Chapter 1

Helping the World through Solar Power

In This Chapter

- Investing in solar energy
- Looking at the benefits of solar power
- Solving for challenges

Producing energy can be dirty work. Carbon emissions, coal slurry, nuclear waste, and other pollutants can wreak havoc on the environment, cause health problems, and make people hopping mad. And many energy sources are in limited supply, particularly fossil fuel sources that have traditionally dominated the world's energy usage. Not only does that drive prices up, but it also leads to political conflicts when people decide they're not willing to share. You're probably not ready to go completely unplugged, but you do want to play your humble part to save the environment, help the country become less dependent on foreign energy sources, and save money. Tall order? Maybe not. Above all the energy sources in use today, solar shows the most long-term promise for solving the world's energy problems. Solar power works well on both large and small scales, and it is possible to start using solar power right away. You can start small, and work your way up.

On any given day, 35,000 times the total amount of energy that humans use falls onto the face of the Earth from the sun. If people could just tap into a tiny fraction of what the sun is providing each day, society would be set. Of course, some problems do crop up, but they're solvable, and going solar can be well worth the effort.

To understand the role solar energy can play in your home, you need to have a good understanding of where your own energy comes from, where it's used, and how much pollution each of your energy sources generates. In this chapter, I explain how solar fits into your day-to-day life — and why it's such a good energy option.

Looking for Sustainable Energy

The words *renewable* and *sustainable* are being knocked around quite a bit, and both are strongly associated with energy conservation. *Renewable* forms of energy constantly replenish themselves with little or no human effort. Solar energy is just one example — no matter how much you use, the supply will never end (okay, it may end after billions of years, but your using solar power won't make the sun burn out any faster). Other examples of renewables include firewood, water (through hydroelectric dams), and wind power. Note, however, that firewood is notoriously polluting; the term *renewable* does not necessarily imply good environmentalism. Firewood also has another potentially severe drawback in that people go out into forests and cut down trees, often without much thought to the overall health of the forest (a good example of not seeing the forest from the trees).

To make sure that resources last, humans need to focus on conservation, recycling, environmental restoration, and renewable and alternative energy sources. *Sustainability* is commonly associated with such a holistic approach to personal lifestyle. Not only are *sustainable* forms of energy renewable, but they also have the ability to keep the planet Earth's ecosystem up and running, in perpetuity. Sustainable energy, such as solar, is nonpolluting to the greatest extent possible. The basic notion behind sustainable energy sources is that by their use, society is not compromising future generations' health and well-being, nor their ability to use their own sustainable resources to any less capacity than we have in the past. Who can argue with this very fundamental version of the Golden Rule?

Consuming the Earth

Here are some statistics about power use in the United States (from DOE):

- Americans import more than half their fossil fuels. Thirty years ago, this figure was only 33 percent, and analysts predict that within a few years, it'll rise to 66 percent. Even though new energy reserves are being found, our increasing consumption of energy is more than offsetting our increased domestic production.
- Of all the energy used in the United States, 39 percent comes from oil, 23 percent from natural gas, 24 percent from coal, 6 percent from hydropower dams, 7 percent from nuclear, and only 1 percent from renewables such as solar energy. On the plus side, the use of renewables is increasing much faster than other forms of energy, particularly with all the government subsidies and incentives that are being promoted.
- Americans get 51 percent of their electrical production from coal, 20 percent from nuclear, 18 percent from natural gas, 2 percent from petroleum, and only around 9 percent from renewables, of which the vast majority is hydro (water). Solar plus wind accounts for only around 0.18 percent of the grand total.

Understanding Why Solar Is King

Solar power has historically been more expensive than other energy options, but that's changing fast because of government investment in technologies, as well as the simple fact that many more people are investing in solar, which results in economies of scale. Solar energy equipment increases your financial standing in basically three ways:

- Savings on your monthly utility bills.
- Appreciation of your home's value.
- Predictability in your utility bills for years to come. When utility rates increase, you'll be largely immune from the increases because you'll be getting your energy from a local source that's not tied in to the utility. Of all these three factors, this one seems to drive people to invest in solar the most.

The following sections cover reasons why solar is a great investment, both financially and environmentally.

Reaping financial rewards

Solar is an investment; you must actively go out and purchase solar equipment and install it at your home. However, after the initial costs, not only do you save money from lowering your energy bill, but you will also see the value of your home increase.

