint Ranney

Key Players:

- The Ranney Family
- National Grid
- Terry Dupuis; Solar Works Inc.
- Commonwealth Solar Program; Massachusetts Technology Collaborative (MTC)
- Nantucket Historic District Commission (HDC)



Flint Ranney reads the production levels of his PV system on the inverter (1). The bi-directional electric meter (2) runs forward or backward depending on energy produced vs. energy consumed.

How PV works:

Photovoltaics is the direct conversion of light into electricity at the atomic level. When the sun's rays strike the semi-conductor material inside the solar cells (usually silicone), electrons become excited and flow into a direct current (DC) of electricity. This current is then fed into an inverter that converts the direct current (DC) into alternating current (AC) electricity, which is then consumed by common household electronics and appliances.

What is a kilowatt-hour (kWh)?

Electric bills are based on kilowatt-hours consumed. A kilowatt-hour is essentially when you use 1000 watts of energy in one hour. For example:

- Using a 1000-watt A/C unit for one hour= 1kWh
- Using a 100-watt light bulb for 10 hours= 1kWh
- Using a 25-watt CFL light bulb for 40 hours= 1kWh

Actions:

Before 2007

- The Ranneys made systematic efforts to reduce their electricity consumption. After having Mass Save perform a home energy assessment, the Ranneys replaced all traditional incandescent light bulbs with compact fluorescent lights (CFLs) and upgraded old and inefficient appliances.

October 2007

- The Ranneys met with Terry Dupuis of Solar Works, Inc. (now Alteris) a Vermont-based solar installer, to determine a feasible location and size for installation of a solar PV and solar hot water system.

Winter 2007-2008

The Ranneys worked with Terry Dupuis to get the permits and authorizations necessary to install the systems. Among these were:

- Approval from the Nantucket Historic District Commission (HDC): The HDC required, among other things, that the solar PV panels be installed directly on the roof without changing the profile of the shed. The straightforward HDC approval may have been a result of the Ranney's home being located outside of the core historic district, and while the panels are visible from the street, they are not obvious or obtrusive.
- An interconnection and net metering agreement with National Grid: The interconnection agreement sets out the requirements for metering and safe connection of the solar PV equipment with the local electric grid. The net metering agreement allows the Ranneys to receive credits on subsequent electric bills when the output of their solar PV facility is greater than their consumption in any billing period.

December 2008

- The Ranneys receive their building permit and begin construction
- The solar PV system installation is completed when National Grid allows the system to be connected to the grid and begin generating electricity. The system as installed is capable of producing up to 2.025 KW from nine SunPower PV panels rated at 225 kW per panel.

Summary of Results

	National Grid kWh YTD	Solar Annual Output	Total Energy YTD	% of Solar (Annual Use)	Dollars Saved at .15 kW	Capacity Factor (Actual output/ maximum name-plate output)
2011 Total	4620	2745	6918	38%	\$411.75	15.5% (2745/17739)
2010 Total	4509	2623	7132	37%	\$393.45	14.8% (2623/17739)
2009 Total	4106	2422	6962	24%	\$381.60	13.7% (2422/17739)
Saved Total	13235	7790	21012		\$1,186.80	
Average/Year	4412	2597	7004	33%	\$395.60	14.7%

Over the past three calendar years (2009 through 2011), the solar PV system generated an average of 2,597 kWh per year. The actual average generation has exceeded the estimated output of 2,490 kWh per year that was projected by Solar Works, Inc. prior to installation.

In the first year alone, the PV system prevented 4325 pounds of CO₂ from being emitted into the atmosphere.*

On bright winter days the system produced more than 3.5 kilowatt-hours of energy; on a sunny day in the late spring it has produced upwards of 13 kilowatt-hours.

The total cost of the PV project was \$25,360, but the Ranneys received almost \$13,000 back within the first year: \$4,050 from the Mass Tech Collaborative, and \$8,600 in federal and state tax credits. In addition, the Town of Nantucket Energy Office is in the process of helping the Ranneys qualify their PV system for Solar Renewable Energy Credit sales, which will bring in an additional \$400 - \$1000 per year (depending on market availability).

Mr. Flint Ranney states that the PV system is no work to maintain. In fact, the rain naturally washes away any pollen, salt, bird-droppings and other residue that accumulates. Snow and ice have never been issues.

Mr. Ranney described the National Grid net-metering program to be "flawless." He frequently compares National Grid's meter readings on his electric bill to the readings he records from his bi-directional meter on a monthly basis, and considers them to be "pretty close."

*Based on SunPower Inverter readings and software

Lessons Learned

What Worked Well:

- Mr. Ranney appreciated working with a professional Project Manager who handled the permitting and oversaw the installation of the system.
- The equipment performs and functions efficiently and without maintenance. Mr. Ranney is equally happy with the system's unobtrusive aesthetics as the high-performance output.

Unexpected Outcomes:

- PV works on the Gray Lady! Even on foggy and rainy days, the system produces 2-3kW.
- The Ranneys' solar home has piqued the interest of many community residents and has proven to be an example of successful renewable energy application on Nantucket.

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