SOLAR WORKS, INC.

Here Comes the Sun...

PROJECT SNAPSHOT

PROJECTS

26 PV systems on public and private high schools, middle schools, and colleges and universities in NH, VT, MA and RI. The focus here is on one New Hampshire project.

TECHNOLOGY

Photovoltaic (PV) Systems

CO_2 EMISSION REDUCTIONS

2-kW systems typically reduce CO_2 by 3,000 pounds annually.

INVESTMENT AND SAVINGS

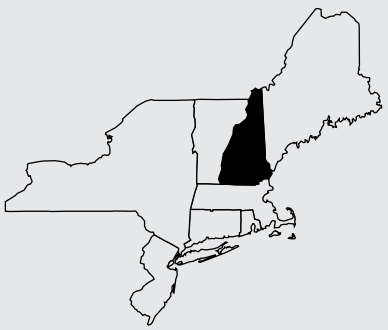
Typical system costs $20,000, including installation, training, and educational materials. It can save $400 on a typical NH electric bill.

LESSONS LEARNED

Ensuring that the PV system becomes a centerpiece of the school's broader educational efforts requires a high degree of cooperation among the partners; the existence of a project champion within the school; a receptive school administration, facility and staff; and the active engagement of the installation firm itself.

FUNDING SOURCES

For the New Hampshire projects, funding sources include the Governor's Office of Energy and Community Services, Public Service Company of New Hampshire, Northeast Utilities and several private firms. Each participating school also contributed funding.



INTRODUCTION

Photovoltaic (PV) systems generate clean electricity. They release no air pollution. They can be built far from the electricity grid, and sized to the task at hand. Nonetheless, in the past PV prices have exceeded those of many competing generation technologies. The mission of Solar Works, Inc. is to move PV into successful, cost-effective applications. This profile focuses on the 26 systems that Solar Works had installed in Northeast by the end of 2000.

THE PROJECT

In 1999, Solar Works launched the Solar on Schools Program to demonstrate the educational, economic and environmental benefits that solar technologies offer to schools and local communities. In the past two years, the company has installed 26 PV systems on public and private high schools, middle schools, and colleges and universities in New Hampshire, Vermont, Massachusetts and Rhode Island – and involved thousands of students in the process. Systems range in size from 500 to 6,000 watts. All told, they provide 41,250 watts of capacity, or 41.25 kilowatts (kW).

Involved in all project phases, Solar Works builds support among key administrators, raises sponsorship funding, enlists the aid of local utilities, installs the PV system, provides hands-on training for students and teachers, supplies resource materials that support the school's curriculums and offers continuing service for the system. Participating schools receive a PV system connected to the regional electricity grid, along with a range of interactive educational resource materials. (The grid-tied PV system is able to supplement its own output with electricity from the regional grid; conversely, it can supply electricity to the grid when the power is not required on site.)

Photovoltaics are woven into the curriculum in many ways. Students build electricity generating devices using PV panels; store energy by connecting the panels to banks of batteries; hook panels up to lighting applications; calculate how much sunlight hits a particular meter on the school's roof; use a data monitor to track the PV system's daily performance; assess fluctuations in voltage, amperage and kWhs caused by variations in weather and sunlight; calculate the amount of power that the system produces as a percentage of the school's overall electricity demands; determine the volume of carbon dioxide emissions avoided as a result of the clean energy generated by the school's PV array; and review state and national energy policy to identify ways in which the development of clean renewables can be encouraged.

Solar Works furnishes system data monitors for each school. Located indoors, the monitors provide detailed, real-time information about the system's operation. They can be connected to classroom computers, and support a wide spectrum of academic activities, including math and science exercises. The company plans to link all participating schools by Internet connection in the spring of 2001, with the goal of creating a virtual learning community in which students share information on the performance of their school's PV system.

A 2-kW PV system costs $20,000, including installation, training and educational materials. In New Hampshire, each school is asked to contribute $1,000 to $2,000, depending on system size, with the balance of the funds coming from the Governor's Office of Energy and Community Services (ECS) and Public Service Company of New Hampshire (PSNH), the state's largest private electric utility. The Northeast Sustainable Energy Association (NESEA) furnished in-kind support.

At Hopkinton High School in Contoocook, New Hampshire, the 2-kW PV system has been one of the most successful Solar on Schools Projects so far. Installed in the spring of 1999, the system consists of 16, single-crystalline PV panels manufactured by AstroPower. By the end of 2000, it had generated some 6,000 kWh and been integrated into the school's science curriculum.

As Will Renauld, a science teacher at Hopkinton High, notes, "we have already used it as the centerpiece for student projects, and will incorporate the science and technology of photovoltaics into the Project Lead the Way pre-engineering program at our school. A technical writing class composed press releases for the Tour of Solar Homes last fall, and middle school students have based several energy projects on our system."