Comparing savings

So how does investing in solar compare to other investments, such as the stock market, a savings account, or a new kitchen?

To compare investments, you need to calculate your payback period. *Payback period* is a measure of how long it takes to recoup your upfront investment with the costs you save by installing solar equipment. If you install a solar water heater system for $4,000 and it saves you $50 a month on your power bill, the system will pay for itself in 80 months, or 623 years. (Though you may easily cut that time in half if the price of oil skyrockets and utility rates double, for example, during a war in the Middle East.)

Now consider other ways you can spend that money. With investments in remodeling, such as a new kitchen, you get no monthly cost reductions at all unless you're installing new appliances that are more energy-efficient. Historical data indicates that if you remodel your home with a new kitchen, you'll only recoup around 70 percent of the cost of the remodel when you sell your home. If you put the same $4,000 into an interest-bearing bank account,

you may get $20 a month in interest (that's at an interest rate of 6 percent, which is difficult to find these days). After 80 months, you'd make $2,000 in compounded interest, or half your investment. And if you put the same money into the stock market, you may enjoy a return of $3,400 in a single year. Of course, you can also lose the entire thing and drive yourself nuts with regret!

When you install a solar PV system, historical data indicates that you will recoup nearly 100 percent of your investment. If you spend $25,000 on a PV system, your home's value will increase by around $25,000, maybe even more if utility rates increase precipitously. It may be said that no other investment that you can make in your home will recoup as much.

To play it safe, choose a variety of investments and decide how much you want to put toward solar power. Stock portfolio managers consider hedging an important facet of a good portfolio. *Hedging* basically entails spreading the risk around over a range of individual investments. That way, if one of your investments goes sour, the effect on your entire investment portfolio will be minimal. "Don't put all your eggs in one basket," as the saying goes.

In short, if you install solar, you'll be relatively risk free from exploding energy costs. If you install a solar PV system that produces as much electricity as you use in your home, you'll never have to worry about paying another electric bill. And you won't have to worry about utility rate increases.

Showing a little appreciation

When you go solar, your home *appreciates,* or increases in value. Realtors can give you statistics that estimate how much the value will go up, given the type of investment and the area you live in.

According to the National Association of Real Estate Appraisers (NAREA), for every dollar you save annually in energy costs with solar equipment, the value of your home increases by up to 20 times your annual energy savings, depending on the type of system you install. For a solar water heater investment of $4,000, the value of your home may increase by at least that much! How can this be? Solar is catching on, and homebuyers are willing to pay more for solar homes that promise energy savings. People are more and more willing to invest in energy systems that are clean and reliable, compared to the fossil fuel mainstay. In some communities, a solar home will sell much faster than a conventional home, and this may be important if you need to move quickly.

Taking advantage of subsidies

Right now, a wide range of government and industry programs are available to help you finance your solar investments. Governments are giving out tax breaks, utilities are offering rebates, and low-interest loans are available for solar investments. The net effect is to make your solar projects less expensive and more attractive on the bottom line. With any solar investment, it's

important to consider the net cost, which is the original cost of the equipment minus any subsidies and rebates. For a PV system, the net cost can be as low as one half of the original cost, which is a considerable savings.

In Chapter 20, I show you how to find the right resources for subsidies and rebates and tax credits, and how to work with the various agencies that you'll need to interact with.

Erasing your carbon footprint

Most energy resources are burned in order to create the useable energy we so take for granted. The worst offender, in terms of pollution, is coal, and the United States gets around 50 percent of its electrical power from coal-fired power plants. Put simply, there's no clean way to burn coal, and that situation is not likely to change in the next decade, or even longer. While you hear a lot of talk these days about "clean burning coal" plants, it's all relative. A clean-burning coal fired power plant is simply cleaner than those that exist now; in the grand scheme of power generating systems, coal is one of the worst offenders in terms of greenhouse gas emissions.

Your carbon dioxide footprint is a measure of how much carbon dioxide you're releasing into the environment by virtue of your energy-consuming habits. A typical American *carbon dioxide footprint* is around 36,000 pounds (18 tons) per year. That's a lot!

