

Going Solar

A Homebuilder's Guide to



Deciding to install solar or make your houses solar-ready involves gathering information from a number of sources and tailoring it to your location and circumstances. This guide can help you through that process. For more details, see *High-Performance Home Technologies: Solar Thermal & Photovoltaic Systems*. Go to Resources, page 8, for download information.



U.S. Department of Energy
Energy Efficiency
and Renewable Energy

Bringing you a prosperous future where energy is clean, abundant, reliable, and affordable

How to Use This Guide

A Homebuilder's Guide to Going Solar is designed to help you assess the benefits to your business and customers of installing solar equipment or making your houses solar-ready. The information comes from studies of builders who have successfully integrated solar into their operations as well as conversations with builders and solar professionals. These studies and conversations indicate that builders want to know:

- Do solar economics work in my area?
- If not, are there other reasons to go solar?
- Is there a local support system of solar professionals I can call on to help me integrate solar seamlessly into my projects?

This effort to educate builders about solar is a work in progress. As you explore the possibility of going solar, we welcome your feedback about what information and resources were most useful to you. Send a message to solarbuilderfeedback@nrel.gov and tell us about your experiences.

SOLAR WATER HEATING SYSTEMS

Solar water heating (SWH) systems are reliable and economical appliances for heating domestic water. They typically consist of collectors, a controller, a storage tank, and—in most parts of the country—some sort of freeze protection.

SWH systems cost roughly \$1,000 to \$4,000, depending on the size and type of the system. However, when they are installed on new houses and the cost is included in the mortgage, the increase in the monthly payment is small. Because the federal income tax deduction for mortgage interest attributable to the solar system further reduces that increase, the solar investment often results in positive cash flow immediately. On a monthly basis, it's likely that your customers will save more than they pay from day one.

Manufacturers have developed packaged systems and streamlined installation processes, making it much easier to incorporate SWH into production building schedules. Studies show that homebuyers prefer homes that include SWH, and builders have found it more profit-



Solar Design Associates/PX15609

able to make SWH a standard feature than to offer it as an option.

In most areas of the country, there are additional financial incentives for installing SWH. The best source for current information about incentives in your area is www.dsireusa.org.

SOLAR ELECTRIC (PHOTOVOLTAIC OR PV) SYSTEMS

Solar electric systems contain modules made up of photovoltaic (PV) cells that generate electricity when exposed to sunlight. They have no moving parts, require almost no maintenance, and last for decades. The PV cells generate direct current (DC) electricity, which is converted to alternating current (AC) electricity by an inverter.

Today's PV systems come in a range of efficiencies and configurations. PV systems with modules that are mounted over existing roofing are still the most common, but building integrated photovoltaic (BIPV) systems are gaining in popularity. In a BIPV system, the modules do double duty—they generate electricity AND function as a finish building material, usually roofing.

At first glance, PV systems look expensive—roughly \$8 per watt installed or about \$24,000 for a 3-kilowatt residential system. However, they are eligible for a number of federal, state, local, and utility financial incentives that can reduce the cost by half or more. The best source for current information about incentives in your area is www.dsireusa.org.

In addition, when PV systems are included as standard features in new, energy efficient homes, and the cost is included in the mortgage, homebuyers often realize positive cash flow from the first payment. See ***Do the solar economics work for my company and customers?***, page 3, for more details.

The building integrated solar water heating system on the White House uses solar absorber plates from SunEarth, Inc. in a low-profile, site-built installation designed to blend with the historically appropriate tene-coated copper standing-seam roof.

TABLE OF CONTENTS

How to Use This Guide	2
Solar Economics	3
Beyond Economics	4
Local Solar Support Systems	5
Find an Installer	5
Going Solar	6
Making Houses Solar-Ready	7
Selling Solar	8
Resources	8



All the homes in this entry-level home development near Sacramento, California, include a building integrated photovoltaic (BIPV) system as a standard feature.

