Clearing the Air

Home Power Dispels the Top RE Myths

Illustrations by Harry Martin

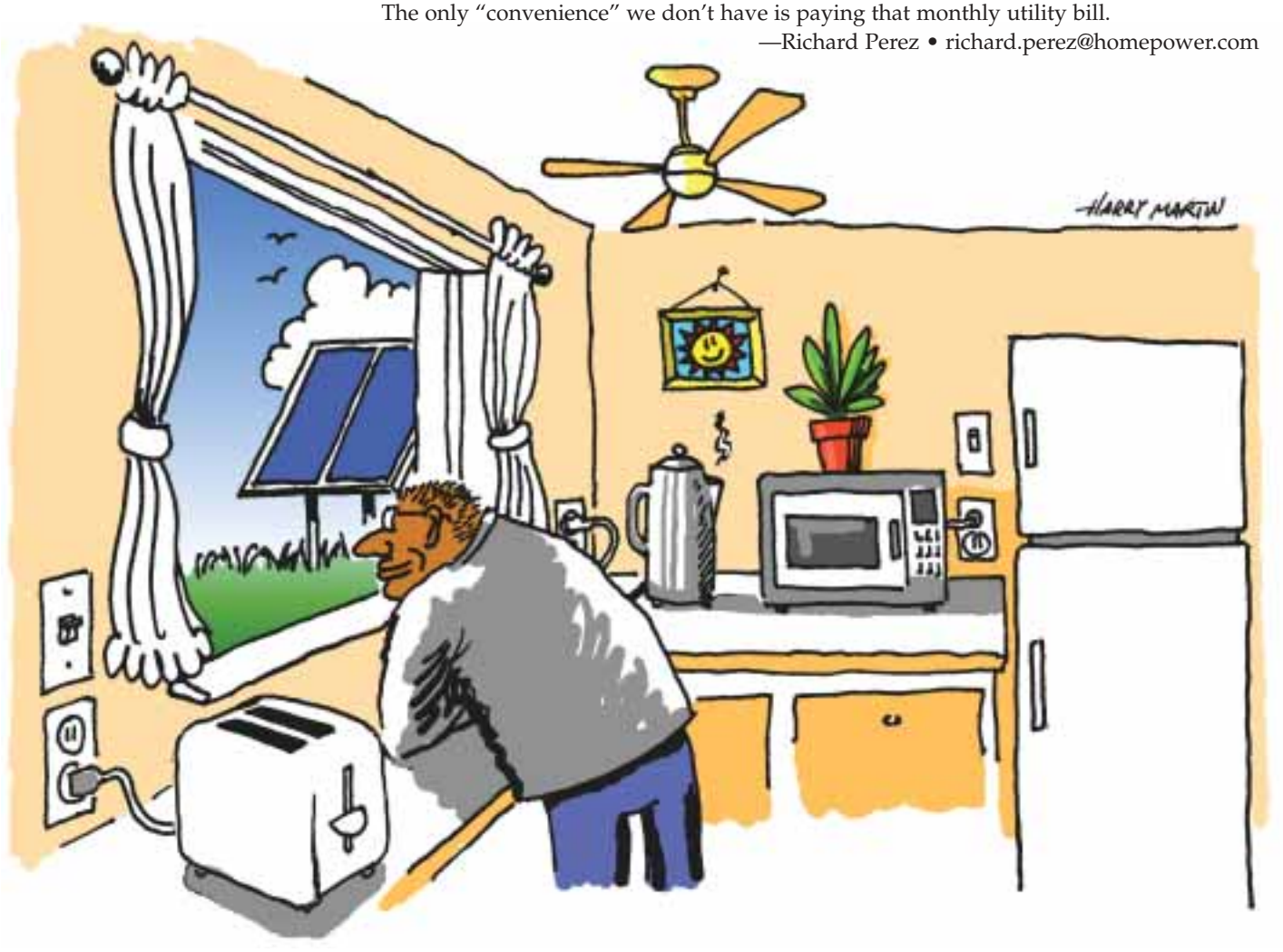
Home Power's position in the small-scale renewable energy (RE) community ensures that we hear it all, every day. Along the way, we've found that there's more than a little misinformation out there. Many RE myths are so widespread that they represent bona fide hindrances to the increasing use of these important technologies. This article is our collective debunking effort, in the interest of clearing the air.

Myth: Solar living means sacrificing conveniences.