Solar, however, has no carbon footprint, other than the energy is takes to manufacture a solar panel (referred to as *grey* or *invested* energy). For each kilowatt-hour (kWh) of energy-generating capacity you install with solar, you'll save that much from other sources, most likely the electrical power grid. No other alternative energy resource can offer this impact except wind power and hydro, but solar is far more versatile and widely available. Wind power is practical only where there's a lot of wind (which doesn't include all the hot air blowing around in Washington, DC). Hydropower is only available where suitable water resources are abundant, and hydropower disrupts the environment in ways that have resulted in the environmental movement frowning upon further hydropower development. (Plus all significant hydro sources in the U.S. have been tapped, anyway.)

Your carbon footprint is valuable for calculating cost versus gain for installing solar systems because — face it — even though pollution isn't costing you directly in your wallet, you need to factor it into your thinking.

When you generate solar electricity, you don't need transmission lines and all the associated inefficiency. Solar is right there, where you use it. When you install a 3kWh active solar system, you're offsetting the need for that much power from your utility company. But you're *saving* about 9kWh of total power consumption because of inefficiencies in the power grid. Therefore,

you're actually saving much more than 3kWh, as well as the associated carbon footprint.

Table 1-1 can help you calculate your own carbon footprint.

Table 1-1 Carbon Emissions for Burnable Energy Sources

Type	*Pounds CO_2/Unit*	*Unit*
Oil	22.4	Gallons
Natural gas	12.1	Therms (Btus)
Liquid propane	12.7	Gallons
Kerosene	21.5	Gallons
Gas	19.6	Gallons
Coal	4,166	Tons
Wood	3,814	Tons

Start with your car:	**Your numbers**	**Example:**
How many miles do you drive per year?	_____	15,000 miles
Mpg?	_____	23 miles per gallon
Divide to yield number of gallons/year	_____	652 gal/yr
Multiply by 19.6 (from above table)	_____	12,782 lbs/yr (ouch!)

To find how much carbon dioxide you produce by using home fossil fuels, multiply the amount of fuel you use by the value in the second column, the pounds of CO_2 per unit. For example, suppose you use 400 gallons of home heating oil; you produce 8,960 pounds of carbon dioxide per year:

$$400 \text{ gal/yr} \times 22.4 \text{ lbs. } CO_2\text{/gal} = 8{,}960 \text{ lbs. } CO_2\text{/yr.}$$

And here's your carbon emissions for the 50 gallons of liquid propane you may use for your barbecue:

$$50 \text{ gal./yr} \times 12.7 \text{ lbs. } CO_2\text{/gal} = 635 \text{ lbs. } CO_2\text{/yr}$$

And here's the footprint for using 1 ton of firewood in a year:

$$1 \text{ ton/yr} \times 3{,}814 \text{ lbs. } CO_2\text{/ton} = 3{,}814 \text{ lbs. } CO_2\text{/yr}$$

Add those together, and your home fossil fuel consumption produces 13,409 pounds of carbon dioxide per year. Ouch! You can cut way down on that if you switch to solar heating and cooking, not to mention all the other solar options that are available.

Then calculate your carbon emissions from electricity use. This number depends on how your local power generators operate. Nuclear reactors emit very little carbon, and coal-fired generators emit quite a bit. The average North American value is 1.33 pounds of CO_2 per kWh. If you're using nuclear energy, you can reduce this number to about 1.0 pounds of CO_2 per kWh,or less. If you're strictly relying on coal-fired electricity, the number could go as high as 2.0. Here's how you calculate the carbon dioxide output if you use 10,000 kWh of energy:

$$10{,}000 \text{ kWh/yr} \times 1.33 \text{ lbs. } CO_2\text{/kWh} = 40{,}000 \text{ lbs. } CO_2\text{/yr (Youch!)}$$

Enjoying solar's unlimited supply

At sea level, on a sunny, clear day, 1 kWh of sunlight energy is falling onto a 1-square-meter surface per hour. Over the course of a sunny day, you can realistically expect to capture around 6 kWh of total energy from this same surface area. That's 180 kWh per month. Five square meters is enough to completely replace a typical monthly power bill! If only it was so easy.

If you were to build an active solar panel measuring 100 miles by 100 miles in sunny Nevada (where you can get plenty of government land for free), you'd be able to produce enough power to handle all the United States' electrical requirements (except when it rained a lot!).

