Chapter 1

Save Money, Save the Earth

Are you about to buy a new appliance? Remodel your house? Upgrade your heating or cooling system? If you're like most of us, you don't do these things very often. When you do, you want to make good choices, both for your pocketbook and for the environment. But you probably don't have time to become an expert. That's where this book can help.

The *Consumer Guide to Home Energy Savings* will help you make wise investment decisions and help you decide which products to buy and how to use them for maximum energy savings. We've listed the best ways to tighten up your house so that your heating and cooling systems won't have to work as hard—or use as much energy. We've pulled together tips on operating new and existing appliances to reduce energy use and improve performance. But before getting into the details, let's take a look at why it makes sense to buy the most efficient appliances and conserve energy in the home.

Saving Energy—and Money—in Your Home

The wonderful thing about saving energy is that, in addition to helping the environment, you save money. It's like contributing to a good cause and ending up with more money in your pocket. Many of the energy-efficient appliances and heating or cooling systems covered in this book cost no more than their inefficient counterparts. With most others, the extra cost is easily repaid in energy savings over just a few years. To top it off, many energy-saving upgrades increase the comfort, convenience, and aesthetics of your home.

■ Operating Cost

When you buy an appliance, you pay more than just the sales price — you commit yourself to paying the cost of running the appliance for as long as you own it. These energy costs can add up quickly. For example, running a refrigerator 15–20 years can cost as much as the initial purchase price of the unit. That 75-watt light bulb you just put in will cost about $7 in electricity over its (short) life.

The sum of the purchase price and the energy cost of running an appliance or light bulb over its lifetime is called its life-cycle cost. The life-cycle costs of energy-efficient appliances are lower than those of average models even though the latter may cost less to buy. To determine a basic life-cycle cost, use the following equation:

LCC = Initial Cost + (Annual Operating Cost x Years of Operation),

where the operating cost can include energy costs, maintenance, and repair. For "years," you would use the expected life of the equipment in question.

■ Rebates

To increase the economic benefits of buying more energy-efficient appliances and boosting your overall home efficiency, check for rebates offered by your local energy and water utilities or tax incentives available from your state or the federal government. Rebates are most common for high-efficiency refrigerators, clothes washers, lighting products, cooling equipment, and home energy improvements like air sealing and insulation. Rebate programs are much more common among electric companies than gas companies, although some gas utilities offer rebates for high-efficiency furnaces and boilers. If you plan to buy a major appliance soon, ask your utility if it offers rebates for efficient models.

For More Information:

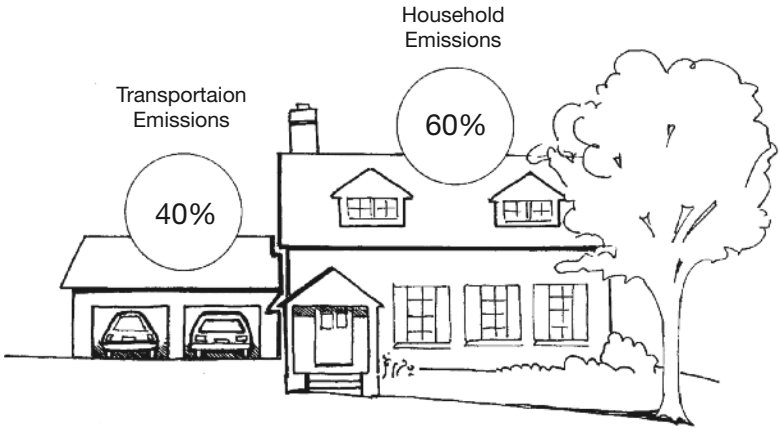
ENERGY STAR offers a "Rebate Finder" on their website where you can look up whether special offers are available in your area.
www.energystar.gov

For tax credit information, contact your state energy office and refer to the Tax Incentives Assistance Project (TIAP) website.
www.energytaxincentives.org

Energy Use and the Environment

Every time you buy a home appliance, tune up your heating system, or replace a burned-out light bulb, you're making a decision that affects the environment. You are probably already aware that most of our biggest environmental problems are directly associated with energy production and use: global warming, urban smog, oil spills, acid rain, and mercury deposition, to mention a few. You also probably know that driving your car less is one of the best ways to reduce your environmental impact. But you may not realize just how big a difference each of us can make by taking energy use into account in our household purchasing and maintenance decisions.

