Chapter 1

Defining Efficiency

In This Chapter

- Looking at four types of efficiencies
- Recognizing inefficiencies
- Finding ways to increase efficiency

Efficiency is the production of a desired effect with a minimum amount of effort or waste. That's the official definition, but you probably already have an intuitive sense of what *energy efficiency* means. Maybe to you it means using less. Maybe it means saving more. Believe it or not, those two goals don't always mean the same thing. That's because there are different kinds of efficiencies — energy, financial, pollution, and labor. (Yes, I know that the title of this book is *Energy Efficiency Homes For Dummies*, and that angle takes front and center, but it's not the whole picture. I think it's important to understand some of the tradeoffs that are inherent in most of your decisions.)

To set and achieve your own efficiency goals, you need to be familiar with the different kinds of efficiencies, understand how these can be at cross-purposes, and get an idea of how you can begin to pursue your energy-efficiency goals. This chapter gives you the lowdown.

Examining the Four Main Spokes of the Efficiency Wheel

There are four different aspects of efficiency:

- **Energy efficiency:** Getting the most useful output from energy sources
- **Financial efficiency:** Getting the most for the least amount of money
- **Pollution efficiency:** Polluting as little as possible
- **Labor efficiency:** Spending the most time relaxing on the couch

To find the right balance among these different types of efficiencies, you need to ask yourself what you value the most. If you're only interested in lowering your costs, financial efficiency is your sole criterion. If you're interested in *going green,* living an efficient, energy-conserving lifestyle, you want to consider pollution and energy efficiency. An ultra-green lifestyle implies pollution efficiency more than energy efficiency or financial efficiency. And going green also requires more labor than a conventional lifestyle. But perhaps your only goal in life is to maximize the amount of time you spend at leisure (believe me, I'm empathetic). In this case, labor efficiency is your most important goal.

In this section, I present some detailed examples of these different types of efficiencies, and in the process, set up the basic premise of this book: Making investment decisions for efficiency improvements in your home always involves tradeoffs. To determine where the energy inefficiencies are in your home, head to Chapter 3. Chapter 5 gives you advice on how to decide which tradeoffs are best for you.

Energy efficiency

The energy efficiency of a device is a comparison, or ratio, of the useful energy output to the total energy input. This ratio is *always* related to the particular situation (the season, timing, desired end result, and so on).

For example, we want a light bulb to produce light. But we all know that a light bulb also produces heat — sometimes a great deal. In the summertime we don't want the heat, so the process is inefficient. A typical incandescent bulb converts only 10 percent of input electrical energy into light energy; the rest goes into heat. Therefore, the efficiency is 10 percent, or very poor. If enough light bulbs are turned on at the same time, the air conditioner may have to be turned on, which means even more inefficiency.

However, in the wintertime you can readily use that "inefficient" heat because it essentially decreases the load on your heating system. In this case, the efficiency may be close to 100 percent. You don't have to turn on your inefficient heating system nearly as much, so using incandescent light bulbs in the winter is a highly energy-efficient process.

Of course, outdoor incandescent light bulbs are just as inefficient in the winter as in the summer. And light bulbs in an unoccupied room are inefficient as well.

As you evaluate where inefficiencies exist in your own home, consider all the factors that the come into play: the season, the desired outcome, and so on.

Conservation versus efficiency

Conserving energy simply means using less. Turning all the lights off in your house is conservation. Efficiency, on the other hand, is using less energy to achieve the same result. Plugging in fluorescents is practicing energy efficiency. Turning off the light and stumbling around in the dark is conservation. The meanings overlap, but the distinction is useful. For instance, if you use a programmable thermostat to turn your heater off during the day while you're at work and then turn it back on right before you get home, you're achieving better efficiency by conserving.

Financial efficiency

The financial efficiency of an appliance is the comparison, or ratio, of cost savings to the cost of the appliance (which includes the original equipment cost plus installation costs and maintenance costs, including energy). The better the ratio of cost savings to price, the more financially efficient an investment is. Another term for "financially efficient" is "cost effective." I use these terms interchangeably.

Solar photovoltaic (PV) panels, for example, are capable of saving costs on a power bill, and they have a well-defined initial price. Similarly, the cost of a new, more efficient appliance can, over a relatively short time period, be earned back by the energy savings.

