Solar Hot Water Case Studies

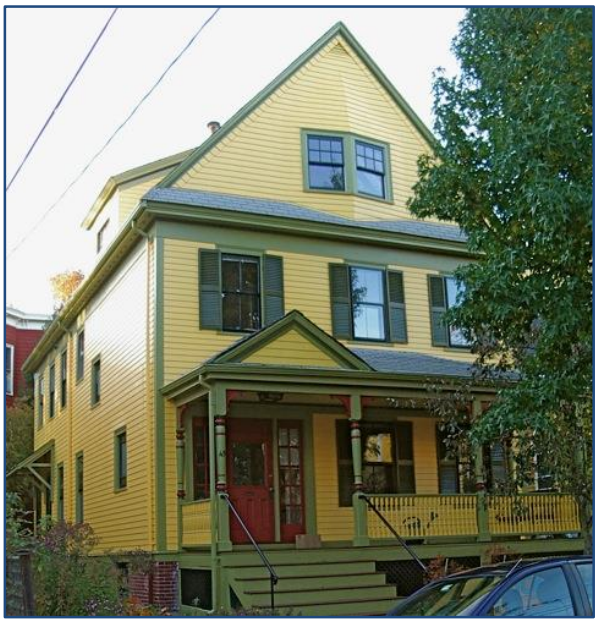
Seven Cambridge homeowners share their stories of installing solar hot water on their homes. In their own words, they provide details about their experiences, from the decisionmaking process to the installation to the final results.

Saving On Home Business Costs

Owners
Amy & Philip

The Building
45 Antrim Street. Single-family wood frame house, built in 1897.

Motivation
We installed PV solar panels for generating electricity in October 2006. We were motivated to reduce our carbon footprint after seeing An *Inconvenient Truth*. The PV system has dramatically reduced the electricity we draw from the grid, and has incurred no maintenance costs or problems of any kind. We knew we had left room on our roof for solar hot water panels. When we heard in 2011 about the grants that were available for that system, we decided it was time to add it. Although the size of our household has shrunk as our sons have grown up, our use of hot water has increased because of my business. I have a home-based business making hand dyed fabrics which requires hot water, and I wanted to reduce my use of gas for heating the water.



The Installation Process
To find an installer, we called Paul Lyons at Zapotec Energy, our contractor for the PV system. He recommended New England Solar Hot Water. They sent a proposal and we called several references, who all gave them glowing reports. They came to the house to discuss various ways to install the panels and run the lines. We discovered we had not left enough room in the chimney chase that we had used for the solar electrical lines, to add the pipe needed for the hot water system, so we agreed to run the pipe and sensor wire outside the house. The contractor was very helpful about showing us ways to install it and figuring out the best way to make the lines visually unobtrusive.

> **"I have a home-based business making hand dyed fabrics which requires hot water, and I wanted to reduce my use of gas for heating the water."**

The system was installed quickly, and the crew who worked on it was punctual, knowledgeable, neat, efficient, and friendly. However, it took many months to get the inspection finalized. The system components came from Germany and the Cambridge inspectors were reluctant to approve them. While we, the homeowners, were not inconvenienced, the

Information About Our System

New England Solar Hot Water specializes in commercial and residential solar hot water systems using the highly rated "SECUSOL" appliance, a high performance German system for single family homes for about **$7,200 installed**. The system uses all Wagner components including 2 Wagner EURO C20 AR flat plate collectors and a 93 gallon storage unit. The collectors are the highest rated available in the US. The system components are integrated into a single "appliance" which results in a small footprint and simple design. The SECUSOL system is a 'drain back' system and is completely immune to overheating and freezing. In addition, there is an unmatched 11 year manufacturer's warranty on the entire system. Solar hot water is a great investment as the system will provide approximately 75% of your domestic hot water using free solar energy.

—from the NESHW website

contractors were. They had to spend a lot of time communicating with the city inspectors, and eventually they were required to replace a German made sensor wire with a cheaper and apparently lower quality wire from Home Depot that the inspectors were familiar with. We are sure our system is fine, but we felt badly about the extra labor the contractors put in. They did not charge us for that. We felt they handled everything very professionally.