For example, did you know that every kilowatt-hour (kWh) of electricity you avoid using saves over a pound of carbon dioxide (CO_2) that would otherwise be pumped into the atmosphere? If you replace a typical 1998 20-cubic-foot refrigerator with an energy-efficient 2012 model, you'll save more than 300 kWh and 500 pounds of CO_2 emissions per year!!



For a typical two-car, single-family household, energy used in the home accounts for more than half of that family's total greenhouse gas contributions and energy costs!

TABLE 1.1 Energy Conservation and CO_2 Savings in the Home

Energy Conservation Measure	Annual Savings			
	Electric (kWh/yr)	Gas (therms/yr)	Gasoline (gallons/yr)	CO_2 (1) (lbs/yr)
Replacing 10 60-watt incandescent light bulbs with 13-watt compact fluorescents (2)	515	–	–	660
Replacing average 1998 refrigerator with high-efficiency 2012 model (3)	315	–	–	405
Replacing a 78 AFUE gas furnace with 94% AFUE model (4)	–	175	–	2,050
Installing a cool roof to replace a black asphalt roof (5)	1,200	–	–	1,535
Installing a solar water heating system (6)	1,950	–	–	2,500
Boosting energy efficiency of new house under construction to 50% beyond 2009 code (7)	1,545	680	–	9,930
Eliminating two car trips per week (8)	–	–	100	1,970
Replacing average vehicle with hybrid (9)	–	–	419	8,205

Notes:

1 See Table 1.2 for CO_2 emissions factors for each fuel.

2 Assumes lights on three hours per day.

3 Average 1997 model uses 690 kWh per year; 2012 model uses 375 kWh per year.

4 Assumes 2,500 square foot house with 34 kBtu per square foot per year and northern climate (6,300 heating degree days).

5 Assumes 2,500 square foot home with average shell and HVAC equipment efficiency in southern climate.

6 Assumes system offsetting 75% of electric water heating needs.

7 Assumes gas savings for space heating and water heating and electricity savings for space cooling and lighting for nothern climate.

8 Carpooling, biking, or using public transit to eliminate two 20-mile roundtrip commutes per week; assumes vehicle getting U.S. average light-duty fuel economy (2010) of 20.7 mpg.

9 Replacement of average 2008 model vehicle (18.9 mpg) with hybrid getting 40 mpg; assumes vehicle driven 15,000 miles per year.

CO_2 is the number one contributor to global warming, a process that scientists say could raise the Earth's temperatures by 3–7°F over the next hundred years. Worldwide, we pump some 31.6 billion metric tons of CO_2 into the atmosphere each year — about four and a half tons for every man, woman, and child on Earth. The United States is responsible for more than 17% of that, or close to 5.5 billion tons per year. On a per capita basis, that comes to more than 15 tons for each American, though some of us produce a lot more than others. Reducing CO_2 emissions by a few tons per year may not seem like a lot, but the collective actions of many will have a dramatic effect.

Carbon dioxide is only one of the environmentally harmful gases resulting from energy use. Others, such as sulfur dioxide, nitrous oxide, carbon monoxide, and ozone, have much more direct effects — effects that can be seen and smelled in every major urban area of the country.

There are numerous energy-saving products and improvements around the home that can help the environment. Table 1.1 shows the reductions in CO_2 emissions achieved from a few energy improvements. With some of these, you'll notice different CO_2 savings depending on the type of fuel used. That's because some fuels give off less CO_2 than others.