Exercising your legal rights to sunlight

You have legal rights to your sunlight; nobody can build up so that your solar exposures are affected. Government acknowledges value in the amount of sunlight that hits your home.

You have a legal right to demand that your neighbors remove trees and other impediments to your solar access. If a neighbor's trees are shading your property, you can do something about it. Remember though, this right goes both ways. If you're shading somebody else's property, he or she can force you to remedy the situation. Check with your local governments to see what sorts of laws apply to your specifics.

Appreciating solar energy's versatility

You can use solar energy in many ways, each with different costs and complexity. Later chapters and the upcoming section titled "Small to Supergiant: Choosing Your Level of Commitment" talk about some projects you can tackle. But for now, consider that solar power lets you do any of the following:

- **Generate electricity for general use:** You can install a solar electric generating system that allows you to reduce your electric bills to zero. This is one of the most popular solar applications on the market today, and the growth in solar powered electrical systems is over 25 percent per year. (See Part IV.)
- **Cook:** Using the sun and your vivid imagination, along with a few easy-to-build ovens and heaters, solar power can help you put dinner on the table. (See Chapter 9.)
- **Practice passive space heating:** The sun can heat your house by strategic use of blinds, awnings, sunrooms, and the like. (See Chapters 9, 13, and 15.)
- **Heat water:** Use solar energy to heat your domestic water supply — or let sun-warmed water heat your house by pumping it through appropriate plumbing systems. You may need no electrical pumps or moving parts other than the water itself. (See Chapters 10, 11, and 12.)
- **Pump water:** You can slowly pump water into a tank when the sun is shining and then get the water back anytime you want. You can also make your tank absorb sunlight and heat the water, thereby reducing the power load on your domestic water heater. (See Chapter 14.)
- **Heat your swimming pool:** You can cover your pool with a solar blanket to heat it cheaply and efficiently. Or you can install solar hot water heating panels on your roof that can heat your pool year round. (See Chapter 11.)
- **Add landscape lighting:** You can put small, inexpensive solar lights around your yard and eliminate the need for high-priced overhead lighting powered by the utility company. With advances in technology, these lights actually look and work better than hard-wired versions. This is the most widely accessible solar technology, and it's nearly fool proof. (See Chapter 8.)
- **Provide indoor lighting:** The technological boom in light-emitting diodes (LEDs) — small, electronic lights that take very little current and provide long lifetimes — has enabled a number of effective solar lighting systems for in-home use with very low power requirements. You can light your porches and even rooms in your house with a small, off-grid photovoltaic system connected to a battery. During the day, the battery charges so that you have enough juice at night to do the job. (See Chapter 9.)
- **Power remote dwellings:** You can completely power a remote cabin, RV, or boat with solar. (See Chapter 18.)

Gaining independence from fossil fuel sources

In the United States, domestic supplies of fossil fuels are dwindling and demand cannot be met at the current rate of consumption growth. Even if new reserves exceed expectations and next-generation oil and gas recovery technologies significantly improve, supply and demand are going to be imbalanced.

In terms of dollars, energy imports accounted for around 24 percent of the U.S.'s $483 billion trade deficit in the year 2002 (note that coal is the only energy source that the United States doesn't import). Here's a breakdown of how much we import of the most common energy resources:

- Fossil fuels: 60 percent
- Natural gas: 16 percent
- Uranium used in nuclear reactors: 81 percent
- Total net fuel import: 33 percent

The U.S. imports more oil from Canada than any other foreign nation. Next in line is Saudi Arabia, then Venezuela, then Mexico. Each of these countries provides around 1.5 million barrels to U.S. markets every day. In particular, the Persian Gulf region supplies the U.S. with around 22 percent of its oil imports, or around 12 percent of total U.S. energy consumption. Our dependence on these sources of oil makes us beholden to the supplying nations, and they play political games with us, as a result. We simply cannot sustain the current level of energy imports, not only because the trade deficit suffers, but also because we are subjected to dubious political pressures from our chief import countries.

The Alaska Arctic National Wildlife Refuge (ANWR) has considerable oil reserves, but it is estimated that at the peak of drilling it will only be able to produce less than 1 million barrels per day. That's a mere drop in the bucket in relation to the amount of energy that we use.

Solar power, on the other hand, is domestically produced, and every kWh of solar energy that we produce reduces our demand for foreign oil sources by the same amount.