Premier Homes/PIX 15610

Do the solar economics work for my company and customers?

If your customers' cash flows are positive from their first mortgage payment, going solar is an easy decision and an easy sell. Solar professionals can use computer models to calculate how much energy a given home requires and how much it will cost to get some or all of that energy from solar equipment. It is always cheaper to tweak the energy design of a home before construction begins, and computer models are perfect tools for this. Go to **LOCAL SOLAR SUPPORT SYSTEMS**, page 5, for help finding a local solar professional who offers this service.

Here are some of the variables that the computer model will take into account.

Rebates, tax credits, and other financial incentives. Incentives vary widely from one region to another, whether you're installing SWH or PV. Sources for information about financial incentives available in your area include:

- DSIRE (Database of State Incentives for Renewables and Efficiency, www.dsireusa.org). DSIRE is a comprehensive source of information on federal, state, local, and utility incentives that promote renewable energy and energy efficiency; it is updated regularly.
- Local electric and gas utilities. Some offer rebates or incentives for installing solar equipment. Visit www.dsireusa.org or check with your local utility.

- Local green building and solar organizations. See **LOCAL SOLAR SUPPORT SYSTEMS** on page 5 for more information.
- Local government and utility personnel. Some offer accelerated building permit processing and other green building and solar incentives.

Energy efficient mortgages. Energy efficient mortgages are available in all 50 states, and can make solar homes more affordable for buyers by including reduced monthly energy costs in the qualification process. Both PV and SWH systems are allowable expenses under the federal guidelines for energy efficient mortgages.

The cost of electricity and natural gas or propane. At current pricing for electricity and gas, homeowners can often achieve a positive cash flow on a solar system financed with a home mortgage from the first payment.



Namaste Solar Electric/PIX15611

In Colorado and many other parts of the country, generous financial incentives make solar systems more affordable.

This table shows an example of a home in Hadley, Massachusetts, which is equipped with both PV and SWH systems and achieved positive cash flow from the first mortgage payment. Since the time of this analysis, utility rates have continued to rise and the homeowners' benefits have increased.

The pre-construction energy analysis estimated that this home with a PV system would consume 41% less energy than the benchmark Building America home. First year electrical savings were over 66%, in part because of the energy consciousness of the homeowners.

For more details, see *High-Performance Home Technologies: Solar Thermal & Photovoltaic Systems*. Go to Resources, page 8, for download information.

Added Costs	Dollars [#]
PV	\$26,445
Solar Water Heating	\$7,808
Energy Efficiency	\$5,848
Total	\$40,101
Incentives	(\$11,370)
Net Costs	\$28,731
Increased Monthly Mortgage*	\$191
Savings	
PV	\$430
Solar Water Heating	\$172
Energy Efficiency	\$1,985
Annual Total	\$2,587
Monthly Savings	\$216
Effect on Cash Flow	
Net Monthly Increased Cash Flow	+\$25

#2006 analysis and energy costs
*7% loan amortized over 30 years

YES The economics work, and I'm ready to go solar.
[Read **LOCAL SOLAR SUPPORT SYSTEMS** and **FIND AN INSTALLER**, page 5. Then go to **Going Solar**, page 6.]

NO In my area, solar doesn't work on economics alone.
What are some other reasons to go solar?
[Go to **Beyond Economics**, page 4.]

“We set out to provide exceptional value for our customers by adding solar power, and in the process we did something exceptional for our business.”

John Suppes, founder and president of Clarum Homes, on his company's decision to include PV systems on their homes.

Beyond Economics— Other Reasons to Go Solar

FOR THE BUILDER

Faster Sales

Solar homes sell at up to twice the rate of their conventional counterparts. Although the best data to date is from California, solar-equipped homes are proving popular in other parts of the country, even in depressed housing markets.



In some parts of the country, notably parts of California, solar homes sell more quickly than other homes.