Costs & Savings

The initial cost of installing the system was $7200, but there were many savings that reduced the cost to under $1000. We received a rebate check from Massachusetts Clean Energy Center for $1135. The grant from the City of Cambridge was $2000. We expect to receive a 30% federal tax credit of $2160. We will also receive a 15% tax credit from Massachusetts, for $1080. This brings our savings to $6375, and reduces the cost of the sytem to $825.

It is not possible to measure the amount of water heated by the solar panels as compared to our gas water heater, as there is no meter to read. Comparing our gas use from this year to last, we are using less natural gas now, but there are many variables involved (weather, my studio production, the number of people living in the house) which make it difficult to measure how much the solar hot water system is reducing our use of gas. But we never run out of hot water!

Working with Neighbors

Owners
Alan & Andrea

The Building
26 Harvey Street, North Cambridge. Built in the 1880s, presumably as a single family residence, perhaps with a storefront at various points over the years, it is currently divided into two condominiums with separate utilities. The system was installed on the shared roof at the expense of one family for the benefit of one family with the permission of the other family.

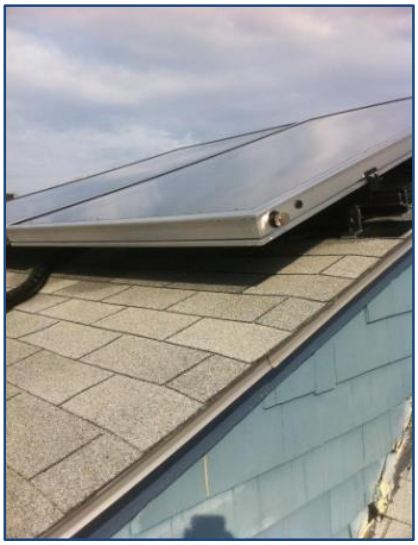
Installation Date
November 2012

Motivation
The owners have been attracted to alternative energy for years but couldn't rationalize the cost of the long payback. The combination of multiple tax incentives and rebates changed that.

Project Goals
Maximize the solar energy benefit on a constrained site. The property is not ideal for solar gain due to orientation, hence the decision to go with a thermal system rather than photovoltaic.

The Installation Process
As a condo association, the co-owners had already had an energy audit performed and followed its basic recommendation, which included additional insulation and changing several fixtures and all bulbs.

Dan Covey of SunBug Solar did an assessment of the roof surfaces, solar orientation, adjacent buildings and trees. Substantial spending on support systems and related infrastructure would be necessary to install many panels, which would only work well during a portion of the year. Upon discussion of the alternatives, the decision was made to go with a more modest, two-panel thermal hot water system, in particular because it functions well despite some shade.



The owners also agreed to perform the carpentry repair work themselves that was needed after the roof penetration and pipe installation were completed down to the basement. As a result, the total price for the system and its installation was just over $10,000, including:

- 2 Schuco Performance Collector Panels
- 1 Schuco 75 Gal Hot Water Tank, with backup capacity

- Installation and related hardware, including flexible, insulated piping
- Sensors, additional internet connection and software for constant monitoring

Two substantial rebates for thermal systems were available at the time of installation:

- After verification by the installer, the Massachusetts Clean Energy Center sent a rebate check of $3,912 to the home owners
- After verification by the installer, the City of Cambridge sent a rebate check of $2,000 to the home owners.
- The home owners have yet to do their taxes, but expect to receive substantial credit against their federal and state income tax liability as well

The other condo owner was given the option to invest in a similar system at the same time but declined.

Therefore, acting as a single condo owner in a tight shared space, it was important to minimize disruption of existing systems (electric, plumbing, insulation) and to negotiate the acceptability of an additional, large water tank in the common area of the condo basement.

It was fundamental to the success of the project to minimize these factors, understand them and estimate them in detail in advance, and then take the time to communicate them with the building's co-owner. There was a lot of consultation with SunBug by the owners before the project was authorized.

The system is based on a glycol solution circulating through an array of two collectors on the roof and back down to the tank in the basement through an insulated, flexible pipe installed under the roof and through the walls of both units.

Cambridge city water enters the system on average at 52°F and circulates through the solar system's heating tank before entering the conventional hot water heater, which uses natural gas.

When the sun shines, the glycol circulates up to the roof, captures heat and brings it down to the pre-heating tank. When the sun doesn't shine, the glycol doesn't circulate, but the pre-heated tank remains insulated, ready to feed warmer water to the conventional heater, which "finishes off" the heating process as determined by its thermostat.