Electrical power is our most important form of energy consumption, and electrical consumption is increasing every year because electricity may be used in so many different ways. Solar power directly supplants the need to produce electrical power the majority of which comes from coal-burning power plants.

Some people believe that we need to promote electric vehicles, which use batteries to power the transmissions. These batteries need to be charged,

and the current scenarios call for plugging in to the grid for the power. Doing so will result in a huge increase in grid-powered electrical demand, which in turn means that we'll be using a lot more coal and emitting a lot more carbon dioxide. An ideal solution is to use solar power, instead of the power grid, to charge the batteries. In some communities, special rate structures are available for those who charge their electric vehicles with solar panels. Look for this sort of thing to proliferate in the next decade.

Eliminating peak power grid problems

In the summertime, on a hot day, air-conditioners run non-stop. The highest demands come in the late afternoon, when the heat of the day is most intense. Worst of all are weekdays, when businesses and offices provide their employees with a lot of conditioned air.

Utilities rely on huge power plants to provide their customers with the vast majority of their energy needs. It's a physical fact that the larger a generating plant is, the more efficiently it may be run (for more details, see my book *Alternative Energy For Dummies* [Wiley]). When peak power requirements exceed the capacity of these large, mainstay power generating plants, the utilities must obtain power from other sources, and these are generally inefficient and expensive, not to mention highly polluting.

In some cases, the utilities simply cannot provide the amount of power that their customers demand, in which case brownouts result (power is simply shut off). In California, brownouts were common in the early 2000s and resulted in people losing their power when they most needed it. Talk about getting hot under the collar!

Solar power systems generate their maximum outputs during the afternoons, when the sun is shining the brightest. Therefore, solar is a perfect solution to the peak power problems that are becoming more and more common across the country. In fact, the reason the state of California launched its solar subsidy program was to help mitigate the peak power problems. It wasn't out of concern for the environment, as most people believe. Solar is the perfect solution for peak power problems, and many utilities rely on their solar customers to help mitigate the need for peak power.

Utilities could, of course, solve the peak power problem by increasing their base capacity (the size of their main power plants), but this is extremely expensive and increases greenhouse gas emissions. The ideal solution to the peak power problem is to increase the use of solar electrical generating systems. By installing a solar generating system with battery backups, you'll be largely immune from power blackouts. Currently, many people install backup generators that run off propane or other fossil fuels just so they won't have to deal with power outages. A solar generating system provides the same backup capacity, with only a fraction of the air pollution. And you don't need an on-site tank for propane or fuel when you go solar.

Acknowledging the Dents in the Crown

Sounds great! You're ready to go! But solar isn't all fun and games. The pros outweigh the cons — especially when you look at the big picture — but you should still understand the drawbacks. This section explains a few things to remember when working with solar energy.

Initial costs and falling prices

Going solar requires an upfront expense. When you go solar, you get a good payback on your investment, but you do have to put out cash upfront. Most people don't want to bother, and many don't have the cash. There are a wide range of financing options (which I describe in Chapter 20), but financing can be difficult to obtain these days. Banks have become very selective; in general, you need equity in your home in order to qualify for a second mortgage, and many people have seen their equity disappear in during economic downturns.

Another issue to contend with is that the cost of solar varies quite a bit from year to year, so timing is an important concern. Buy now, or wait? Government subsidies play an important role in the net cost of solar equipment, and so politics plays a role in the equation. In the fall of 2008, for example, when the markets were plunging, the federal government increased the Investment Tax Credit from a cap of $2,000 to a straightforward 30 percent of the out-of-pocket price you pay after state rebates and other credits. This made a huge difference in the net cost of solar photovoltaics, and people who bought their systems prior to the change regretted not having waited for a few more months. Predicting how subsidies will change is impossible, but you must at least try to anticipate the future. A crystal ball may help, but there's no guarantee. (Unfortunately, there are no *For Dummies* books on predicting the future.)

Reliability and timing

Solar works only when the sun is shining. If you want energy at night or on a dark day in the winter, you need either batteries or other energy resources. What makes sense in Arizona doesn't necessarily make sense in Seattle, Washington. Ultimately, solar relies on Mother Nature's generosity, and this varies from region to region. In fact, it even varies over different locations at your home.