BP Solar/PIX15612

More Satisfied Customers

Studies indicate that solar homeowners are more satisfied, and satisfied homeowners recommend their builder to others twice as often as neutral owners. Even when neighboring houses are energy efficient, consumers in communities that include solar equipment are more satisfied with their home purchases.

Streamlined Sales Process

Installing solar as a standard feature simplifies the buyer's decision-making process. Studies indicate that consumers prefer solar—both SWH and PV—as a standard feature, because it takes the guesswork out of their purchase.



Copyright 2008 Cheryl Ungar/PIX15613

All 42 homes in McStain Neighborhoods' Bradburn Village in Westminster, Colorado, feature photovoltaic systems as standard features.

More Profitable

Builders' experiences indicate that making solar equipment standard is more profitable than offering it as an option. In one California development, all 306 homes included solar hot water systems and 120 homes included PV systems. The builder found that it was more profitable to offer solar systems as standard features rather than options.

FOR THE BUYER

Faster Appreciation

Solar homes appreciate more quickly. Shea Homes houses in California equipped with solar went up in value by over 55%, compared to about 45% for a comparison conventional community.



GE Energy/PIX15614

Shea Homes included building integrated photovoltaic systems as standard equipment on homes in this California development.

Energy Price Stability

Heating water and generating electricity with the sun help homeowners manage the risks associated with future price shocks. Part of the cost of a home equipped with solar systems includes a locked-in energy price over the life of the solar equipment, because the "fuel"—sunshine—is free.

Lower Energy Bills

Homes with solar equipment have lower energy bills. Based on an analysis of utility bills, energy costs in a California development of solar homes were 14 to 54% lower than a comparison community.

“All 257 homes sold out in the first year they were on the market (rather than the three years planned). Prices were initially advertised as ranging from \$379,000 to \$499,000, but some units sold for as much as \$600,000.”
John Suppes, President of Clarum Homes

YES I'm ready to go solar now.
[Read LOCAL SOLAR SUPPORT SYSTEMS and FIND AN INSTALLER, page 5. Then go to Going Solar, page 6.]

NO I'm not ready to install solar, but I am interested in making my houses solar-ready.
[Read LOCAL SOLAR SUPPORT SYSTEMS and FIND AN INSTALLER, page 5. Then skip to Making Houses Solar-Ready, page 7.]

LOCAL SOLAR SUPPORT SYSTEMS

If you're new to solar, it can help to have an informational or professional support system (or both). Here are some tips for finding fellow solar enthusiasts.

Seek out green building or other groups in your area that offer local solar information or marketing support. In some locations, green builders and affiliated businesses have joined forces to share information about what works and what doesn't.

Check with local governments and building departments for green building programs. A study released by the American Institute of Architects in late 2007 (www.aia.org/release_112807_grcities) reports that nearly 40% of the U.S. population lives in a city with a green building program.

Several national organizations have local chapters you can join:

- Regional chapters of the American Solar Energy Society (www.ases.org/about/chapters.htm) often offer educational events for members and the general public.
- Members of regional chapters of the Solar Energy Industries Association (www.seia.org/statechapters.php) include installers and other solar professionals.
- Members of local chapters of the National Association of Home Builders that are affiliated with the Green Building Initiative (www.thegbi.org/residential/) may have local solar experience and contacts.
- The U.S. Green Building Council (www.usgbc.org) has local chapters, and now has a LEED™ (Leadership in Energy and Environmental Design) program for homes.

“
[When we] hooked up the solar...we all stood there and watched the electric meter spin backward. My advice for builders considering solar is to find a good installation contractor and go for it.”

Joe Gregory, a residential production manager for Bob Ward Companies



As builders and consumers learn about the benefits of going solar, residential solar equipment becomes more common.

FIND AN INSTALLER

Teaming up with a reliable, experienced solar installer is the single most important strategy for solar success.

