NATIONAL TOUR OF SOLAR HOMES

When It Comes to Solar Energy, Maine Home Shines

PROJECT SNAPSHOT

PROJECT
Solar home

TECHNOLOGY
4.2-kilowatt ASE photovoltaic modules, passive solar design, solar hot water system, and high-efficiency insulation and windows.

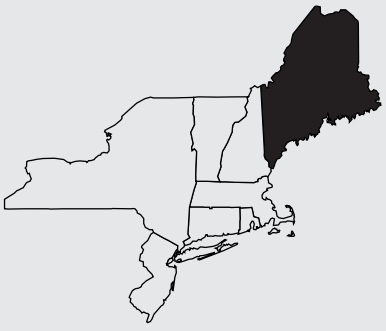
CO_2 EMISSION REDUCTIONS
6,800 pounds annually

INVESTMENT
$32,000 for all of the above energy-saving technologies

LESSONS LEARNED

- To get the most out of the sun, a home should be properly sited, and then designed to take advantage of the available solar energy.
- Net metering is central to the economics of on-site electricity generation.
- Some energy-saving technologies have much shorter payback periods than others.
- New construction allows all of the energy-efficient features to be carefully integrated into the home's overall efficient design.

FUNDING SOURCES
Homeowner



INTRODUCTION

The electric power grid links generators and consumers together with wire. But it is a system plagued by inefficiency, and by environmental risk. Line losses alone may average five percent of total output, and power generation is notorious for its myriad environmental impacts: acid rain, deadly particles, ozone smog, toxics – not to mention global warming.

Imagine, if you will, an alternative grid – a system that joins generator to consumer, one that is linked to others not by wire but by wisdom. That, in essence, is what the Northeast Sustainable Energy Association (NESEA) does each year when it helps to organize the National Tour of Solar Homes. The idea is simple: find private homes and businesses that showcase the effective use of solar power, and open them up over a weekend for a free public inspection. The Tour is an annual, nationwide event, and for the past five seasons NESEA has been its prime sponsor in nine Northeast states. This year NESEA organized 165 owners, and worked on publicity and coordination with local sponsors.

PROJECT DESCRIPTION

One of the most noteworthy homes on the tour is William Lord's 2,900-square-foot residence in Kennebunkport, ME. Built in 1995, Lord's home incorporates a number of highly efficient, environmentally sound technologies. The house has been recognized many times for the effective way it integrates an array of photovoltaic (PV) panels directly into its design. The roof incorporates 4.2 kilowatts (kW) of PV modules manufactured by ASE Americas, Inc. The house also employs a solar hot water system, an air-to-air heat exchanger, radiant floor heating, low-consumption plumbing, a fresh-air intake, passive radon mitigation measures, high efficiency (R-8) windows, vented walls that extend the life of the siding and stain, and propane backup for heating, cooking and clothes drying. The solar-heated water feeds the tap, and provides heat by circulating through radiant tubing built into the floors on the first and second levels.

While the 480-square-feet of panels on half of the roof focus on the single task of producing hot water, the 16 panels on the other half serve as an electric power plant, sending 48 volts of direct current to a basement inverter, which converts it to 240 volts of alternating current.

The house cost a total of $300,000 to build. All told, the environmental features described here accounted for $32,000 of that, or a little more than 10 percent. The architect was Solar Design Associates of Harvard, MA, and Spang Builders was the contractor.

For each of NESEA's tours – and the Lord house was no exception – homeowners were on hand to answer questions, offer information about construction and renovation, discuss operation and maintenance issues, and describe what it's like to live in close proximity to renewable energy technologies. The Tour showcased a wide variety of buildings, from rural and remote single-family houses to urban multi-family dwellings and businesses. They were of many sizes and price ranges, from small self-sufficient cabins and suburban family homes, to large, custom-built residences, and commercial stores and offices. The Tour focused on a range of technologies as well, including passive solar and climate-responsive buildings; active solar systems (among them, domestic hot water and solar electric systems (photovoltaics)); hybrid systems that incorporate more than one power source, such as wind or micro-hydro; and energy-efficient buildings that consume little electricity and have low energy costs.