Also, timing of energy use can make a lot of difference in how your utility bills add up. In a typical scenario, solar energy availability is at its peak when the household power demands are minimal. It's out of phase with need. This scenario isn't much of a problem with solar water heaters because they inherently store the collected solar energy for later use. But solar electric requires

either batteries for energy storage or a special system called an intertie, which connects to your public utility. In Chapter 16, I explain the technical details of an intertie system.

It's important to understand the affect that intertie has on your power bills. Figure 1-1 shows the typical residential energy requirements and the energy production of a solar system.

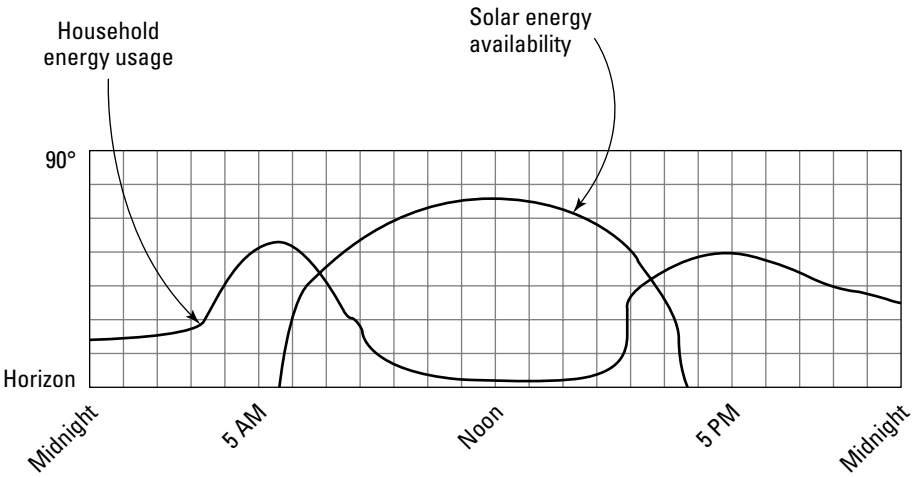

Figure 1-1: Daily energy use versus the availability of solar power.

On this typical winter day, the heater is on all night but turned low, and the lights and appliances are off. In the morning, the family turns up the heater, turns on lights, takes hot showers, cooks breakfast, and gets ready for school and work. Then everybody leaves, and the day warms up so the heater shuts down. At the end of the afternoon, when the sun is on its way down, everybody returns. Lights are turned on, the heater's turned up, a log is tossed into the fireplace, cooking begins in earnest, the kids play video games and make a big mess, the vacuum is run, and so on.

To take full advantage of solar power, you may have to alter your energy consumption habits. Throughout this book, I explain how to make the best use of solar power. You can certainly install solar without changing your consumption habits, but you'll get a better return on investment when you understand how best to take advantage of your new technology.

Red tape and aesthetically minded neighbors

You may have to work around building codes. Bureaucrats are a big hassle, and interfacing with government agencies is frustrating. In addition, only

qualified contractors should install complex electrical systems. Even if you choose to install a complex system yourself (which you can usually do if you're well versed with tools), you have to deal with the county building codes and know how to schedule inspectors and handle the problems that may occur. Solar can be very simple and straightforward, but it can also entail a lot of technical details.

Also, most solar panels are ugly. Nobody wants to look at them. If they're your own and you're benefiting, it's acceptable. If they belong to your neighbors, it's a different story. In some communities, solar panels are forbidden. Many CC&Rs (Covenants, Conditions and Restrictions) prohibit solar panels altogether, but this situation is changing; in fact, most legal bans of solar panels are being stricken by the courts in favor of environmental conscience. At some point, the federal government will likely enter the picture and prohibit all banning of solar panels. Several ongoing efforts are working to make solar panels less obtrusive, so this problem will become less important over time. You can now buy solar panels that blend right in to your roof; it's almost impossible to tell the panels are even there. You can also buy panels in different colors.

Effort and upkeep

Going solar takes work. Making good decisions about solar power can be difficult unless you've done your homework. And not only do you have to do some research, but you also have to work with the equipment itself. Here are some issues to consider:

- **You face some dangers.** Active electrical systems can shock you if you don't know what you're doing. Water heating systems can scald you. You're much safer sitting in front of your TV than climbing around installing solar equipment on your roof.
- **You face equipment challenges in freezing weather.** Solar water heating panels can freeze up in the winter. You have to pay attention to how they're working. Many new solar thermal heating systems get around the freezing problem by using some form of anti-freeze, but there are still a good number of existing and new systems that still use water exclusively.