Choose an experienced local installer. Local green building or solar organizations can be valuable resources for finding established solar installers. Talk to other building professionals in your area. Patterns will emerge identifying the most professional and reliable solar companies.

Several national organizations maintain databases or membership directories of solar professionals:

- The American Solar Energy Society (ASES) is a national nonprofit organization dedicated to increasing the use of solar energy in the United States. Check with your local ASES chapter (www.ases.org/about/chapters.htm) for leads on local solar professionals.
- Findsolar.com (www.findsolar.com) is a national database of solar professionals sponsored by the American Solar Energy Society, the Solar Electric Power Association, and the U.S. Department of Energy.
- The Solar Energy Industries Association (SEIA) is a national trade association for the solar industry. Check with the SEIA chapter in your area (www.seia.org/statechapters.php) to find solar installers.



Ask local solar companies if they have NABCEP-certified installers. The North American Board of Certified Energy Practitioners (NABCEP) certifies both SWH and PV installers. Go to www.nabcep.org to find certified installers in your area.

Check with community colleges, chapters of green building or trade organizations, and manufacturers for certification and/or training programs for solar professionals. Ask the installers what trainings they've taken or certifications they've earned and check out www.ircusa.org/courseCatalog.php?action=Search for training programs in your area.

Do your homework. Check references and professional credentials and affiliations for the solar companies you're considering. The solar industry and its allies, including the U.S. Department of Energy's Solar America Initiative, are working hard to develop codes and standards. If you're installing solar, we welcome your feedback at solarbuilderfeedback@nrel.gov.

Puget Sound Solar, the company that installed the PV system on the Garst home in Olympia, Washington, has NABCEP-certified installers on its staff.

Photo courtesy of SunPower/PPX15615

Sam Garst/PPX15616

Going Solar

Whether you intend to install solar as a standard feature or offer it as an option, following these simple steps will help ensure successful solar installations. Many builders find that making solar equipment standard on their homes is more profitable, and homebuyers prefer it because it simplifies purchasing decisions.

PV AND SWH BASICS

ALWAYS make energy efficiency improvements first. Energy efficiency is the most cost effective way to reduce utility bills and improve comfort. And the less energy a house requires, the smaller and less expensive the solar equipment will be.

Plan for solar during the site selection and design process. Orient streets and houses to take maximum advantage of the available solar resource.

Introduce the solar installer(s) and related subcontractors. Ideally, get all the related subcontractors in the same room for a planning session.

Keep solar roof areas unobstructed. South facing with no shade during the peak solar window (approximately 9:00 a.m. to 3:00 p.m.) is best, but a solar system will perform adequately at a less than optimal orientation and tilt. See *High-Performance Home Technologies: Solar Thermal & Photovoltaic Systems* for more details. Go to Resources, page 8, for download information. Add shading analysis sun chart and site assessments to your homeowner manuals.

Carefully assess present and future shading. Shading by maturing trees or nearby construction is far more likely to impact solar system performance than less-than-optimal orientation and tilt.

Model—or have your solar professional model—your project for performance, system sizing, and economics. See www.eere.energy.gov/buildings/tools_directory for a listing of free and available-for-purchase energy models and estimators.

Require quality assurance inspections. Especially with SWH systems, inspections greatly reduce failure rates.



Decker Homes/PIX15617

Although a south facing orientation is best, solar systems will perform well at different orientations, as this Ohio home demonstrates.

Spray paint or otherwise mark collector areas on roof to alert other trades. Roof vents, chimneys, gables, or other obstructions should all be located to the north of the planned solar installation.

Install collectors after roof and painting are completed if possible. If this isn't possible, protect them from overspray with plastic sheeting, and make sure someone has responsibility for removing plastic.

Place solar equipment parallel with and close to roof decks. Careful design and installation can reduce both aesthetic impact and wind loading.

Choose packaged systems if possible to take advantage of the economies and convenience of pre-engineering. Some manufacturers offer "plug-and-play" connectors that make installations faster and more durable.