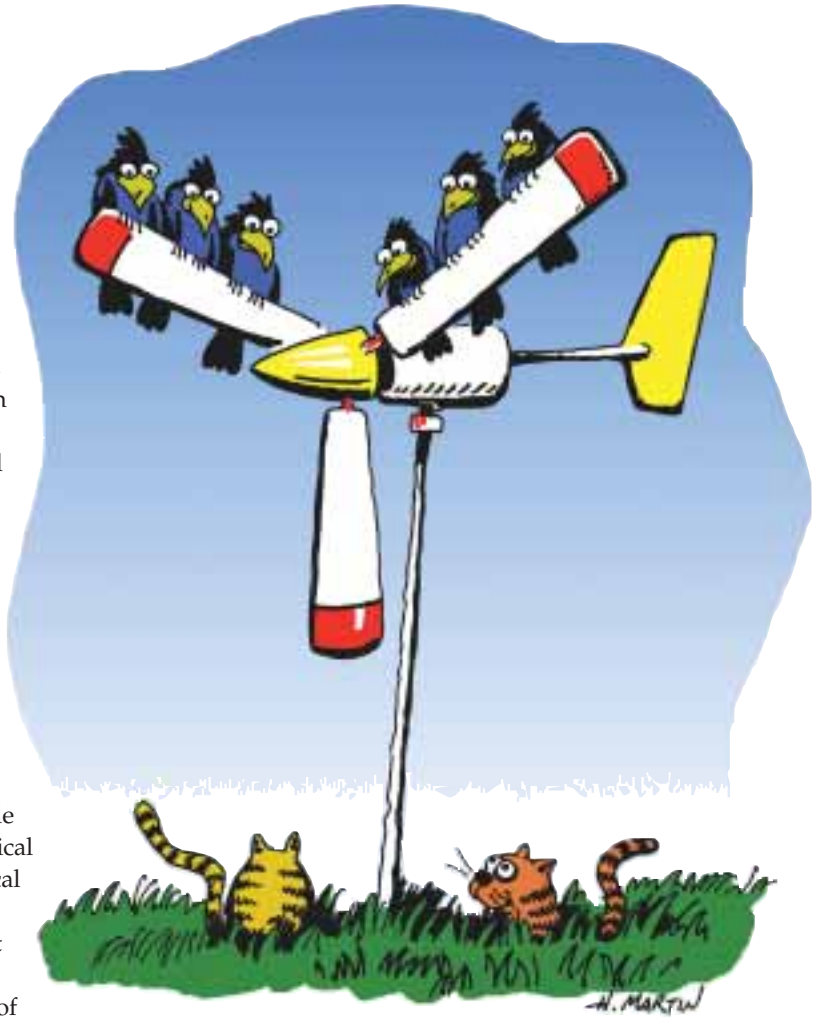
Our solar home has all the conveniences that Karen and I want. Solar energy provides the electricity to run computers for our work; it pumps our water from the well; it entertains us with video and audio; it washes our clothes; it reheats our food and drinks in the microwave; it powers our refrigerators and freezers; it powers our ham radio, telephone, and Internet communications; it runs our power tools; and it lights up our nights. Solar heat cooks our food, heats our house, and provides hot water for washing our clothes, dishes, and bodies.

The only "convenience" we don't have is paying that monthly utility bill.

—Richard Perez • richard.perez@homepower.com



Myth: Wind turbines kill birds.



Do wind turbines kill birds? Some do. Is it significant? No. The question has been studied a great deal for utility-scale turbines. These massive turbines kill fewer than two birds per turbine per year. While no one wants to kill any birds, this number is dwarfed by the number of birds killed by habitat destruction, pollution, domestic cats, electrocution by utility lines, and collisions with windows, cars, and buildings.

For example, in the United States, agricultural pesticides are conservatively estimated to kill 67 million birds per year. Wisconsin Department of Natural Resources research suggests that rural free-ranging domestic cats in Wisconsin kill about 39 million birds each year. The windows in your house probably kill more birds in a year than the average wind turbine.

What about home-scale turbines? No studies have been done on these turbines, and researchers do not consider the issue significant enough to study. Compare a utility-scale turbine with a home-scale turbine. Even ignoring the massive towers, a typical utility-scale turbine is 50 to 200 times larger than a typical home turbine in swept area. This in itself is enough to answer any concerns about birds and a wind turbine at your home.