  

  The anti-freeze systems are more expensive, but not everyone needs one. Be wary of contractors who are more interested in selling you the most expensive system possible than selling you the right system for your needs. It's ultimately up to you to do your homework and decide which system is the best for your application.
- **You're on your own for upkeep and repairs.** If you get your power from the power company, keeping things maintained and running is its problem. If you have a big array of solar panels on your roof, it's *your* problem. If they break, you pay. When they get old, you update. Warranties

run for 25 years for solar PV panels, but you may have to pay some labor costs to have warranty work done. At the very least, you have to understand your system so that you'll know when it's not working properly. If a single panel goes out in a solar PV system, for example, the production may suffer to the tune of 25 percent or more. You're the one responsible for determining how your system is working and taking the necessary measures when it's not working properly.

- Solar panels affect other roof maintenance tasks. If you need a new roof, for example, you have to either pay a contractor to remove and then reinstall the panels once the new roof is in place, or you have to do the work yourself. In general, you can expect to pay a contractor around $1,500 to remove and reinstall panels when you put on a new roof. This estimated price fluctuates quite a bit, depending on the type of roof you have, and how large a solar system you're working with. In addition, while your panels are removed and the roof is being changed, you're not going to be generating any solar power. If you're saving $400 per month on your utility bills with your solar system, and it takes two months to install a new roof, you need to add $800 to the net cost of the roof job (in addition to the cost of removing and reinstalling the panels).

Consider the condition of your roof before you install solar panels. If you're going to need a new roof in a few years, you may be better off waiting until the new roof is in place before you purchase your solar system. If you're going to be changing your roof, ask your solar contractor for a bid to remove and reinstall the panels; get the contractor to guarantee the bid for a few years, if possible.

It's to contractors advantage to downplay the cost of removing and reinstalling panels. So watch out for unscrupulous contractors (more on them in the next section) who tell you that they'll move the panels for a very low price. Once you've got the system in place you're going to be stuck with whatever price they charge.

Unscrupulous contractors and wild claims

Alternative energy is a hot topic these days, and you hear a lot of wild claims being propagated by the media, which sometimes fail to verify the accuracy of these claims, and by folks out to make a quick buck by selling something that's too good to be true. Some claims are obvious nonsense, like the story of the inventor who designed a new engine that gets 100 miles per gallon by using water as fuel. Others are a lot more difficult to judge.

Here's an example. A solar PV contractor in the Sacramento area where I live tells customers that he can install a revolutionary new energy saving device in the fuse box, so that the household uses half the power to achieve the

same results. He offers to sell a solar system half the size of other contractors, since that's all that's needed, in conjunction with the revolutionary new device. Sounds great, doesn't it? But it doesn't work, and when the customer comes to realize that the wild claims are bunk, it's too late. You can always launch a lawsuit, but that's expensive and time consuming and your contractor may have already gone out of business because he's already been sued any number of times.

The solar power industry is changing daily, along with the technology. Following are suggestions on how to protect yourself:

- **Don't look just at the price; look at the system's long-term reliability.** It's almost always the case that time-tested technology works better than radical new technology. It's not just a question of whether something works or not; it's also a question of whether something works for years and years, because that's what you're ultimately looking for. Bottom line: In general, if it sounds to good to be true, it is. If you talk to a contractor who wants to install a radical new technology that will solve all your problems for half the cost that other contractors are bidding, run for the hills.
- **Pay attention to the amount of experience the contractor has.** With the economy suffering, there are a lot of "solar contractors" who were electrical contractors or plumbers only a year ago. They work out of their garage, and have very little overhead rate. You may get a fine system installed by one of these contractors, but you should wonder if your warranty will be honored a few years down the road. You should also wonder if the system will operate as optimally as possible, because experience counts for a lot. Every solar installation is a little different, despite the fact that the equipment may be exactly the same. It's in the details where good contractors pay off. You may be tempted by the lowest price, but you should be skeptical of the lowest price as well. You can get information on the veracity of contractors over the Internet.
- **Get conversant about solar power.** The simple fact is, you need to understand solar to the point where you can critically judge the equipment that you're buying. The less you need to trust the contractor's performance claims, the better off you will be. In fact, when you understand how your equipment is going to work, you can tell how good a contractor is by simply noting whether or not he exaggerates the future system's performance.
- **Ask for a performance guarantee.** Even with a good contractor, you can't always get this because performance depends on how much sunlight you ultimately get. But when you ask, you'll get a sense of your contractor's honesty by the way they respond to your request. In fact, if your contractor is more than happy to give you a performance guarantee, you should be skeptical.

