Welcome to the 21st Annual National Solar Tour

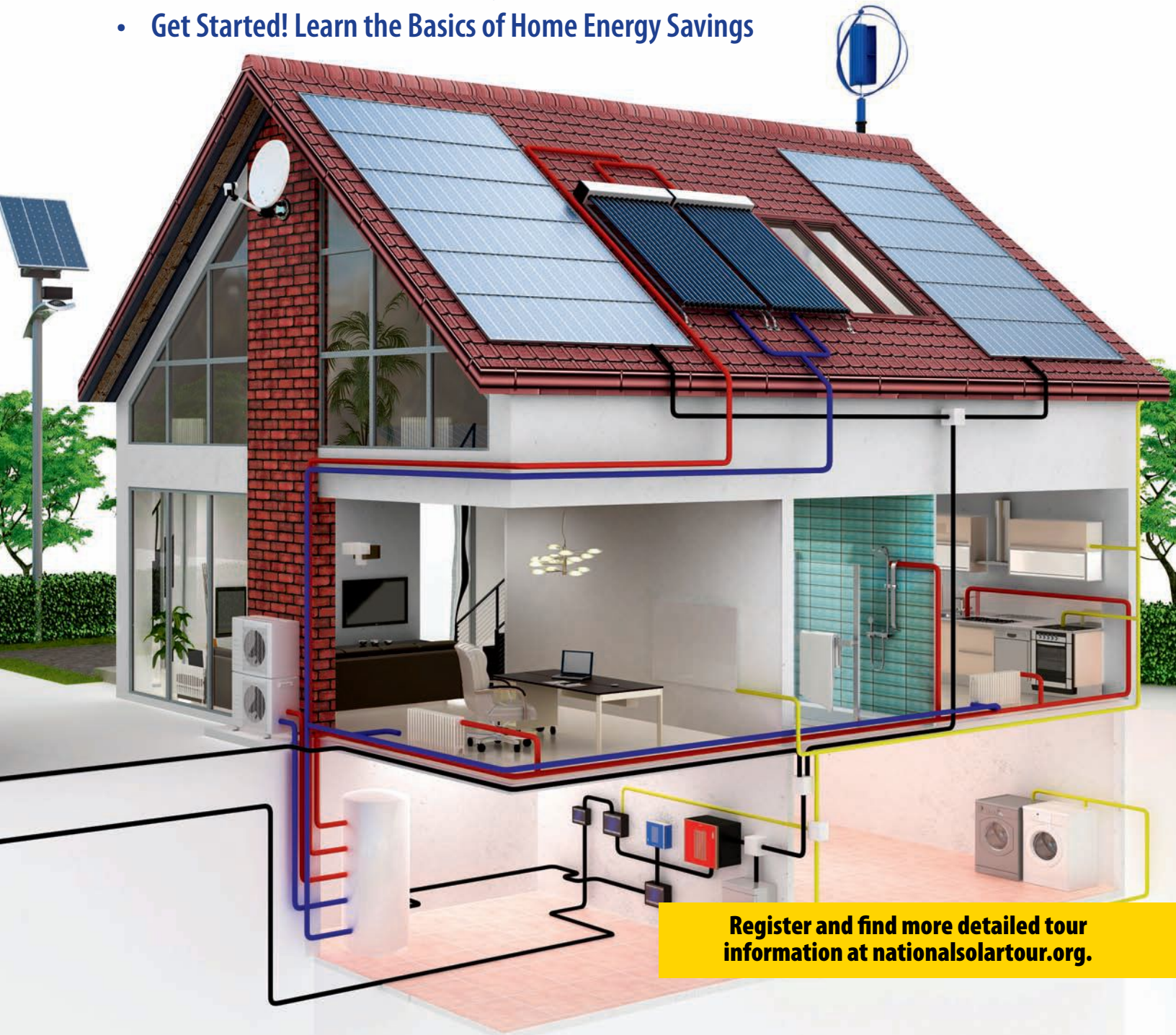
SOLARTODAY

October 2016

AMERICAN SOLAR ENERGY SOCIETY

National Solar Tour Guide

- All You Ever Needed to Know About Solar (PV) Warranties
- Questions to Ask a Solar Energy Salesperson
- Get Started! Learn the Basics of Home Energy Savings



Register and find more detailed tour information at nationalsolartour.org.