THE RESULTS

The rooftop PV generating system typically produces more than 4.5 megawatt-hours (MWh) of electricity each year, roughly 590 kWh more than the home uses. Comparing the Lords' February 2000 energy costs with those of a neighbor illustrates the extent of the savings: the Lords spent a total of $46 dollars that month; the neighbor shelled out $540. As noted, the Lords rely on propane for cooking, drying clothes and, infrequently, backup heating. At the neighbor's, all

heat is provided by burning oil. Based on this comparison, the Lords' energy-saving features will pay for themselves in just over 57 years. Nonetheless, the family was very interested in incorporating some of the most advanced and costly technologies – such as the roof-integrated PV system – both to show that they indeed work, and to gain valuable experience in how they work. The average family looking to build a new home is not likely to incorporate all of these measures. But some – high-efficiency insulation and windows, for example – offer much shorter payback periods, and in fact are being incorporated into more and more new buildings.

The Lord house also highlights an important energy policy issue, the importance of a little-known regulatory program known as "utility net metering." Under net metering, a customer who generates electricity on-site essentially can sell it back to the utility during times when the customer is generating more than he or she needs. The customer receives a bill for the energy used each month net of the energy generated back into the grid. This billing arrangement makes home generation far more cost effective, since excess energy is sold rather than lost. Maine is one of about 20 states that currently require utilities to offer net metering arrangements to customers, and this was a significant factor in the Lords' decision to invest in the PV array. To get a sense of its impact, consider this: If the Lords were to sell back to the grid the same amount of electricity that they consume each month, their total electricity bill would be $8 – the cost of the fixed monthly hook-up charge. As it is, they use an average of only 326 kWh a month, and export 49 kWh. At a typical local utility cost of $0.12 per kWh, the family saves $40 a month – and $500 annually – on electricity costs alone.

By generating roughly 4,500 kWh of emission-free electricity each year, the Lords' solar system avoids some 6,800 pounds of CO_2 emissions. This is equivalent to the CO_2 associated with driving about 7,650 miles in a typical passenger car. The system also avoids nine pounds of NO_x that otherwise would be emitted by the regional electricity system each year, and 28 pounds of SO_2.[1]

LESSONS LEARNED

The construction and operation of the Lord's home offers several key lessons:

- The most important initial decision is to find a piece of land that maximizes solar gain – both as a function of weather and of potential home design.

- For a PV array to be a sensible investment, it is essential to be able to arrange for net metering from the local utility.

- Some technologies incorporated into the house are very cost effective, offering payback periods as short as a few years. A homeowner who wants to save energy and cut CO_2 emissions need not incorporate all of the systems that the Lords did.

- With new construction, a number of efficient features like a passive solar system can be "designed in" from the outset. Reducing energy use in existing buildings can present additional challenges.

FUTURE COMMITMENTS

The Lords will continue to gather data on PV system performance, and post it on a dedicated website (the URL is listed below). For its part, NESEA's plans for 2001 include its sixth year in a row as the Northeast's prime sponsor of the National Tour of Solar Homes.

ORGANIZATIONAL PROFILE

The Northeast Sustainable Energy Association is a regional membership organization. Its members include engineers, educators, builders, students, energy experts, environmental activists, transportation planners, architects and other citizens interested in responsible energy use. NESEA's overarching goal is to bring clean electricity, green transportation, and healthy, efficient buildings into everyday use in order to strengthen the economy and improve the environment. The focus of its programs and activities is the northeastern United States, from Washington, D.C., to Maine.

CONTACTS

Interested members of the public may call or send an e-mail to receive a free information packet, which includes materials about the National Tour of Solar Homes and how to build a solar home. The toll-free number is 1-877-44-SOLAR, and the e-mail address is jtauer@nesea.org.

The website for the Lords' home is: www.solarhouse.com

[1] All emission reductions cited here are calculated based on New England Regional marginal emission rates, provided by ISO New England. See Appendix A for a discussion of these calculations.

CLEAN AIR-COOL PLANET CASE STUDY RATING

This case study reduces CO_2 emissions equivalent to the following:

Avoiding the consumption of 6 barrels of oil per day

OR taking .47 vehicles off the road (which is equivalent to driving one vehicle 7,650 miles per year)

Assumptions: 1,093 lbs of CO_2 per barrel of oil. Vehicles are average passenger cars (approximately 20 lbs CO_2 per gallon of gasoline - 22.5 miles per gallon, averaging 16,000 miles per year)