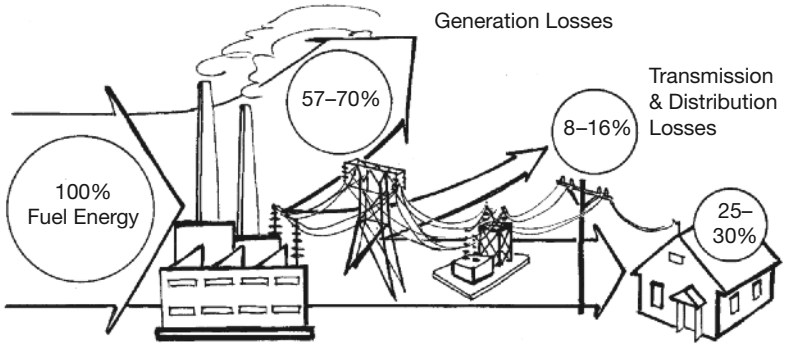
If you are interested in reducing your carbon footprint, Table 1.2 provides a comparison of the CO_2 emissions from common household energy sources. With this information, it's easy to calculate just how much CO_2 you are introducing into the atmosphere through your energy use. Simply look at your energy bills to find out how much fuel you are using: gallons of oil, therms of natural gas, kilowatt-hours of electricity, etc. Multiply that value by the quantity of CO_2 produced per unit of fuel in Table 1.2.

You may notice that CO_2 emissions per unit of energy are much higher for electricity. That difference stems from inefficiencies in the process of converting fuel to electricity and distributing the power through the grid to end-users in their homes and workplaces. Electricity often travels great distances from the power plant to the buildings where it is used. The figure on page 6 illustrates the losses attributed to each stage of electricity generation, transmission, and distribution.

TABLE 1.2 CO_2 Emissions from Different Energy Sources

Fuel Type	CO_2 produced per unit of fuel	Lbs CO_2 per million Btu
Fuel Oil	22.4 lbs/gallon	161
Natural Gas	11.7 lbs/therm	117
Propane	12.7 lbs/gallon	139
Gasoline	19.6 lbs/gallon	157
E-10 (10% Ethanol-Gas Blend)	17.7 lbs/gallon	146
Wood (1)	2.59 tons/cord	216
Coal (direct combustion)	2.48 tons/ton	210
Electricity from coal only	2.15 lbs/kWh	644
Electricity from oil only	1.88 lbs/kWh	601
Electricity from natural gas only	0.94 lbs/kWh	286
Electricity (national weighted average including all generation types)	1.28 lbs/kWh	374

1 If the wood is harvested on a sustainable basis, there is no net CO_2 emission because the growing trees absorb more CO_2 than is released when burning the wood.



Only one-third of fuel source energy reaches your home as electricity.

For More Information:

If you are interested in becoming "carbon neutral," the following resources will help you calculate your carbon footprint and find the most trusted carbon offset companies.

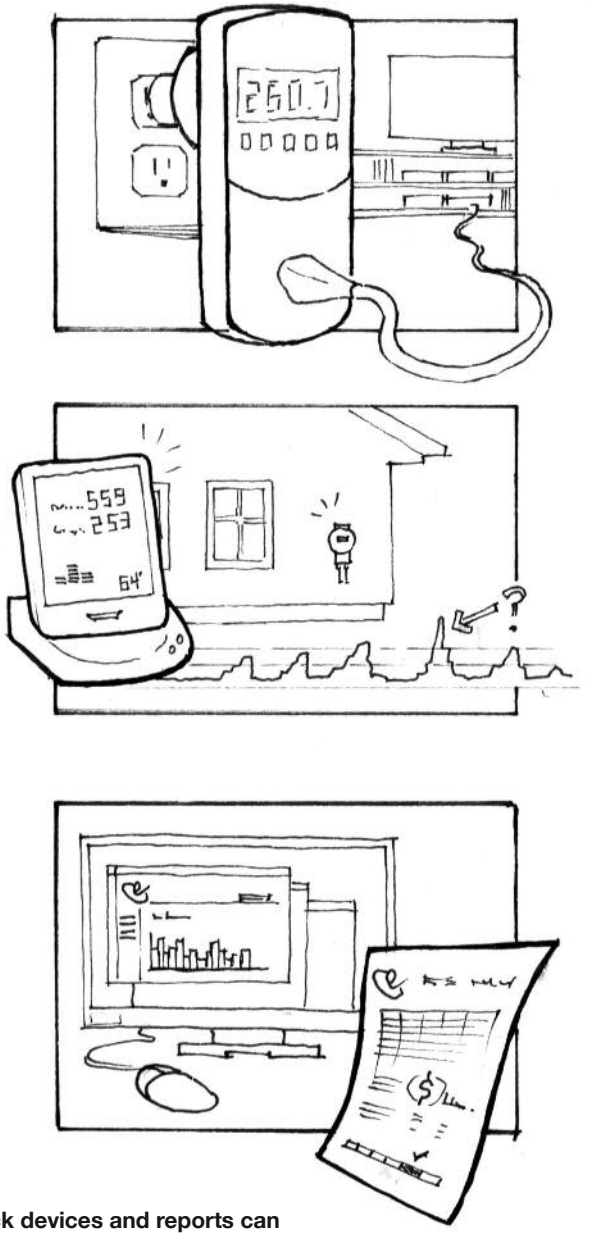
CoolClimate Network www.coolclimate.berkeley.edu