Find a Local Tour Near You

The ASES National Solar Tour is held in most neighborhoods in October, but tours can be organized any time of year. See tour listings at nationalsolartour.org.

See Solar in Your Neighborhood By CARLY RIXHAM

American Solar Energy Society (ASES) is taking it to the streets with our flagship event, the National Solar Tour. Thanks for going on tour with us!

This year marks our 21st annual tour, which takes place in neighborhoods across the country during the month of October. The US Department of Energy also designates October as Energy Awareness month. The National Solar Tour is the world's largest grassroots solar movement — where homes, businesses, schools, religious meeting centers, and other organizationsacross the country open their doors and roofs to neighbors who are looking to learn more about how they can utilize renewable energy in their own lives and communities.

This year's National Solar Tour highlights many unique renewable energy features, net zero homes and other notable sights. Many homes have a trifecta of clean energy- for example PV, geothermal, and electric vehicle. What's your trifecta? Grey water re-use? Rainwater harvesting? Composting toilet?

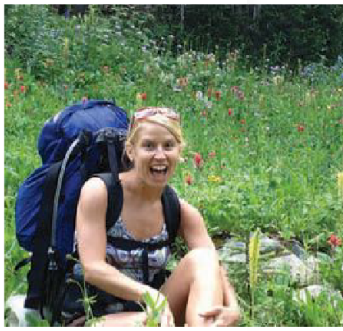
The premise of the tour is to get neighbors talking about local incentives, local installers /contractors, local laws. Ask your neighbors about their monthly utility bills. Learn how much you can save while you help the planet. Research the options and discover your neighborhood's best-kept solar secrets! Find out about the return on your investment with solar thermal, or solar electric options for zero money down in most states. Learn about sustainability, and best of all, get to know your neighbors!

From grassroots to grasstops, we can work together to be stewards of the planet. But we must act with haste. If you are thinking of going solar, now is the time. The 30% Investment Tax Credit has been extended, and legistlation has recently been proposed to offer tax credits for battery storage systems.

I have a vision of 100 percent renewables globally by 2050. With the amount of renewables that are available to the grid, it is not a far stretch. This movement is being adopted by businesses, cities, and nations all over the world. Is your home next?

Let's start a conversation in our own backyard. The National Solar Tour demonstrates an array of practical and economical solutions available right here, right now. It encourages neighborhood conversations addressing the growing need for clean energy.

We are also proud to announce that the U.S. Department of Energy Solar Decathlon is taking place during next year's tour in Denver, CO, October 5-15, 2017. If you are interested in being a volunteer for Solar Decathlon 2017, please contact volunteers@confluencec.com. Volunteering supports and celebrates the remarkable student teams that bring their solar-powered houses and passion to the Solar Decathlon. Thank you!



Carly Rixham is the executive director of ASES. Learn more about ASES — and join us today! — at ases.org.

National Solar Tour
www.NationalSolarTour.org

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ASES NATIONAL SOLAR TOUR

All You Ever Needed to Know About Solar (PV) Warranties

By Jacob Bayer

Adding a photovoltaic system to one's home is a long-term commitment; systems can last 30 years or more. Manufacturers' warranties on the equipment can vary a lot, and that makes some deals a lot better than others. How can we tell which warranty is better? What should we look for in the confusing, legally-binding fine print? Here are some of the top things to check before passing judgment on the quality of a warranty.

Addressing the Elephant in the Room

Before discussing any specific warranty terms, one has to address time as the ever-present elephant in the room. Most PV module warranties last 20-25 years, and we've already seen companies lasting less than that. Big or small, any solar manufacturer can go bankrupt and with its fall, your warranty can become void.

