

## Chapter 1

# Soaking Up the Pluses and Minuses of Solar Power

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### *In This Chapter*

- ▶ Investing in solar energy
  - ▶ Looking at the benefits of solar power
  - ▶ Solving for challenges
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**p**roducing 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. Not only these conditions drive up prices, but they also lead 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 outside energy sources, and save money. Tall order? Maybe not. Of all the energy sources in use today, solar shows the most long-term promise for solving the world's energy problems.

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, you find out 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* doesn't 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 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.

## 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 two ways:

- ✓ Savings on your monthly bills
- ✓ Appreciation of your home's value

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 also may see the value of your home increase.

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



To compare, 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. 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 6 $\frac{2}{3}$  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. If you put the same \$4,000 into an interest-bearing bank account, you may get \$20 a month in interest. 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. Of course, you can also lose the entire thing and drive yourself nuts with regret!

When you go solar, your home *appreciates*. 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.



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.

Erasing your carbon footprint

Most energy resources are burned. The worst offender is coal, and the United States gets around 50 percent of its electrical power from coal-fired plants. 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 *carbon dioxide footprint* is around 36,000 pounds (18 tons) per year. That's a lot!



Solar, however, has no carbon footprint. For each kilowatt-hour (kWh) of energy-generating capacity you install with solar, you save that much from other sources, most likely the electrical power grid. Among other alternative energy resources, only wind power and hydro can offer this impact, but solar is far more versatile and widely available.

These numbers are 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. 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 1-2 provides an example of a calculation.

| Table 1-1 Carbon Emissions for Burnable Energy Sources |                              |               |
|--------------------------------------------------------|------------------------------|---------------|
| Type                                                   | Pounds CO <sub>2</sub> /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          |

**Table 1-2 Carbon Emissions for Your Car (Example)**

| <i>Questions</i>                       | <i>Your Numbers</i> | <i>Example:</i>       |
|----------------------------------------|---------------------|-----------------------|
| 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 Table 1-1)      | _____               | 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<sub>2</sub> 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. You can cut way down on that if you switch to solar heating and cooking.

Calculate also 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<sub>2</sub> per kWh. If you're using nuclear energy, you can reduce this number to about 1.0 or less. If you're strictly relying on coal-fired electricity, the number could go as high as 2.0.

Here's how you find out the carbon dioxide output if you use 10,000 kWh of energy:

$$10,000 \text{ kWh/yr} \times 1.33 \text{ lbs. CO}_2/\text{kWh} = 13,300 \text{ lbs. CO}_2/\text{yr} \text{ (Youch!)}$$

## *Enjoying solar's unlimited supply*

At sea level, on a sunny, clear day, 1 kWh of sunlight power is falling onto a 1-square-meter surface. 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, 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 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. Solar power enables you to 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.
- ✓ **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.
- ✓ **Practice passive space heating:** The sun can heat your house by strategic use of blinds, awnings, sunrooms and the like.
- ✓ **Heat water:** Use solar energy to heat your domestic water supply — or let sun-warmed water heat your house. You may need no electrical pumps or moving parts other than the water itself.
- ✓ **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.

- ✓ **Heat your swimming pool:** A solar blanket heats your pool cheaply and efficiently. Or you can install solar hot water heating panels on your roof that can heat your pool year-round.
- ✓ **Light up your landscape:** 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.
- ✓ **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.
- ✓ **Power remote dwellings:** You can completely power a remote cabin, RV, or boat with solar.

## *Acknowledging the Dents in the Crown*

Solar 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.

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### *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. (Chapter 4 of this book gives you ideas for financing your solar investments.)

### *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 Phoenix doesn't necessarily make sense in Seattle. 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 is everything. In a typical scenario, solar energy availability is often 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 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.

On a typical winter day, for example, 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.

## *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.

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 homeowners associations have covenants that prohibit solar panels altogether, but this situation is changing; in fact, most legal challenges to 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.

## *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 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.



- ✔ **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. Most new solar thermal heating systems get around the freezing problem by using some form of anti-freeze, but a good number of existing and new systems still use water. The antifreeze systems are more expensive. If you don't need one, you don't want to pay the extra cost, so water-based systems will always be available.
- ✔ **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.

## *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. The following sections show you ways to get involved.

### *Small- to midsized projects*

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.

Pick up a copy of *Solar Power Your Home For Dummies* (Wiley) by Rik DeGunther for instructions on tackling a range of solar projects and to find out about some of the larger projects you might want to hire a specialist to add to your home.



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*

Full-scale photovoltaic energy generators are the king of the mountain these days. You probably won't be able to install one of these systems on your own.

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 provide a warm room in the winter.

*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. 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, for example, 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?