Global Footprint Network www.footprintnetwork.org

Despite this drawback, electricity remains vital to our way of life and our economy, and it offers a number of benefits over other fuels for many end-uses. To minimize the negative impacts, we must learn to get the most out of every kWh by using energy as efficiently as possible and looking for new opportunities to support renewable power sources and onsite or local power production.

The federal government and many state governments have recognized the importance of energy efficiency to our nation's security and economic prosperity. Appliance efficiency standards that took effect in the early 1990s saved more than 88 billion kWh in 2000 — about 28 million tons of CO_2. Updates to these standards will save more than 250 billon kWh in 2010. Despite these impressive gains, standards only eliminate the lowest-efficiency products from the market. It is up to consumers to do the rest and demand more from the marketplace. If the roughly 40 million households in climates with large heating needs boosted their furnace or boiler efficiencies to 90% or higher, some 45 million tons of CO_2 emissions would be eliminated each year. Substituting compact fluorescent lamps for the ten most frequently used incandescent lamps in every house in the country would reduce CO_2 emissions by about the same amount!

To get a sense of just how effective energy conservation can be, take a look at the 1970s and 1980s. From 1973 to 1986, the U.S. gross national product grew 36% with no increase in energy use at all. Had efficiencies remained at 1973 levels, we would be spending an extra $150 billion in energy bills each year and pumping 1½ times more CO_2



Feedback devices and reports can

into the atmosphere! We are already saving the equivalent of 13 million barrels of oil each day — half of the OPEC output — and, compared with 1973 projections, we're getting by with 250 fewer large power plants than would have otherwise been required.

Planning Energy Improvements

As you think about how to reduce your environmental impact and energy bills, it can be hard to know where the best opportunities lie. The "Home Energy Checklist for Action" found in the inside covers of this book provides one way to prioritize some common home improvements. It is also useful to understand how your appliances stack up in terms of energy use, as shown in the pie chart on page 12. Keep in mind that, although heating and cooling consume by far the most energy, your best opportunities for reducing these pieces of the pie may come not from replacing equipment but from improving the efficiency of the building itself.

■ Understanding Energy Use in Your Home

To understand energy use in your home, you need information beyond what you find on your typical electricity or gas bill. To get a real handle on what's happening in your home, it's helpful to know how much energy different products use and how your home's energy use changes over the course of the day and in response to changes in your behavior. Power meters and power use monitors can help.

A power meter is a device that you plug in between the appliance and the wall socket. You can watch the electricity use change as the appliance goes in and out of power modes. In addition to giving instant readings of power use, several of these devices will record energy consumption over the course of an hour, day, week, or even a year; you can download the data to your computer and see graphs of the trends. Use a power meter to find your leading sources of energy consumption. This will help you to prioritize which products to unplug or to replace. Two models to look for are the Kill A Watt™ and the Watts Up? Pro Power Meter.