Extend for Safety

There is a way to lower the risk of your warranty becoming void. Purchasing an extended warranty, which is a contractual agreement between you and your solar equipment retailer, gives you extra security. This way, two companies are responsible for your system in the guaranteed period. Should the manufacturer go out of business, your retailer would have to cover all repairs and replacements mentioned in the warranty.

Insure your Insurance

Manufacturers are also aware of the risk, so some of them offer insured warranties. This type of warranty transfers liability to an insurer in case of bankruptcy, so customers can get proper care for their systems even if the company is not around to provide it. However, this practice is not that popular - only a handful of installers practice it.

Read the Fine Print

Even after insuring that you have a warranty and someone to service it, reading the fine print is advisable. The devil's in the details, and every warranty has a huge number of details. It's true that you cannot expect all details to work in your favor, but make sure that at least the important ones insure smooth sailing in the future.

Who Pays the Shipping on Replacement Equipment?

Shipping costs are nothing to sneeze at, so check who's responsible for them in case of a defect. The manufacturer will always repair or replace a module as guaranteed, but if the shipping is not covered, that can cost you a pretty penny. Take into account that panels on average weigh about 23 pounds and an inverter can weigh more than 50, incurring significant costs in transportation. Make sure that the manufacturer covers shipping and all aspects of replacing defective equipment.

Who Pays for Diagnostics and Interventions?

When some part of a PV system fails, someone has to diagnose and intervene, and that someone in most cases is a licensed solar installer. Unless the warranty covers this cost, you will end up paying. Warranties that include on-site assistance as well as repairs usually don't charge you for it. However, read the warranty details (in advance!) and determine if more than equipment repair is guaranteed.

Which Defects Are Eligible for Coverage?

One of the most important questions the warranty has to answer is, "What qualifies as a defect eligible for coverage?" A warranty may last a quarter of a human lifetime, but it does not cover all possible defects and damage scenarios.

For example, PV modules might be resistant to rough weather conditions, but most manufacturers won't cover damage that occurs during a hailstorm. These kinds of situations can usually be covered by homeowners' insurance, so check what's covered in the manufacturer's warranty and extend your homeowner's insurance to cover the rest.

What's the Guaranteed Repair Time?

In the end, we circle back to time as a crucial factor. Whenever a defect has been noticed and reported, it takes solar companies time to act, and that time can vary a lot. A good warranty always notes the time to complete repairs. This is especially important in cases of inverter failure, as without the inverter, the whole system goes offline.

Final Judgment

It's quite hard to determine which one of the questions raised above is most important for the average consumer. All of them are quite serious, and it's almost impossible to quantify their value. As a consultant, I usually make the recommendation based on what the customer values the most. After all, there is no perfect warranty, just one that makes the customer feel safest.

Jacob Bayer is an entrepreneur, startup enthusiast and father. He is founder and CEO of the energy consultancy Luminext Incorporated. He consults nationwide in the residential and commercial sectors in energy efficiency and renewable energy. He can be reached at jacob@energyserviceforless.com and through his website www.energyserviceforless.com/.

Questions to Ask a Solar Energy Salesperson

Courtesy of New York Solar Energy Society

An informed consumer is a powerful consumer! Here is a list of questions you may want to ask your potential installer to help you make a wise investment in clean, renewable energy.

1. What year was the company established?
2. Will you give me a firm quote or an estimate?
3. How are contract changes addressed? Do I have the right to cancel?
4. Do I get a system performance guarantee?
5. How do financing options (lease, PPA, loan, cash) differ?
6. How much can I save using solar?
7. What if I sell?
8. Who designs the system and forecasts actual output?
9. Will it meet local building and fire codes?
10. Who gets the permits?
11. Who knows if my roof is OK?
12. Do you recommend a single inverter or mini inverters or an optimizer?
13. Should I interconnect to the grid? Can I get power during a blackout?
14. Who is responsible for fixing any damage to my roof during installation?
15. How much money is due upfront?
16. Which rebates and incentives come to me? Federal? State? Other?
17. Can I add more panels/modules later?
18. Should I wait for newer technology?
19. Can I apply for shared solar or community aggregated solar?
20. Are installers your employees?
21. How long will it take?
22. Do I need to be here?
23. What warranties are on different parts of the system and who's responsible for each? Who do I call if there are problems?
24. Will my home value change? Will my real estate taxes go up?
25. What if I move?
26. Are the panel/modules blue or black? Will neighbors be notified?
27. How long will they produce maximum power? Will they degrade much?
28. Can squirrels chew the wiring? Are leaves a problem?
29. May I see your state license number and is your insurance paid?
30. Will there be a master electrician on site?
31. Do you have customer references and examples?
32. What is the process for future roof replacement? Cost?
33. What are the performance variables like hot or cold weather?
34. What if a new building is built and shades my system?
35. Will you perform a whole house audit and let me know how to reduce all my energy demands?
36. Can you quote a canopy system, a ground mounted system or a tracking system?
37. If I have an electric vehicle, how much solar energy is needed to charge it?