Photo courtesy of SunPower Corporation/PIX15618

SunPower's SunTile® is a roof-integrated solar tile designed to blend into flat and S-tile roofs.

PV GUIDELINES

Today, there are different PV technologies to choose from, depending on the solar resource in your area, the amount of roof space available, and the products available through local solar companies.

Building-integrated photovoltaic (BIPV) systems double as building materials. BIPV products offer the convenience and economy of functioning as a building material—usually roofing—AND generating electricity.

SWH GUIDELINES

In most areas of the United States, SWH is a cost-effective technology for heating residential domestic water. SWH economics are usually better for homes with electric water heaters than gas water heaters. Here are some tips to avoid callbacks and ensure your customers years of inexpensive, trouble-free solar-heated water.

Only install systems that are Solar Rating and Certification Corporation (SRCC) certified (www.solar-rating.org). The SRCC provides independent certification of solar water and swimming pool heating collectors and systems. Some states (Florida, for example) require their own certification.

Install the simplest system that will work in your climate. In most areas of the United States, SWH must incorporate freeze protection.

Making Houses Solar-Ready

Your customers will appreciate your forethought in making their homes solar-ready, because it will save them time and hassle when they decide to install solar equipment. A solar-ready house will be easier to sell as energy prices rise and consumers become more aware of the environmental and climate consequences of various energy technologies. By making a home solar-ready, you are providing your customer an opportunity to increase the value of their investment.

Review "PV AND SWH BASICS" in the "Going Solar" section, page 6.

Design and plan the home as if you were going to install the solar equipment during construction.

Consider paying a local solar professional as a consultant to help with this process.

Leave unobstructed roof space for the collectors and/or array.

Plan ahead with various trades to avoid shading from vents, chimneys, etc.



R. Carter Scott/PIX15619

This Massachusetts development features PV systems on each house as standard equipment.

Clearly label all end points of wires or pipes.

Clearly label the location of structural reinforcements.

If standoff mounts or racks are required, install them before the final roofing material to ensure proper flashing.

In the homeowner's manual, document the intended placement for future solar equipment, including arrays, collectors, tanks, inverters, and switches.

Getting Ready for PV

Design space for inverters and disconnects near the main service panel.

Leave space in the main service panel to handle a power input breaker.

Pre-wire or install empty metal conduit from the roof to near the main service panel.

Install conduit from the inverter location to the main service panel.



Namaste Solar Electric/PIX15620

Leave space in the breaker box for a double-pole 30 A breaker (solar electric feed).

Provide a vertical wall area to mount an inverter in the mechanical area of the house.

Minimize the distance (wire run) from the array to the inverter.

Install an electric disconnect switch for the future solar electric system.

Leave a copy of the wiring notes and diagrams in the electrical panel.

Post a sign or label on the electrical panel door indicating that the home is SOLAR READY.

Include system schematics, manufacturer's literature, installer's contact information, and any other pertinent paperwork in the homeowner's manual.

Getting Ready for SWH

Install 3/4" copper pipe for both cold and heated water from the roof to the location of the hot water storage tanks.

Cap the pipe and install so that it is accessible on the top.

The bottom should dead end until the solar system is installed.

Insulate the pipe.

If required, run sensor wires parallel to the copper pipe.

Install electric cable if required for a future pump.

Leave space near the water heater for hot water tanks, valves, pumps, heat exchangers, expansion tanks, and other needed equipment.

Include system schematics, manufacturer's literature, installer's contact information, and any other pertinent paperwork in the homeowner's manual.



Eric Lee/PIX15621

Retrofitting solar equipment to an existing house is easier and less disruptive if the original builder makes the house solar-ready.

New low-cost solar water heaters like the SunCache are coming on the market. Davis Energy Group, in partnership with SunEarth Inc., developed the SunCache, with significant support from the National Renewable Energy Laboratory.