Small to Supergiant: Choosing Your Level of Commitment

No matter where you start, you can always expand your solar system. For example, you can invest in a small photovoltaic system for your rooftop and then expand it as you go, spreading the investment costs over a long period of time. Read on for ways to get involved.

Small- to mid-sized projects

In Part III, I detail a wide range of simple, straightforward solar projects available to the do-it-yourselfers. From installing landscape lighting to a stand-alone photovoltaic powered attic vent fan, you can begin investing in solar today with minimal cost and effort. The small-scale projects feature safe operating levels (typical voltages in a photovoltaic system are so low that you won't be able to get a shock). And if you're no good with tools, have no fear. Some of the projects don't even require a screwdriver — you can buy off-the-shelf solutions that you can use out of the box.

You can also do a number of things in your yard to improve the solar exposure of your home. Deciduous trees (which shed their leaves in the fall) planted strategically about your house can ensure summertime cooling while allowing solar energy to help warm your house in the winter. Planting bushes in the right spots can reduce the cooling effect of wind, especially around your pool. And you can also increase the breezes flowing through your house by strategically arranging trees and bushes. Chapter 8 shows you how.

In Chapter 9, I describe a wide range of small-sized solar investments you can enjoy right now. Some of these projects, such as the attic vent fan, can save you money. It can keep your attic cooler in the summer and lower your air-conditioning bill. And some of the projects — such as the swimming pool light ball — are just plain fun. You can even build a solar oven that'll cook almost everything you cook in your kitchen stove!

Chapters 10, 11, and 12 explain how you can use the sun to heat water and how you can put it to work in your home. Installing a solar heating system on your swimming pool is a reasonable do-it-yourself project with very real results, not just in terms of costs saved but also added enjoyment. Installing a water heating system for your domestic supply gets a little trickier, and it's a project usually contracted out to the pros. But if you're good with tools, you can probably install one on your own.

If you're intending to install a full-scale solar energy system in your home, a great way to find out about the character of solar energy is to start with the simpler projects. You discover the importance of good solar exposure, and you determine when and how solar works the best — as well as the worst. You'll be in a better position to make good decisions on how to invest the big bucks when the time comes.

Large projects

In Part IV, I describe the larger projects that are wise choices for solar investment. Full-scale photovoltaic energy generators are the king of the mountain these days. You probably won't want to install one of these systems on your own, but you can, if you have the necessary skill. I tell you how to research the available options and decide which is best for your needs. And I tell you how to find and choose the right contractor for the job.

Greenhouses are attractive, and you can grow your own food in them, year-round in some climates. But you can also use a greenhouse or sunroom to heat your home in the winter. In Chapter 15, I show some examples of the most popular greenhouse projects.

Off-grid living means there's no utility company power coming into your home at all. You can use a solar power system, backed up with a gasoline-powered generator, to provide all the power you'll ever need. In Chapter 18, I describe the things you need to keep in mind if you decide to take this plunge. It's not for everybody, and it really doesn't make much sense unless you're living so far away from the utilities that just running the lines to your house would cost a ton. But for some of the more independent-minded readers, it's the only way to go.

Designing a solar home from scratch

Designing a solar home from scratch is clearly the most efficient way to achieve solar energy advantages. Most existing homes are inefficient in a number of ways. Insulation may be lacking. Sunlight exposure was not thought out — it's just what happened when the house was built on the lot. But when you design your own home, you can control all the variables. You can achieve excellent sunlight in the morning while blocking off the afternoon heat. You can shelter for wind by taking advantage of existing trees and cover. Best of all, you can build your roof to achieve perfect solar exposure.

You can also ensure energy efficiency by using the right materials and building techniques. The fact is, a good house design can make it so that you don't need much energy at all. What could be better for the environment?