Energy-Efficiency Basics

By **Seth Masia and Carly Rixham**

It's cheaper to save energy than to make energy. If you want to offset $100 a month in utility bills, the right place to start is not with a solar array on the roof, but with insulation under it.

First, Look at Your Heating and Cooling Bills

Whether you battle high heating or cooling expenses, a quality roof and windows, good insulation and proper sealings are important in maintaning a controlled climate. Most homeowners can save 20 to 25 percent by caulking air leaks around windows, doors, foundations and soffits. Check the attic insulation, too. It's cheap to add an extra layer of batting or blown-in cellulose. It's more expensive to swap out old single-pane or metal-frame windows for more efficient modern insulated triple-pane wood- or vinyl-frame windows. The cheapest fix of all is to renew weather-stripping around all doors and window sashes, and put insulating covers on pet doors.

Spending $2,000 on insulating upgrades may cut heating costs by 50 percent and pay for itself in about three years. The U.S. Department of Energy (DOE) website (energysavers.gov) includes interactive worksheets to help you figure out how much more insulation you may need (depending on your climate), how much it may cost and, depending on what you're paying for heat energy today, how long the payback period may be.

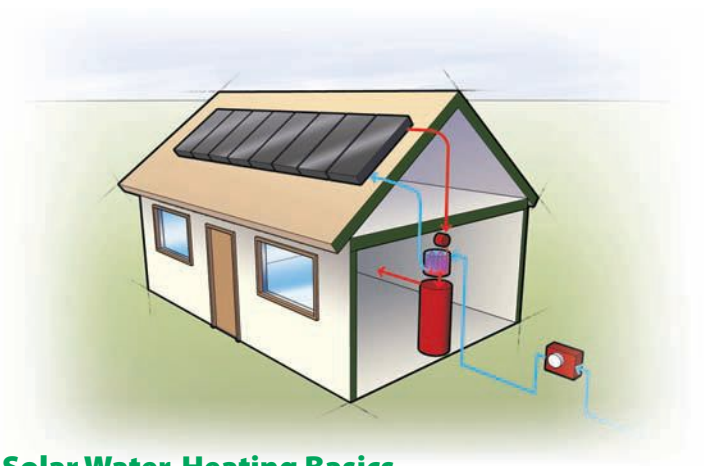
Heating and cooling systems can usually be improved. Be sure to change the furnace air filter quarterly. Get ductwork cleaned and air leaks sealed, and make sure that ducts are insulated at least to local codes. Your ductwork should be set up to heat (or cool) recirculated air from inside the house, but the furnace should draw combustion air from outside — you don't want to burn fuel using air you've already paid to heat.

If you heat with oil or electricity, consider installing a modern high-efficiency gas furnace or ground-source heat pump. A $6,000 investment in insulating and HVAC improvements might pay for itself in five or six years.

Not sure where to start? The most direct way to find cost-effective fixes, especially in an older house, is with a professional energy audit. Check with your utility company to see if they offer free or reduced-cost audits. Standard price for this service is $200 to $400. It may include a blower-door test to locate air leaks.