I'm committed to going solar or solar-ready. What's next?

SELLING SOLAR

It's time to educate your staff—especially your sales staff—about the finer points of solar systems. Use this publication as a starting point, and consult *High-Performance Home Technologies: Solar Thermal & Photovoltaic Systems* for more details. See Resources, this page, for download information.

The strategies mentioned here are sales techniques that work for other solar builders.

Educate your sales force. Builders who successfully integrate solar agree that educating yourself, your staff, your subcontractors, and your customers is critical.

Use walk-throughs, models of house features, and model homes as education and sales tools, both for your sales force and your customers. Provide samples of solar systems for browsers to examine. If net metering makes it possible in your area, let visitors watch the electric meter spin backwards. It's a proven crowd pleaser.



groSolar@/PIX15622

Let prospective homebuyers see for themselves that solar installations need not detract from the appearance of a home.

Hold training sessions for consumers and tradespeople. Generate traffic through your models and educate potential customers at the same time. Manufacturers and installers often have excellent sales and training tools that they will share with their customers.

Hand out publications detailing the benefits of energy efficiency and solar technologies—yours or others. Reprints of articles about the benefits of going solar—especially if they mention you or your company—are powerful sales tools.

Advertising—energystar.gov has information about designing advertising. Emphasize your energy efficiency and solar features to set you apart from the competition.



Clarum Homes/PIX15623

Web site. Use your Web site to educate potential customers about your commitment to energy efficiency and solar technologies.

Compact discs. CDs offer an opportunity to provide lots of information in a tiny package.

Free publicity. Send out press releases; offer your services to print, radio, and TV journalists as an expert interviewee; invite the press to open houses and other events and functions. Editorial mentions are often far more powerful publicity than advertisements.

In this California community, unobtrusive PV systems quietly generate clean energy.



Sam Gans/PIX15624

For some homeowners, solar systems are an indication of their commitment to environmental protection and national energy security.

Offer energy efficiency guarantees. Some builders guarantee that their customers' utility bills will stay below a prescribed maximum. See www.eeflhome.com, for example.

Publicize your affiliations with green building and solar organizations. These affiliations can increase your credibility among consumers.

Resources

Free download of Volume 6 of the Building America Best Practices Series, *High-Performance Home Technologies: Solar Thermal & Photovoltaic Systems* www.eere.energy.gov/buildings/building_america/pdfs/41085.pdf

Feedback on this document or your solar experiences
solarbuilderfeedback@nrel.gov

Database of solar and energy efficiency incentives
www.dsireusa.org

Study of green building programs
www.aia.org/release_112807_grcities

American Solar Energy Society
www.ases.org

Solar Energy Industries Association
www.seia.org

Findsolar.com
www.findsolar.com

The Green Building Initiative
www.thegbi.org

U.S. Green Building Council
www.usgbc.org

North American Board of Certified Energy Practitioners
www.nabcep.org

List of solar training programs
www.irecusa.org/courseCatalog.php?action=Search

List of energy models and software
www.eere.energy.gov/buildings/tools_directory

Solar Rating and Certification Corporation
www.solar-rating.org

Energy efficiency guarantees
www.eeflhome.com

For more information contact:
EERE Information Center
1-877-EERE-INF (1-877-337-3463)
www.eere.energy.gov

Prepared by the
National Renewable Energy Laboratory (NREL)

Operated for the
U.S. Department of Energy, Office of
Energy Efficiency and Renewable Energy
by Midwest Research Institute • Battelle

Printed with a renewable-source ink on paper containing at
least 50% wastepaper, including 10% postconsumer waste

DOE/GO-102008-2599 April 2008

A Strong Energy Portfolio for a Strong America. Energy efficiency and clean, renewable energy will mean a stronger economy, a cleaner environment, and greater energy independence for America. Working with a wide array of state, community, industry, and university partners, the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy invests in a diverse portfolio of energy technologies.