The existing conventional hot water tank was able to remain in place with simply a new source of incoming, warmer water. This tank was estimated to be over 20 years old with an unknown useful life. The option was available to purchase a solar pre-heating tank that also has the capacity to "finish off" what the sun can't always do. The decision was made to install the tank with this optional backup capacity, so that some day, when the conventional tank dies, it will not need to be replaced.

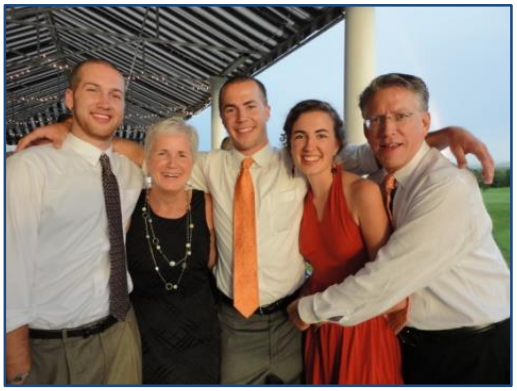
"Acting as a single condo owner in a tight shared space, it was important to minimize disruption of existing systems."

Results

It is anticipated that in the summer months the solar system will have excess capacity for domestic hot water, but in the winter months the gains are modest due to ambient temperatures and solar angle. The data collection systems have only been in place for a couple winter months. The chart above is indicative of what happens on a bright sunny day in February.

The real question will be the long-run reduction in natural gas consumption, and it will be difficult to assemble conclusive data. As an "empty nest" family of five, with three 20-something children residing

at home sporadically, the year-to- consumption of hot water will be erratic. Also fundamental will be the long run temperature patterns which make it difficult to compare one year to the next.



At this point, it is has been confirmed that the system is operating as intended and was well installed. The availability of web-based monitoring data, as shown, contributes dramatically to the satisfaction and involvement of the owners and their immediate network. Without it, the system would be invisible and more forgotten, as it cannot even be seen from the street.

Lessons Learned

- Individual condo owners can make an individual investment in solar systems which rely on use of common areas, both on the roof and in the basement. One key to such an arrangement is to minimize the system features, and another is to communicate detailed estimates of time and disruption in advance.
- Locations with constrained solar potential become attractive when there is a multiplicity of overlapping rebates and tax incentive

Balancing Function and Aesthetics

Owner/Architect
Thomas

Installation Date
February 2013

The Building
114 Hamilton Street**.** A single-family, wood-frame, 1,000 SF home built around 1880, probably to house a local factory worker family. When the house was bought in 1998, it had not been inhabited for two years and not renovated in a number of decades before that. A full renovation was required.

Motivation to Add Solar Hot Water
The homeowner, an architect, has long taken an interest in green building and energy savings. The owner completed a gut rehab of the building over several years in two major phases. New double-paned windows, full insulation, low-flow plumbing fixtures, installation of European low-energy and U.S.-made energy star appliances, strategic use of recycled building materials and conversion to a high-efficiency gas heating system all contributed to a tighter envelope and smaller carbon footprint through lower energy use and costs.

A Cambridge Energy Alliance presentation at a local Greenport Forum inspired the owner to take advantage of city, state and federal grants and tax credits to install a solar hot water system to realize additional energy savings and provide an opportunity to learn from the process in order to be able to encourage clients to do the same.

Installation Process
The first step in the process involved an energy audit. Next Step Living did an assessment, suggesting some improvements, re-lamping the entire house with free compact fluorescent bulbs, and providing information about additional energy savings opportunities including NSTAR's MassSave program. The owner is considering participating in NSTAR's photovoltaics program which allows for excess electricity produced by the panels (installed free of charge on a lease basis, or bought outright) to be sold back to the NSTAR grid for use elsewhere.

> **"NESHW completed the entire installation process in one day with a crew of three."**

The owner elected to work with New England Solar Hot Water (NESHW) of Duxbury Mass. A representative made a site visit and determined that the house orientation was ideal for a solar

hot water system. A Wagner SECUSOL Compact solar hot water system was chosen based on available space and occupant water demands. This system is a "preheat" installation that works with the existing hot water heater acting as "back-up."