Look Into Energy-Efficient Appliances

The typical refrigerator built in 1980 costs about $154 in electricity to run for a year, at today's average rate of 11 cents per kilowatt-hour. A modern high-efficiency refrigerator runs for about $55 a year. The average homeowner would save $99 a year — enough to pay for the refrigerator in a few years. A new water-heating system may be cheaper still.



Solar Water-Heating Basics

Edited by **Barry Butler, Liz Merry** and **Diana Young**

In most parts of North America, the best bang for your solar energy buck is with domestic solar water heating (DSWH). It's a no-brainer in the desert Southwest and in semitropical Florida and Hawaii.

A complete DSWH system can be installed for $4,000 to $7,000, depending on its size, complexity and the climate. These systems are now eligible for the 30 percent federal tax credit. At today's energy prices, over the life of the system, the cost to operate is about 20 percent lower than a conventional gas water heater and 40 percent lower than an electric one. As gas and electricity prices rise, DSWH will look like a better and better deal. The benefits are much greater since solar energy avoids 2,400 pounds of CO_2 per year and provides a secure domestic source of hot water.

Solar water-heating systems come in two flavors: passive and active. In warm climates, a simple passive system can provide plenty of hot water.

Passive Solar Water-Heating Systems

Passive systems are installed in areas where freeze protection is not an issue. The most common types are integral collector storage (ICS) and thermosiphon systems.

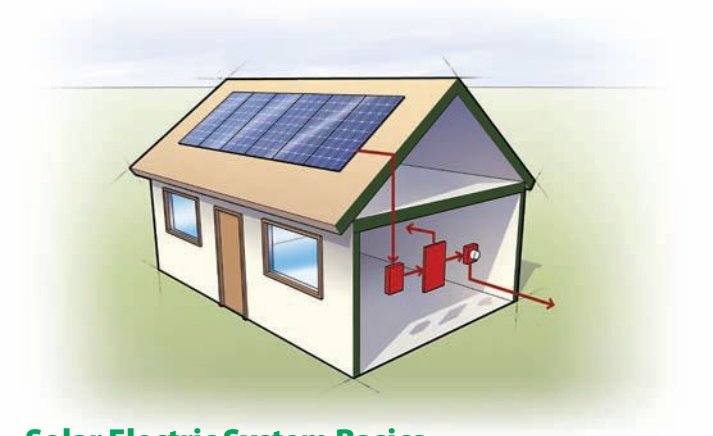
In an ICS (or breadbox) system, cold city water flows into a rooftop collector. The collector holds 30 to 50 gallons of water in a serpentine pipe with a heat-capturing coating. Hot water from the collector flows directly to a conventional water heater; in effect the sun does most of the work usually performed by the water heater's burner. As hot water is withdrawn from the water heater, cold water is drawn into the collector, driven by pressure in the city water pipes.

A thermosiphon takes advantage of the fact that water rises as it's heated. Solar-heated water in a flat-plate collector rises through tubes and flows into the top of an insulated storage tank. Colder water at the bottom of this tank is drawn into the lower entry of the solar collector. Water thus flows in a continuous loop, continually reheating during daylight hours. When a hot water tap is opened in the house, hot water flows from the top of the storage tank, and is replaced with cold city water flowing into the bottom of the storage tank.

Although the system is simple, thermosiphons put an 800-lb storage tank high on the roof, which should be reinforced to support it. Other solar water-heating systems put the storage tank at ground level or in the basement, where it's not a structural challenge.

Active Solar Water-Heating Systems

Active systems use an electric pump to circulate water through the collector. In warm climates, a direct (or open-loop) system is practical: City water goes into an insulated storage tank. A pump draws water out of the storage tank to pass through the solar collector and go back into the tank.



Solar Electric System Basics

Edited by **Joseph McCabe, PE.**

A basic home photovoltaic (PV) system consists of weather-protected panels, also called modules, fastened side-by-side on a racking system to form an array. The PV modules produce direct current (DC), which flows to an inverter. The inverter changes DC voltage to alternating current (AC) for the household electric circuit.

Excess power from the inverter may flow out of the house through the utility company's electric meter, into the city-wide grid. The utility will credit the outflowing electricity against electricity purchased from the grid at night. This process is called net-metering.