Birds must navigate through a wide variety of obstacles in their flying careers. Wind turbines pose no special hazards to them, and are in fact easier to notice and avoid because they move. In my twenty years of living with wind turbines, I've seen birds regularly alter their courses to avoid our turbines. Birds sometimes even perch on our turbines' stopped blades, but they leave as soon as the wind comes up and the blades start rotating.

Everything humans do has an impact on other people and on the environment. If you're looking for an energy source with *no* impact, good luck. Obviously, wind farms need to be sited intelligently, not directly in major bird migration flyways. But before we stop installing wind turbines because of a few bird kills, we should get rid of cars, buildings, utility lines, and cats…

For more information on wind turbines and birds, see www.awea.org/faq/sagrillo/swbirds.html

—Ian Woofenden • ian.woofenden@homepower.com

Myth: Solar panels make electricity from the sun's heat.

There are two major types of solar panel technologies. When it comes to how they work, they couldn't be more different from each other.

Solar hot water panels, also known as solar thermal panels or solar "collectors" capture the sun's *heat* to provide hot water for domestic use or home heating. These are large, dark, rectangular panels usually measuring around 4 by 8 feet (1.2 x 2.4 m). They look like very shallow rectangular boxes, and have been around and in use on residential rooftops for decades.

The second type of solar panel is the photovoltaic (PV) panel, also known as a solar-electric panel or module. These smaller and much lighter-weight panels use the sun's *light* to make electricity via what's known as the "photovoltaic effect." PV modules perform best in cool temperatures under bright sunlight. They come in all different sizes (including some that are cleverly disguised as roofing materials) and are turning up in a wide variety of residential, commercial, industrial, and scientific applications.

So you can get hot water from the sun's heat and electricity from the sun's light. If you've got sunshine, there's nothing keeping you from choosing both!

—Scott Russell • scott.russell@homepower.com

Myth: It takes more energy to build PVs than they can ever produce.

Some skeptics of solar energy claim that it takes more energy to make a photovoltaic module (PV) than it can ever produce in its lifetime. The truth is that PVs typically recoup their embodied energy in two to four years. According to an article published by the National Renewable Energy Laboratory (NREL), today's single and multicrystalline modules have an energy payback of about four years, and thin-film modules about two years.

Most PV modules in the field are made from hyper-pure crystalline silicon. Purifying and crystallizing the silicon consumes the most energy in making these PVs. Thin-film PVs are made from considerably less semiconductor material, and therefore have less embodied energy in them. Most of the energy consumed is in the thin-film surface. The aluminum frame on any PV accounts for about six months of its payback time.

Solar energy is an amazing technology considering that PVs go on to produce clean, pollution-free energy for at least 25 to 30 years after they have achieved payback. For more information on energy payback, see the National Renewable Energy Laboratory's Web site (www.nrel.gov) and Karl Knapp & Theresa Jester's article titled "PV Payback" in *HP80.*

—Eric Grisen • eric.grisen@homepower.com

Myth: Burning wood as fuel is bad.

Plenty of bad things can happen when burning any carbon-based material. But wood is renewable in the short term, which makes it one of the best carbon-based fuels for heating. CO_2 is a problem with burning nearly anything. In the case of wood, the same amount of carbon is released by burning as would be released by the natural decay of a fallen tree—there is no net increase in atmospheric carbon. With fossil fuels, the common alternative to wood fuel, the carbon is permanently locked up in the fuel unless burning lets it out, causing an increase in atmospheric CO_2, a proven cause of global warming.

There are negative effects of burning wood, mostly from particulates that get released. But using an EPA-certified wood heater will minimize this problem. There is always some kind of negative impact from creating heat. The goal of the considerate and responsible energy user should be to minimize these impacts, helping our world to become as sustainable as possible. The best way to heat is with the sun. But if you have to burn something, either make sure it is renewable, or that it is made with a renewable resource, and be sure it is done as efficiently as possible. See John Gulland's article on efficient and clean use of wood as a fuel in *HP99.*

—Michael Welch • michael.welch@homepower.com

Myth: Solar-electric module production is toxic to the environment.

A while back, there was a media barrage claiming that photovoltaic (PV) manufacturing was extremely hazardous to the environment. PV manufacturing does require the use of chemicals that are designated as toxic by the U.S. Environmental Protection Agency (EPA). Employee safety is paramount during the manufacturing process, and chemicals used must be disposed of in an environmentally sound manner.