For an even more sophisticated, big-picture look at your home's real-time electricity use, you might also consider purchasing a power use monitor. These devices are programmed to read information from your electric meter and communicate the real-time changes in use

through an easy-to-read screen. The best monitors are wireless and portable. When your clothes dryer turns on, you'll see the degree to which your electricity use spikes. When nothing is operating, you'll see what the background buzz of electric use is in your house, and try to track down the top appliances to be unplugged. Plus, power meters and real-time monitors can be a way to get your family involved and interested in saving energy. Some good monitors to look for are The Energy Detective (TED), the Power Cost Monitor, and the Cent-A-Meter.

While it's very helpful to see how much energy your home is using and which products and behaviors are the biggest culprits in your home energy use, how do you know whether you're an energy hog or an energy miser? To put your energy use in context, it's valuable to know how your energy use compares to that of your neighbors or your broader community. A number of utilities around the country are offering this information to customers in the form of reports showing how your energy use stacks up and offering recommendations for energy improvements.

A growing number of online tools are also available to help you understand and manage your energy use; some even offer rewards for taking action and contests to make the whole process more fun. In addition to these tools, a large number of utilities are working to give customers new ways to download detailed energy use data in customized formats through the Green Button program. Check with your utility for more information and to encourage them to offer more of these tools and services.

■ **Setting Priorities**

For More Information:

A good selection of power meters and real-time monitors is available here.
www.powermeterstore.com ■ (877)766-5412

HOW TO USE THIS BOOK

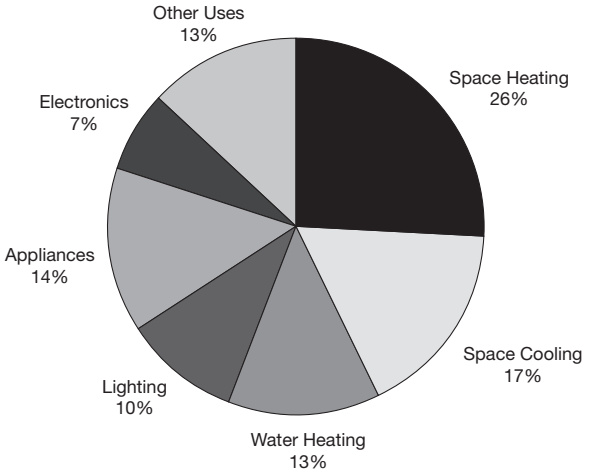
The *Consumer Guide to Home Energy Savings* is the most complete and up-to-date guide available on energy savings in the home. Following a review of measures to tighten up the building shell itself, the book focuses on the things you put in it your home—including major appliances, heating equipment, air conditioning, lighting, and electronics—and how the energy use of those products can be reduced.

If you're about to buy a new appliance or heating system, you'll be most interested in the tips on what to look for when buying new equipment. Otherwise, look for guidance on how to get the best energy performance through operation and maintenance of the products you already own. For further information and updates, we've included links directing you to valuable online resources provided by ACEEE and many others.

The decision to make certain energy improvements can be obvious — if you have a broken appliance and need to replace it, for example, use this book to make a smart purchase decision. But there may be other important priorities for your house that you are unaware of. If this is the case, you may want to perform a quick self-audit, or go ahead and hire a professional to help find the most cost-effective improvements (see Chapter 2).

Some of the more involved energy improvements mentioned here, such as replacing windows and insulating, make the most sense when you are planning other remodeling work. If you are going to extend a wall out to enlarge your kitchen or put in a larger dormer for a master bedroom expansion, by all means boost energy efficiency at the same time. Rebuild walls with high insulation levels. Put in high-performance insulating windows.
As long as you're ripping out walls, take advantage of the mess and go

The breakdown of energy use in a typical home



Source: Energy Information Administration, 2012, *Annual Energy Outlook*

a little further, boosting the efficiency of some of the adjoining walls and windows as well. With a small addition, some of this work might even pay for itself right away if it means, for example, that you can get by without adding a separate heating system or expanding your current heat distribution system.