The owner/architect certified that the roof could support the weight of the solar panel and worked with NESHW to determine the least invasive and most aesthetic way to introduce the new plumbing via the attic and through closets in the house, connecting ultimately to the insulated hot water tank in the basement.

"It is important to work with the selected installer in advance to determine the best balance of function and aesthetics."

NESHW took the lead in completing all applications and permitting and met with the Historical Commission for approvals. NESHW completed the entire installation process in one day with a crew of three. All went very smoothly.

Lessons Learned

It is important to work with the selected installer in advance to determine the best balance of function and aesthetics when introducing new plumbing into the building. An architect is also required to verify structural load strength and to sign off at the end of the project.

Paperwork can take longer than actual installation. If deadlines must be met, it is wise to start early. It is also important to find an installer who has experience working with the Cambridge Building Department on similar projects – this can streamline the approvals process considerably. NESHW and the Cambridge Energy Alliance and were very knowledgeable, accommodating and helpful in arranging for this particular installation.

Anticipated Savings

The equipment and installation of the system cost $6,200. With grants from the Cambridge Energy Alliance and Mass. CEC as well as State and Federal Tax credits, the cost will be reduced to approximately $1,925. It is anticipated that the system will save enough gas to pay for itself after approximately five years. In the warmer months with longer daylight for example, all hot water can probably be obtained from the solar hot water tank alone.

Initial Performance Data

As the installation is not yet three months old, no initial performance data is available

California Dreamin'

Building & Installation Details

I installed a solar hot water system in December 2012 on the roof of my townhouse condo in W. Cambridge. I live in a 5-unit condominium grouping made up of 4 townhouse units and a single unit that is a historically significant farmhouse from the late 19th century.

The orientation of our building is not optimal for a bigger installation as we have many sloping roofs in different directions. Also, my condo neighbors are in different places as far as being ready to get involved with solar at this point, so it made the most sense for me to do a solar hot water installation on my own. Perhaps at some time we'll expand to a bigger system for our 5 households?

The Installers

My installation was handled by Jamie Leef and Eric Stolz of S & H Construction. I can't say enough about S & H! They were real professionals and took care of everything as well as educating me along the way. The only surprise to me was the need to keep the old traditional hot water heater as well as the new one, so I had to clean out more of the cellar than I had planned, in a hurry!

Results

I benefited greatly from a grant from the Commonwealth of Massachusetts ($1900) as well as from the Cambridge Energy Alliance ($2000). The total cost of my installation was $9100, so my out of pocket cost was $5000. My hot water costs vary according to when my young adult children are home, or when my household consists of just me and my beagle (who doesn't take a lot of showers). I estimate my payback time at about 8—10 years.

"My brother lives in Santa Barbara CA and has solar panels which generate all his electricity; he was my inspiration to pursue solar in our New England location."

My brother lives in Santa Barbara CA and has solar panels which generate all his electricity; he was my inspiration to pursue solar in our New England location. All things considered, I think we are doing quite well in beginning to use renewable energy in our little Cambridge condo.

A New Neighborhood Attraction

The Building
49 Granville Road. This is a two-family home built in late 1800's and has been converted to two condominiums.

The Project
One of the condominium owners is motivated to make a difference in the battle to fight the effects of climate change on our earth. She shifted careers a few years ago from consulting in the building industry for over 20 years to work in the renewable energy field. She joined a Somerville-based startup SunBug Solar, and with three partners began putting solar on homes, schools and businesses around the state. In their 4th year, the owner turned to her own home to look for the opportunity to demonstrate to her neighborhood, Huron Village, that solar works.

Our home was the first in the neighborhood to have solar hot water. People walk and drive by and stop to look at the Big Boy. Now they see the panels on the roof and the dialogue shifts to "Cool, solar energy…"

The system is a Schuco, German manufactured, solar collectors with a 60 gallon storage tank in the basement that feeds water heated from the sun to their existing gas fired hot water heater. The solar collectors will generate 40-60% of their hot water needs and save them money on their gas bill each month.

The owner was able to use a state rebate from the Clean Energy Center as well as a rebate program specifically for solar hot water provided by the City of Cambridge. In addition they were able to get a 30% federal tax credit. The system cost $11,375 but after rebates and tax credits, the cost was less than $5,000. The home owner is ecstatic that she can bring solar to her community and make it work for her family too.