The federally funded National Renewable Energy Laboratory (NREL) researched the media claims and concluded, "By using well-designed industrial processes and careful monitoring, PV manufacturers have minimized risks to where they are far less than those in most major industries. All of these risks fall well within the range already protected by OSHA and similar regulations."

A thorough analysis of the environmental impact that various energy sources have on the environment must take into account the net effect of a given source over the source's operational lifetime. When you compare the environmental impact of PV technology to traditional energy sources like coal and nuclear energy, PV comes out on top, hands down.

Nukes produce nuclear waste, and even after spending billions of taxpayer and ratepayer dollars, no acceptable disposal solution has been brought to the table. Fossil-fuel-based energy sources like coal produce air pollution over the power plant's entire operational lifetime—as long as it's running, it's polluting. Burning coal releases sulfur dioxide, which results in acid rain; nitrogen oxide, which results in smog; carbon dioxide, which results in global warming; particulates, which result in lung damage; and an array of heavy metals like arsenic, lead, and mercury, which result in birth defects and brain damage.

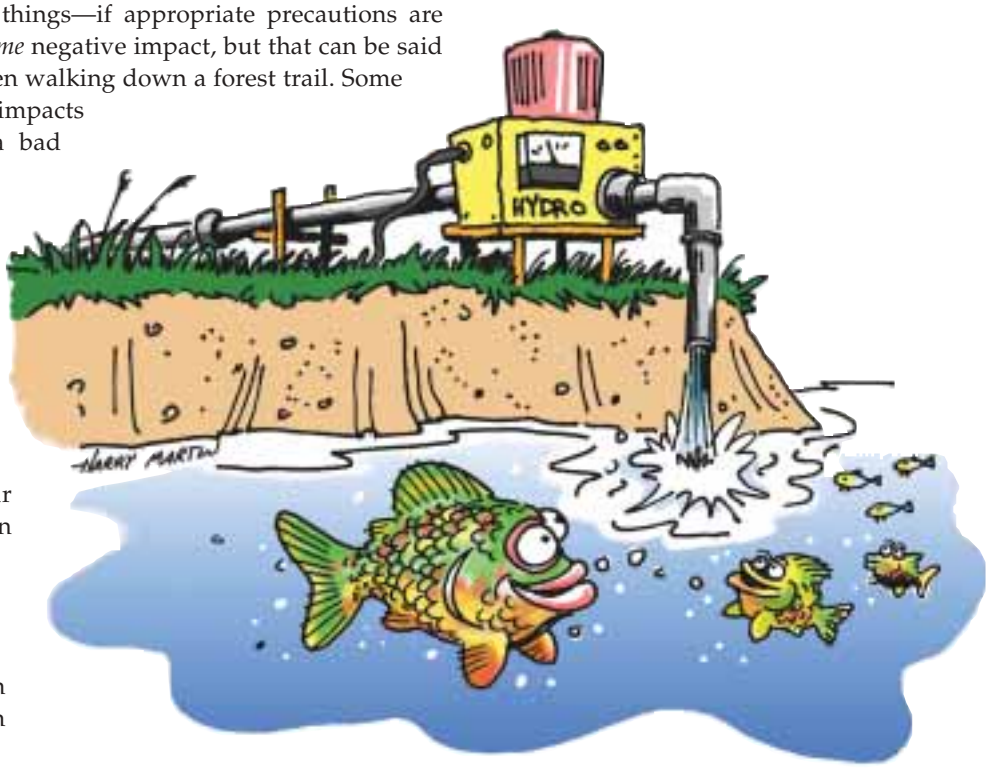
On the other end of the spectrum, PVs produce no emissions and require no use of finite fuel sources. PVs manufactured today are expected to be producing energy 50 years from now. PVs offset all the energy used to manufacture them (embodied energy) in two to four years in most locations. Fossil, nuclear, or solar—which energy source would you want in your backyard?

—Joe Schwartz • joe.schwartz@homepower.com

Myth: Microhydro is bad for river life.

The impact of microhydro on fish and other river life is tainted by association with blatantly destructive, large-scale hydro, which seriously impedes fish movement, changes stream temperatures and flow rates, slices and dices aquatic life, and even drowns entire ecosystems.

Microhydro does none of these things—if appropriate precautions are taken. There is always going to be *some* negative impact, but that can be said for nearly every human activity—even walking down a forest trail. Some misguided folks do not consider the impacts of what they do, and they give a bad reputation to those of us doing similar things in a more caring and respectful manner.