Pollution efficiency

The pollution efficiency of an appliance is a comparison, or ratio, of the useful *output work* (the job that is being done) to the amount of pollution that is generated in the process. Solar PV panels create impressive output power while generating essentially zero pollution. Coal stoves create a lot of output power but also generate a lot of pollution. In evaluating pollution efficiency, you need to consider more than just how much pollution the appliance or system outputs. Solar panels, for example, create no pollution while they are operating, but pollution is created in the process of manufacturing a solar panel.

REMEMBER

As you weigh the costs and benefits of pollution efficiency, keep in mind that there are usually no easy answers because the values being compared aren't always mathematically measurable. How much value, for example, do you attribute to helping the environment? Acceptable costs differ depending on your viewpoint. Some people, for example, want only to go green, in which case they will accept poor financial efficiency in favor of good pollution efficiency. Others try to balance financial and pollution efficiencies.

Labor efficiency

Labor efficiency is a comparison, or ratio, of how much work an appliance does to the amount of personal labor required to run and maintain it. A wood stove, for example, is labor inefficient because you have to stack wood, haul it inside, set it in the burn chamber, watch and stoke the fire as necessary, and then clean ashes. A gas stove, on the other hand, is very labor efficient — you only need to turn it off and on. Labor also includes pre-buy research, purchase hassles (like financing or delivery truck rental), installation (including cost of tools and hourly labor), and the maintenance and operational burdens over time.

Analyzing efficiencies

When analyzing efficiencies, be sure to consider the life expectancy of a particular investment. Answer these questions for every option you're considering:

- How long will an appliance last?
- How does the pollution output vary over time?
- Will the energy efficiency decrease over time (the answer is almost always yes because parts wear out, friction increases, and so on) and if so how by how much?
- How much maintenance will be required over time, and will you be able to do the labor and maintenance, in years hence?
- How long is the warranty, and how much will unwarranted repairs cost?
- Who will be doing the service and where do parts come from?
- How will the future costs of energy affect the financial efficiencies?
- What are the financing costs and are there tax advantages now? Will there be tax advantages in the future that aren't available now?

To find out how to determine the payback of energy-efficient improvements you're thinking about, go to Chapter 5.

Looking at energy storage and efficiency

Some forms of energy are easy to store. Gasoline is a liquid that pours easily and can be transported readily. It can sit in a sealed container for years. Wood pellets can be stored for years with little loss in potential. Corn, on the other hand, attracts rodents and can very quickly go from being fuel in your storage bin to "food" that attracts large, furry assaults in the middle of the night. The heat from a fire can be stored in the materials in a room, but it doesn't last very long after the fire goes out. It's beneficial to consider energy not as a go/no-go proposition, but as a continuum.

Solar energy, on the other hand, can't be stored, so it must be converted into a different form in order to be stored. Solar power can be stored as heat, which is how a solar domestic hot water heater works. Or it can be converted into electricity and fed into a battery, which then converts the electrical energy into chemical energy. When the energy is to be used, later that night or the next morning, the chemical energy is then converted back into electrical energy, which is fed into an appliance. This whole chain process is extremely inefficient because each step in the process is inefficient and the inefficiencies only multiply.

Opening Your Eyes to Inefficiency

Most people don't understand just how inefficient energy-consuming processes are. If you're only interested in cost effectiveness, you don't really need to know how inefficient processes are because, for you, saving money is the bottom line. But if you're interested in energy efficiency, and particularly pollution efficiency, you should understand just how utterly inefficient most energy consuming processes are. It would be impossible to define all the ways energy consumption processes are inefficient in a single book, much less a short introductory chapter, but it is important that you get a feel for the scope of the problem. The following sections offer two examples to illustrate.

Electrical grid inefficiencies

Most household appliances are powered by electricity, which is the least efficient method of consuming energy (more on this in Chapter 2). In many cases, it's also the most polluting alternative, because a majority of electrical energy comes from coal-fired furnaces. In addition, electrical energy is transmitted via the power grid, which uses power lines and transformers to deliver the AC voltages to your home. There are *line losses* (lines heat up and lose energy in the process) in the power wires, sometimes as much as 50 percent if the distances are great. Every transformer and substation is inefficient as well.