SOLAR WORKS PV PROGRAM PARTICIPANTS IN THE NORTHEAST (THROUGH 2000)

Northampton High School	(MA)	Merrimack Valley High School	(NH)
Dexter School	(MA)*	Goffstown High School	(NH)
Berlin High School	(NH)	Proctor Academy	(NH)
Conval High School	(NH)	Chandler Cottage Educational Center	(NH)
Hopkinton High School	(NH)	Moultonborough Academy	(NH)
Kennett High School	(NH)	University of New Hampshire	(NH)
Souhegan High School	(NH)	*UNH has installed two PV systems*	
Portsmouth High School	(NH)	New Hampshire Technical Institute	(NH)
Hillsboro-Derring High School	(NH)	Roger Williams College	(RI)
John Stark Regional High School	(NH)	Woonsocket High School	(RI)
Newmarket High School	(NH)	Cabot School	(VT)
Nashua High School	(NH)	Winooski High School	(VT)
Londonderry High School	(NH)	University of Vermont	(VT)
Monadnock Regional High School	(NH)		

*PV system to be installed by the Fall of 2001

THE RESULTS

Together, the 26 PV systems Solar Works has installed in the Northeast produce some 54,000 kWhs annually, avoiding 35 tons of CO_2 emissions.[1] The Hopkinton PV system contributes about 2,980 kWh of the school's annual electricity needs, approximately six percent of total demand. This is enough to run ten desktop computers for four to five hours a day during the school year. By avoiding the use of this much energy from the regional electricity grid, Hopkinton's PV system reduces CO_2 emissions by about two tons annually. This is equivalent to the CO_2 emitted from burning 3.5 barrels of oil a year or driving about 4,400 miles in a typical passenger car.

Hopkinton's solar cells also cut NO_x and SO_2 emissions from the regional electricity system by seven and 17 pounds a year, respectively. This helps to reduce acid rain, ground-level ozone smog and fine particulate pollution.

At a broader level, PV costs have fallen considerably over the past two decades, but remain above those of fossil-fuel generation. Capital costs range from $5-$7.50 per installed watt. For a 2.3-kW solar array, they are about $15,400. This includes modules, installation, and an inverter and other system equipment. Total costs per kWh are a function of the PV system's output, which in turn is heavily dependent on local insolation – that is, the amount of solar radiation that reaches the panels, total levelized[2] energy costs of residential-scale PV systems tend to be in the $0.21-$0.45/kWh range. By comparison, customers in New Hampshire pay about $0.13/kWh. Given that a typical bill is $70 for 500 kWh, the electricity generated by the Hopkinton system shaves about $400 a year off the school's $7,000 electricity bill. A PV system like Hopkinton's would pay for itself in about 50 years. That, however, does not include its value an educational resource or its environmental benefits. And, given that the schools themselves pay only $1,000 to $2,000 for the system, the payback to them declines to about five years – a very attractive rate of return.

LESSONS LEARNED

To be successful, a program like Solar on Schools must meet a number of challenges:

■ Each school needs a "champion"– a well-respected teacher who is enthusiastic, and is determined to see the project succeed over the long term.

■ Keep school facilities and maintenance staffs in the loop every step of the way to win their active support and overcome occasional resistance to new technology. Faculty and administrators will help incorporate the technology into the curriculum, and keep it there.

■ A community outreach program should be developed so that parents, local businesses and civic groups can learn about the PV system's benefits.

■ The PV system should be in a highly visible location.

The cooperative efforts of the State Energy Office and private funding sources also have contributed in key ways to project success.

FUTURE COMMITMENTS

Three New Hampshire high schools joined the Solar on Schools Program very recently: Nashua High School, Portsmouth High School, and ConVal High School in Peterborough. Another 10 PV systems are planned for schools throughout New England in 2001, including schools in Connecticut and Maine.

COMPANY PROFILE

Since 1980, Solar Works, Inc., a privately owned company, has provided solar energy services and equipment to government agencies, utilities, private businesses, homeowners and not-for-profit organizations in the United States and overseas. Fourteen people currently staff Solar Works, with another seven acting as sales representatives. Annual sales total $1 million.

Solar Works, based in Montpelier, VT, maintains sales offices in the New England states, and New York and Maryland. Each office is responsible for site visits, installing and servicing PV systems, and directing sales and marketing efforts. These offices also work with public utility commissions, environmental advocates and electricity providers on state and local policy issues important to the development of PV, including utility interconnection, net metering[3] and tax incentives.

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[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.

[2] "Levelized" refers to the fact that both capital and operating costs have been spread evenly across each kWh of output.

[3] "Net metering" refers to state regulatory policy that allows a customer with a renewable generating unit to be billed each month for the difference between the electricity the customer consumes from the grid, and electricity that the customer's generating unit – PV, for example – provides to the grid. This allows the customer, in effect, to use the local grid as a storage device for excess electricity, which can be withdrawn later, when needed. Use of the grid in this way considerably enhances the value of small renewable generators.

CLEAN AIR-COOL PLANET CASE STUDY RATING

This case study reduces CO_2 emissions equivalent to the following:

Avoiding the consumption of .009 barrels of oil per day.

.009 barrels per day which is equivalent to 3.5 barrels per year

OR Taking 0.27 vehicles off the road per year.

0.27 barrels per day which is equivalent to driving one vehicle 4,393 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)