■ Understanding ENERGY STAR

Once you've identified your high-priority areas and are ready to look for new products, look for the ENERGY STAR. The U.S. Environmental Protection Agency (EPA) and the U.S. Department of Energy (DOE) recognize the local and global environmental significance of energy-efficient products. Working

For More Information:

Enter your zip code and some details about your home into these online tools to see what energy savings are possible based on the current conditions of your house.

www.hes.lbl.gov/consumer/ ■ www.energysavvy.com/home-energy/

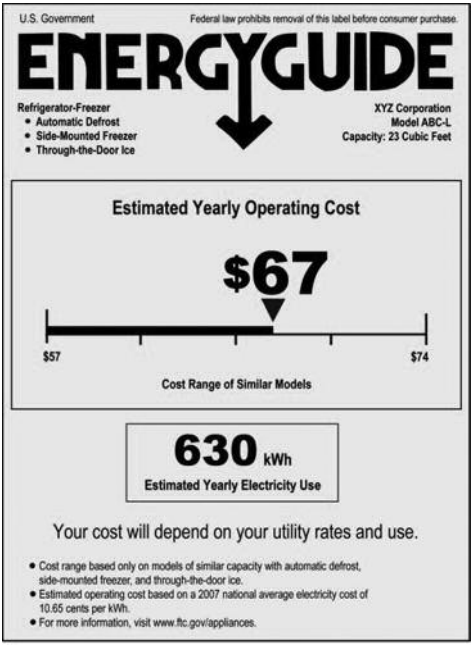
in voluntary cooperation with manufacturers and retailers, these agencies have created a distinctive ENERGY STAR label to help consumers identify energy-efficient heating and cooling equipment, appliances, computers, lighting, and home electronics. Many homebuilders offer ENERGY STAR homes, which include a variety of energy-efficient features and equipment. ENERGY STAR homes are at least 15% more energy efficient than the current International Energy Conservation Code. You can even get an ENERGY STAR-qualified whole-house retrofit to optimize your overall home energy performance.

ENERGY STAR qualifies over 50 different types of products.

■ Beyond ENERGY STAR

ENERGY STAR is designed to highlight the top 25% of covered products based on energy efficiency. For many products, there is a significant difference between the top 5% or 10% and the top 25%—the very best performers can save additional energy and money (and water in the case of clothes washers and dishwashers) compared to other ENERGY STAR-qualified models. For other products, there is no ENERGY STAR program.

New resources are available to help you find the most efficient products available. TopTen USA is an independent nonprofit organization working to identify and publish information about the most energy-efficient products on the market. It maintains lists of top-performing models on its website (toptenusa.org) along with tools to help consumers find the products and compare prices from retailers in their local area. TopTen USA is beginning to work with utilities to connect consumers to rebates for listed products. As of 2012, TopTen USA covers refrigerators, freezers, clothes washers, dishwashers, water heaters, televisions, computers, monitors, LED lighting, and vehicles.



A typical EnergyGuide label

ENERGY STAR is also working to help consumers identify the most efficient models in several ENERGY STAR product categories. The ENERGY STAR Most Efficient designation highlights the top-performing ENERGY STAR models for a given year. For 2012, the program is recognizing Most Efficient refrigerators, clothes washers, televisions, and heating and cooling equipment.

■ Understanding EnergyGuide Labels

Federal law requires that EnergyGuide labels be placed on all new refrigerators, freezers, water heaters, dishwashers, clothes washers, televisions, room air conditioners, central air conditioners, heat pumps, and furnaces and boilers. These labels are bright yellow with black lettering. The EnergyGuide label can be useful when evaluating how the specific product you are considering compares to other products of the same type. EnergyGuide labels are not required on kitchen ranges,

microwave ovens, clothes dryers, portable space heaters, and light fixtures. For these products, look for the energy-conserving features discussed throughout this book. When purchasing light bulbs, consult the new FTC Lighting Facts label (described in greater detail in Chapter 11).

The main feature of the label is a line graph showing how the energy cost or energy efficiency of that particular model compares with other models on the market of comparable size and type. You will see a range of lowest to highest. A word of caution — the ranges shown on the labels are not updated frequently, and manufacturers are constantly introducing new appliances.