The idea is to minimize the impact of microhydro by following some simple rules.

- Always leave enough flow in the stream bed for aquatic life.
- If migratory fish use your stream, make sure that they and their fry can swim past your diversion, and cannot be drawn into the penstock intake.
- Always put the diverted water back into the same stream bed in a way that does not cause erosion.

—Michael Welch
michael.welch@homepower.com

Myth: Solar electricity is too expensive.

There is a huge public misconception that solar energy is simply too expensive to bother with. The reality is that, both on and off-grid, solar energy is cost effective in many applications.

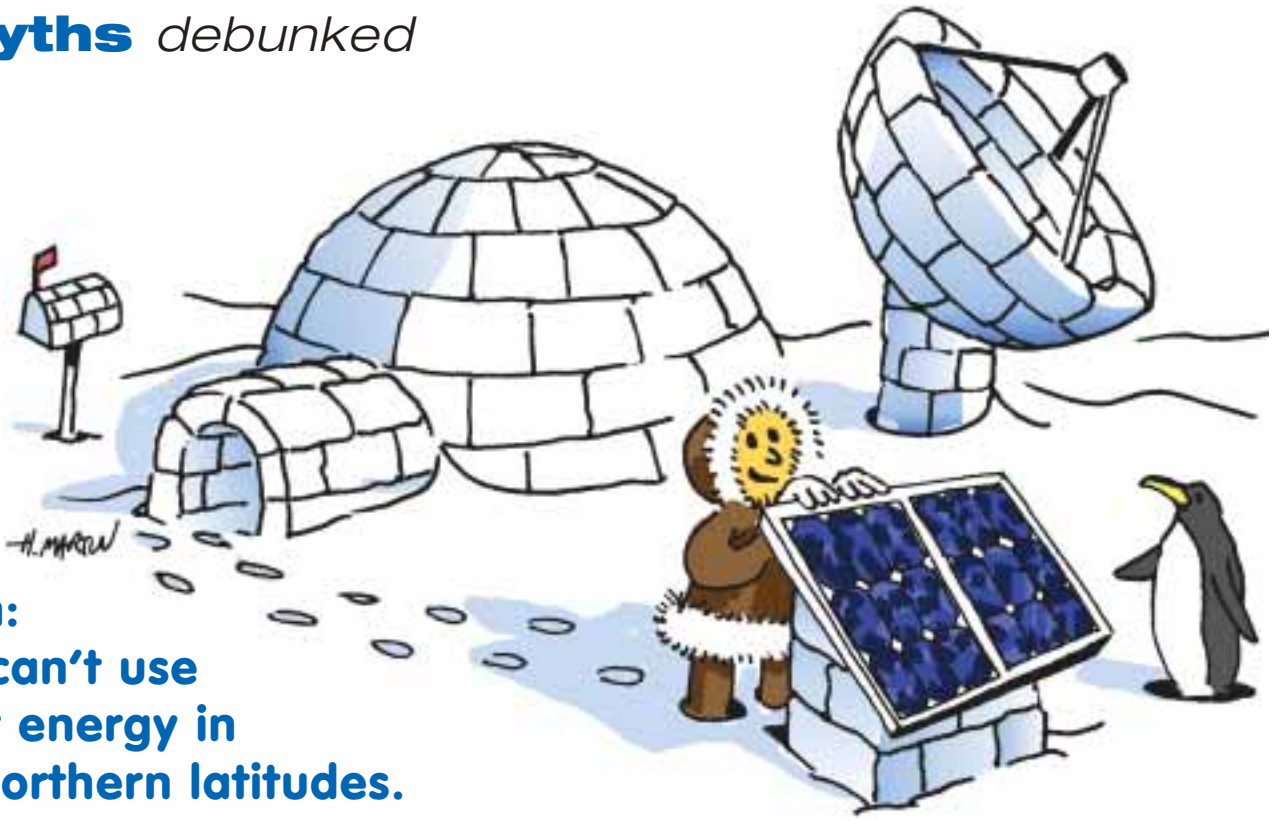
Right out of the gate, it's important to understand that on-grid, a substantial amount of "smoke and mirrors" is going on behind the scenes, making true energy cost comparisons unfair at best. The historical trend shows U.S. federal energy subsidies favoring mature energy sources like coal and nuclear over renewable sources by a factor of one hundred to one. A report based on U.S. Department of Energy (DOE) data by the Congressional Research Service (CRS) states, "Because the great bulk of incentives support mature fossil and nuclear equipment, the existing subsidy structure markedly distorts the marketplace for energy in a direction away from renewables."