As a general rule, electrical systems are only around 30 percent efficient. This means that the electricity that comes into your home is mostly wasted before you use it. And when you use it — even if you use it wisely — you're wasting a good deal of it as well.

Consider a vacuum cleaner. How much energy does it take to move a small pile of dust from your floor to the vacuum bag? Very little. But by the time you get done plugging your vacuum cleaner into the wall socket and turning on a big, noisy electrical motor and swishing the wand across the floor, you've used hordes of energy. So vacuuming is maybe around 5 percent efficient. Compound this with the electrical inefficiencies from the utility grid and you come up with a net efficiency of less than 2 percent! This means that you've used 50 times more energy than you really needed to clean that dust up off your floor. At the same time, you've released 50 times more carbon dioxide into the atmosphere. An alternative? Get out the broom and dustpan.

Transportation inefficiencies

Autos take a lot of energy to produce. Factories consume copious amounts of electrical power, and most factories have their own power substations with transformers and high-voltage lines. So before you even drive your new car off the lot, you've consumed nearly as much energy as your car will consume to transport you the first 30,000 miles. This is true for even the most fuel-efficient autos and trucks. And it's certainly true for a hybrid auto, which consumes even more energy to produce than a conventional auto.

Your car weighs around 30 times more than you, so the vast majority of energy it expends to transport you to work and back is actually dedicated to transporting itself back and forth. You represent just a small fraction of the total work expended. Now that's inefficient!

The big oil companies burn around two gallons of gasoline to get you a gallon at the pump. Energy is required for drilling the crude from the ground, and then transporting the raw crude to a refinery some distance away. The process of *cracking* (breaking down raw components so as to output refined products such as gasoline, heating oil, and so on) requires a great deal of energy. Then the refined products need to be transported, first to the regional hubs and from there to the local gas stations. Gas stations consume energy and resources so that they can operate and sell you the gas.

All in all, your auto represents about 1 percent efficiency compared to a bicycle.

Becoming More Efficient

Efficiency is the cheapest and easiest way to save the world from the runaway effects of human consumption. A wide number of new technologies are coming onto the market with the express goal of reducing the amount of energy it takes to perform a particular task. A myriad of new devices purport to reduce pollution while doing the same essential work. But it's a simple fact that the easiest, fastest, and cheapest way to reduce pollution and energy usage is simply by using less energy with the equipment you already have.

TIP

When you recycle, you are saving resources, energy, and landfill space. Go to Chapter 14 to find out how simply using less, reusing more, and recycling what's left over can yield big efficiency benefits.

Getting greater efficiency from your current systems

You don't need to invest in new equipment to achieve impressive results. For example, when you drive less, you use less gas. Two people in a large SUV use less gas per person than two people each in their own separate hybrids, so carpooling is much more effective than fuel-efficient autos.

Similarly, when you turn your thermostat down in the winter and put on a sweater, you are immediately using less energy, and this is just one simple example.

There are myriad other ways to reduce inefficiencies in nearly every aspect of your home: sealing leaks and beefing up your insulation, taking advantage of natural air movement, using your appliance more efficiently, and so on. Head to Part II for system-by-system solutions.

Supplementing or replacing existing systems

Sometimes the way to greater efficiency is to replace or supplement your existing systems with more-energy-efficient systems. When you replace an open fireplace with a high-efficiency wood or gas stove, for example, you not only eliminate the unbelievable amount of energy waste associated with open hearths, but you supplement your existing HVAC system, meaning you can use it less. Part III explains how these alternative energy sources and others — solar power, radiant heat, geothermal heating systems and so on — can enhance efficiency.

Every contribution you make adds up. There are no "little" contributions. The U.S. Department of Energy has estimated that if everybody were to pitch in, energy consumption could be reduced by up to 20 percent. That's a major and immediate change in not only our dependence on foreign oil, but our contribution to greenhouse gases. If everybody were willing to pitch in not only by being more energy-efficient, but also by investing a few hundred dollars for improvements, energy consumption could be reduced by up to 30 percent. This would drop the cost of energy because demand would decrease, and the net effect would be more like a 40 percent reduction in cost for all of us.