For refrigerators, freezers, water heaters, dishwashers, clothes washers, televisions, and room air conditioners, the range shows estimated annual energy cost based on typical usage and national average electricity and/or natural gas prices. The most efficient models will have labels showing energy cost (represented by the downward-pointing triangle) at or near the left-hand end of the range. The annual estimated energy consumption is also provided in kWh/year for electricity or therms/year for gas. The label shows the usage and energy price assumptions used to calculate the reported energy use and operating cost.

For central air conditioners, heat pumps, and furnaces and boilers, the range is not annual energy cost, but rather the energy efficiency ratings for these products (SEER, HSPF & SEER, and AFUE, respectively). Therefore, labels on the most efficient models will show the efficiency rating at or near the right-hand end of the range since the higher the rating the more efficient the product. To estimate your operating costs for these products, refer to the manufacturer's fact sheets available from the seller or installer.

■ Quality, Reliability, and Availability

When shopping for major home appliances, you may want to call several stores or dealers to check the price and availability of different models that you find on the ENERGY STAR website or other listing. You can ask the salesperson for information about the efficiency of each model, but be aware that he or she may not know very much about

energy performance. Take this guide along when you shop to make sure the appliances contain recommended energy-efficient features. Many retailers are beginning to include more energy use information on the products they carry on their websites.

Also keep in mind that energy performance is not the only consideration you should use when selecting home appliances. Consumers must consider how effectively the appliances perform their primary functions — cleaning dishes, keeping food cold, etc. — as well as how much energy they use in doing it. For example, you wouldn't consider buying a dishwasher that didn't get your dishes clean, even if it used just half as much energy. This book does not pretend to be a comprehensive review of product reliability or performance, or a guide to convenience features found in these products; there are other sources for that information (see the Appendix). It is worth noting, however, that energy-efficient appliances are generally high-quality products due to the better materials and components used in their construction.

For the latest innovative energy-saving technologies, consider doing some additional research using the growing list of newsletters and journals (both online and print) that cover green products. Some top publications are listed in the Appendix under "Home Energy Publications and Newsletters."

New Homes

If you are building a new house or a major addition, do it right the first time, saving money and the environment for decades to come. Today's state-of-the-art energy-efficient houses typically require less than a quarter as much energy for heating and cooling as most existing houses. There are thousands of homes in the northern United States and Canada with yearly energy bills that total just $200 to $300.

These homes cost more to build than a standard house, but not that much more. You might spend an extra $5,000–$10,000 to build a super-efficient house with R-30 walls, R-38 ceilings, R-19 foundations, R-3 windows, and very low air leakage. But that extra cost will usually be recovered in just five to ten years through energy savings. Plus, you'll be more comfortable, and you'll have the satisfaction of knowing that

your house is dumping less pollution and carbon dioxide into the atmosphere.

Once you get an idea of what you want, contact builders or architects in your area and find out how experienced they are with energy-efficient construction. Special skills are required to build high-efficiency houses and to install features such as heat-recovery ventilation systems. You may need to spend a little extra time looking for the right builder, but the time and effort will be well worth it.

Sustainability

Saving energy is one of the greatest impacts you can have on reducing environmental degradation. But it does not make your lifestyle environmentally sustainable. The *Consumer Guide to Home Energy Savings* touches on some important considerations like water conservation, indoor pollutants, and appliance recycling, but the book is not exhaustive. If you are interested in becoming more environmentally sustainable, it is important to consider the materials and chemicals that comprise your products as well as the resources that go into their manufacture, transport, and disposal. This applies not just to household equipment but to all items you purchase. Look for ways to reduce your overall consumption. Buy locally grown foods. Reduce the number of miles you drive by combining trips, carpooling, biking, or taking public transportation, when feasible. By choosing a more sustainable lifestyle, we contribute to making a safer, healthier environment for ourselves and our children. And you just might find these changes improve your overall quality of life in surprising ways.

For More Information:

To learn more ways to improve your environmental sustainability, refer to resources in the Appendix of this book or go to www.aceee.org/consumer