The bottom line is that renewable energy *appears* to be more expensive than traditional electricity generation sources, but the reality is that you pay the difference every year come tax time. If you include the costs of increased pollution, habitat destruction, health care costs, etc., then RE looks even better. Fortunately, many individual states are doing what the feds refuse to do, and are implementing rebate programs for renewables that serve to even out the financial playing field a bit. For some great economic analyses of the cost effectiveness of grid-tied PV, see the article by Greg Bundros in *HP99* and the article by Paul Symanski in this issue.

Off-grid, people have been realizing the financial advantages of solar energy for more than a decade. Property beyond the reach of the utility grid is typically undervalued, and a great investment. We're not necessarily talking about living "out in the sticks." A good rule of thumb is that a solar-electric system costs less than a utility line extension of a quarter mile (0.4 km) or more.

I had the local utility provide me with an estimate for running a line to my off-grid home site (though I was never going to take them up on it!). They came up with a cost figure of US$32,000. I used this estimate as leverage when I purchased the property, which substantially lowered the seller's asking price. From day one, renewable energy technology saved me over US$10,000 compared to bringing the grid in. How's that for an incentive!

—Joe Schwartz • joe.schwartz@homepower.com



Myth: You can't use solar energy in far northern latitudes.

Solar energy can and does work in northern latitudes. A trip to any well-designed passive solar building can be one of the most uplifting experiences in the cold winter months because of the warm, cozy atmosphere it affords. Every square foot of south-facing insulated glass can let in the heat equivalent of about a half gallon of heating oil from the sun each heating season. Cover the glass with insulating shades or shutters at night, and the heat equivalent can increase to nearly a gallon for each square foot of window.

There are too many examples of the successful use of solar energy in northern latitudes to be included here, but hundreds of solar home owners in far northern latitudes have opened their doors in the American Solar Energy Society's National Solar Tour (www.ases.org). *Home Power* magazine has been bringing you articles about successful solar-electric systems in Canada and the northern United States for the past seventeen years. Germany, the world's second largest user of electricity generated by PV modules, is not located in the Sunbelt, but rather at 48 to 54 degrees latitude.

Obviously, the largest obstacle to using solar energy in the north is the short, cloudy days of winter. Annual net metering of PV systems has really helped overcome this obstacle for on-grid solar-electric systems by providing a year's energy "storage" (in terms of dollars and cents from a billing perspective). The long, sunny days of summer can directly compensate for the shorter days of winter in northern latitudes.

Something interesting to think about is that the peak electrical loads in many northern cities, such as my home of Burlington, Vermont, have shifted from the winter months to the summer months over the past ten years. This shows that there is ever increasing potential of solar electricity in northern latitudes to complement the passive solar and solar thermal systems that have been working for the past twenty or more years up north.

—AJ Rossman • aj@drakersolar.com

Myth: Lead-acid batteries wind up as toxic disasters in our landfills.

Hardly any other industry does a better job at recycling than the lead-acid battery industry, and this includes aluminum, glass, paper, and plastics. More than 90 percent of spent battery lead is recycled, which is two to four times higher than many other major recyclable commodities. And 60 percent of the lead used in manufacturing lead-acid batteries is derived from recycled lead. Most of the lead used in your car's battery has probably ridden around in three or four other cars before it got to yours.

Worn out lead-acid batteries are accepted for recycling by all outlets that sell these batteries—it's the law. From there the batteries are broken open, and the lead is removed and resmelted for reuse in new batteries. The only way a lead-acid battery winds up in a landfill is if a careless user dumps it there. So don't break the recycling chain—return your spent batteries to a dealer for recycling!

—Richard Perez • richard.perez@homepower.com

Myth: Grid-intertied PV is hazardous to utility lineworkers.

Although this may be one of the most pervasive myths in the electricity industry, I was unable to locate a single documented instance of injury or death to a utility worker from a grid-intertied inverter. The reasons for this are two-fold—modern inverter design and lineworker safety protocol.

Inverters are perhaps the most highly scrutinized piece of electronics used in residential applications. Their safety and proper functioning are certified by some of the same agencies that verify the safe operation of all the other appliances in your home.