"Our home was the first in the neighborhood to have solar hot water. People walk and drive by and stop to look at the Big Boy. Now they see the panels on the roof and the dialogue shifts to 'Cool, solar energy…'"

Low Tech but Logical

The Building
A triple-decker condo, built in the 1920s. In the photo it's the yellow house on the right.

Motivation
Solar hot water has just always appealed to me as a relatively low-tech but logical way to take advantage of the sun's energy. I had seen a demonstration system awhile ago that impressed me, but when I inquired about the economics, it seemed like the expected payback time at least 10 years, which felt too long. When I found about the Cambridge rebate program, the 6- to 8-year payback made the investment more appealing.

The Project
I talked with 3 national chains and 2 local solar installers, and ended up going with one of the local firms. Their price was competitive, plus they had a wealth of experience, strong knowledge of the various incentive programs, and were willing to spend time to educate me about the technology and the cost analysis.

The installation took longer than expected--3 days--but went smoothly overall. After installation, we did have some fluctuations in water temperature that required having the installer come out to adjust regulator valves.

> **"I have been impressed by how much hot water we are able to get on a clear, but chilly, winter's day."**

Anticipated Savings
The gross cost of the system was $11,872 for a 40-tube vacuum-type system. After the Massachusetts CEC grant and the Cambridge solar HW program grant, plus the federal and state tax credits, we expect the net cost to be in the range of $2,500 to $3,000.

Initial Performance Data
Our system was installed in November 2012, so we do not have a great deal of data yet. I have been impressed, however, by how much hot water we are able to get on a clear, but chilly, winter's day--the vacuum tubes can still get the collector up to 130 degrees! It is clear that in the sunnier months

the system will be able to provide most or all of our hot water. You can take a look at the data on the web at: http://dashboard.sunwatchmeter.com/home/169#HW/169:8

A Bumpy Road

Location
127 Clay Street

Installation Date
July 2012

Motivation
To reduce my carbon footprint and save money in the process. When the Cambridge Energy Alliance notified me of a $2,000 grant, adding to other available grants and tax credits, it became possible for me to spend about $2000 for a system that would have cost $8,000 without incentives.

> "It became possible for me to spend about $2000 for a system that would have cost $8,000 without incentives."

Project Goal
Heat my water with the sun as much as possible, with the new electric water heater as back-up on cloudy days.

Installation Process
I have had many troubles with the solar hot water system. I deserve part of the blame, mainly due to an inadequately conducted search for an installer. Of the companies I called, only Charles Nadel/Advanced Energy Systems Development was installing solar hot water systems at private residences. I unwisely went with Mr. Nadel instead of continuing my search.

By all accounts, Mr. Nadel installed the system properly. But a problem arose, again one for which I'm partly to blame. Mr. Nadel told me that either his electrician could do the electrical work for $350 or I could hire one of my choosing. I opted for the latter, and the electrician I chose failed to disconnect the lower heating coil as instructed. As a result, I started heating my water with electricity rather than the sun.

As I watched my utilities bills skyrocket, Mr. Nadel and other solar energy technicians examined the system. Only after four months did Mr. Nadel figure out the problem. I had the electrician disconnect the lower heating coil. However, the other heating coil was damaged, meaning I now had no electrical back-up at all. After numerous failed diagnoses, Mr. Nadel replaced the coil under warranty.

Still, the back-up electric water heater wasn't sufficient. Mr. Nadel recommended turning up the thermostat on the upper heating coil. I did so, to little effect. Eventually, Mr. Nadel stopped responding to my pleas for assistance. Fortunately, an expert on water heaters helped me get the system up and running. The solar aspect of the system has been excellent from the start, but the back-up is now, after so much trouble, adequate at best.

> "Avoid my mistakes, and do due diligence while searching for an installer…The Cambridge Energy Alliance and Energy Sage are highly recommended resources. Use them!"

Lessons Learned

I am wary about recommending a solar water heater, given the difficulties I've had with mine. If you do decide to purchase one, avoid my mistakes and do due diligence while searching for an installer. My failure to get two or three bids was – well – pretty stupid. The Cambridge Energy Alliance (Meghan Shaw) and Energy Sage (John Gingrich) are highly recommended resources; they are knowledgeable, accessible, and on your side. Use them!