In an off-grid system, common in remote locations, DC power flows from the modules through a charge controller (also called a regulator), an electronic device that produces a smooth flow of current at the desired voltage. From the charge controller, the power can go to a set of storage batteries and then on to the inverter, as needed.

Most home systems today use crystalline silicon PV modules because they produce the most power in the limited space available on a house roof (cheaper thin-film modules are common in large industrial arrays).

Crystalline PV cells use silicon, a little bit of boron and phosphorus along with anti-reflection materials and a screen printing of electrically conductive grid lines on the top and a coating of aluminum on the bottom to collect the electrons.

Thin-film modules are made from very thin layers deposited on an electrical conducting surface. These materials may originate as silane gas for amorphous silicon, cadmium and tellurium for CdTe, or copper, indium, gallium and selenium for CIGS. The deposition techniques may include sputtering, co-evaporation in a vacuum, electro-deposition, sintering or other techniques. Many variations of thin-film materials are being investigated for low-cost manufacturing and higher solar-to-electrical efficiencies.

Installation Location

Location is critical to PV performance. The array should face the sun. This usually means due south, though if you have a heavy air-conditioning load in the late afternoon you may want to point the array southwest. The array should not be shaded during any part of its productive day. The array should be tilted upward at the correct angle to optimize seasonal exposure — typically at the angle of your latitude so it gets sunlight at a right angle at the spring and fall equinoxes. Some arrays can be made adjustable for varying the angle at different seasons.

Microinverters

Many new grid-tied systems feature microinverters, typically attached to the rack underneath the PV modules. These systems harness power at the module level, rather than the system level.

ILLUSTRATIONS BY KURT STRUVE

Wind System Basics

By **Mick Sagrillo**

It seems that everyone is interested in wind turbines, an intriguing technology that converts the kinetic energy in the moving wind to useful electricity. Let's look at the steps required to see if a small wind system (defined as up to 100 kilowatts in nameplate capacity) is in your future.

Step 1: Examine why you want a wind system. Energy independence? Lock in future energy costs? Return on investment? Do your part to mitigate global climate change? Support the renewables industry? Power an electric vehicle? Set an example for your family and community? Put your money where your values are?

These are valid reasons for installing a wind turbine. Your goals will affect the system you choose, the amount of money you are willing to spend, and the time you are willing to commit to being your own utility.

Step 2: Quantify the amount of electricity you use now. Most people put up only one wind turbine and they usually want it to generate the amount of electricity they consume over the course of a year. Cost-effectiveness changes with increasing size — the bigger the turbine, the more you spend on the installation, but the cheaper the cost of electricity will be over the life of the system. Matching the size of the system to your annual load maximizes the value of your investment if you can't sell the excess.

Step 3: Reevaluate how you use electricity and why. It's always cheaper to save energy than it is to generate it, so streamline your consumption. The most cost-effective way is to alter your electricity-use habits — turn off lights in unoccupied rooms, mind the thermostat, put "vampire" electronics on a switchable power strip. But habits are hard to change. Investing in high-efficiency appliances makes excellent sense. The rule of thumb is that every $1 spent on efficiency saves $3 in wind system costs.

Step 4: Determine how much fuel (wind) you have at your site. The best way is to hire a small-wind site assessor to evaluate your site and wind resource. This service may be available for a fee from a local wind installer, but be sure to shop around. You want an assessment of your wind resource, not a sales pitch for a particular turbine or manufacturer. Consider this akin to hiring a building inspector to evaluate a house you are interested in buying. The inspector's job is to evaluate the condition of the house and report back to you so you can make an informed decision as to whether or not the house is a wise investment. During this process, the inspector represents your interests only, as should a wind site assessor, and present you with unbiased information to evaluate.

Find more solar basics, on topics including ground source heating and cooling, passive solar building and working with a solar contractor, at **solartoday.org/solar-basics**.

Advanced solar and storage technology from Enphase empowers you with green energy that not only saves you money, it gives you peace of mind. Make the smartest choice for you and your family. Find out more at enphase.com/getsmart.

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