Inverters for use in grid-intertied systems are required (by IEEE, the *NEC*, and UL) to disconnect from the grid for any number of conditions. These include grid outage, high or low voltage, high or low frequency, and inverter malfunction.

Inverters are required to have several redundant safety devices built into their electronics to ensure that they disconnect from the grid if anything at all is wrong. Nonetheless, utility companies and lineworkers are quite safety conscious, and leave nothing to chance.

Lineworkers are trained to always ground any potentially energized conductors when performing utility line maintenance. In addition, grid-intertied systems are routinely required to have a safety disconnect available for the lineworker's use to lock out any solar electricity generation from being backfed onto the grid.

Lineworker safety protocols make a great deal of sense. During utility outages, many people use engine generators to keep the electricity on in their homes and businesses. Most engine generators do not have the intricate electronics that inverters have to ensure lineworker safety. If they are not correctly hooked up with a transfer switch to isolate selected circuits in the home from the utility grid, the generator can backfeed electricity to the grid through the utility's transformer, which converts it to extremely high voltage.

Lineworkers have been killed by engine generators, so it's a good thing they practice safety rigorously. In fact, the problems with engine generators are the reason utilities have been so cautious about allowing any other customer-owned generating sources on their lines at all.

Since inverters have such a strong safety record, some day soon they will be a common and accepted part of many home electrical systems. They will outlast the urban myths of lineworker lore. For a more thorough discussion of utility-intertie inverters and how they work, see *HP71*, page 58.

—Linda Pinkham
linda.pinkham@homepower.com

Myth: All solar heating systems need a backup fossil fuel energy source.

While it is true that most solar heating systems have a conventional backup heating system, it isn't absolutely necessary. Fossil fuel heat as a supplemental system is a cost, financing, and comfort decision. Many solar energy heating systems rely on the renewable resource of wood for any heat not supplied directly by the sun.

A combination of passive and active solar energy collection is probably the easiest and most cost effective way to avoid a conventional backup system. A super-insulated passive home design in a sun-friendly climate can provide all but a small fraction of the energy needed to heat a home. An active solar heating system typically stores heat in a large storage tank (many people use an indoor pool) for the times that the passive system is unable to collect enough energy, or a severe storm calls for more heat than normal. A PV system provides the required electricity. This type of design is not the norm by far—it's just a little too expensive up front for most people—and it might require the owners to put on a sweater indoors a few times a year.

The expense of going 100 percent solar and the possibility that the home might fall to 60°F (16°C) or so in rare circumstances are the reasons that most solar homes have a conventional backup. Another factor that looms large for many people is that mortgage bankers are very nervous about lending money on homes that fall out of the conformity they are familiar with.

—Chuck Marken • chuck@aaasolar.com

Myth: Hydrogen fuel cells are a renewable energy source.

Hydrogen fuel cells produce DC electricity from hydrogen. They do this cleanly and quietly. But where does the hydrogen come from? Though hydrogen is the most common element on earth, unlike sun, wind, and falling water, it is not freely available. It must be stripped out of hydrocarbons or split out of water. These operations take energy, and the actual energy source may not be renewable at all.

Hydrogen can be thought of as an "energy carrier." We use some energy to get it out of hydrocarbons or water, and then we get the energy back when we run the hydrogen through a fuel cell or engine. Every conversion of energy has an efficiency cost and an equipment and maintenance cost. If hydrogen fuel cells have a place in renewable energy systems, they must be a step forward in terms of cost,

efficiency, and environmental friendliness. The jury is still out on this issue.

In renewable electrical systems, hydrogen fuel cells might replace two different components that we use today—generators and batteries. Many people use gasoline, diesel, or propane-fired generators as charging or backup sources in off-grid or on-grid RE systems. Fuel cells could be a quieter, cleaner answer, even if they use nonrenewable fuels.

To replace batteries in RE systems, you need two other components besides the fuel cell. First, an electrolyzer is needed to split hydrogen out of water, using your surplus renewable energy. Then you need a hydrogen storage system—not a simple proposition.

Any new technology takes time and money to develop. Hydrogen fuel cells may play a role in RE systems in the future. But the energy sources that power them should be the sun, wind, falling water, and the like. Otherwise we are just pinning our hopes on more nonrenewable energy, with a high-tech twist.

—Ian Woofenden • ian.woofenden@homepower.com