CHAPTER 5

ENERGY MANAGEMENT STRATEGIES AND ENERGY POLICY
How energy decisions affect our lives

TERMS IN GLOSSARY

active solar
American Recovery and Reinvestment Act (ARRA)
blackout
brownout
Clean Air Act
compact fluorescent light bulb (CFL)
cool roofs
demand response
direct use geothermal
distributed generation
ecological
energy efficiency
green pricing
Green Tags
incandescent light bulb
independent power producer
indirect (hidden) costs
microgrid
net metering
passive solar
peak load
policy
rebate
renewable energy certificate (REC)
renewable portfolio standards (RPS)
smart grid
tradeable renewable energy credit (TRC, TREC)
U.S. Environmental Protection Agency (EPA)
true-cost pricing

REMINDER

W = watt
kW = kilowatt = 1,000 watts
MW = megawatt = 1,000 kilowatts
1 megawatt can serve about 1,000 homes in the United States.

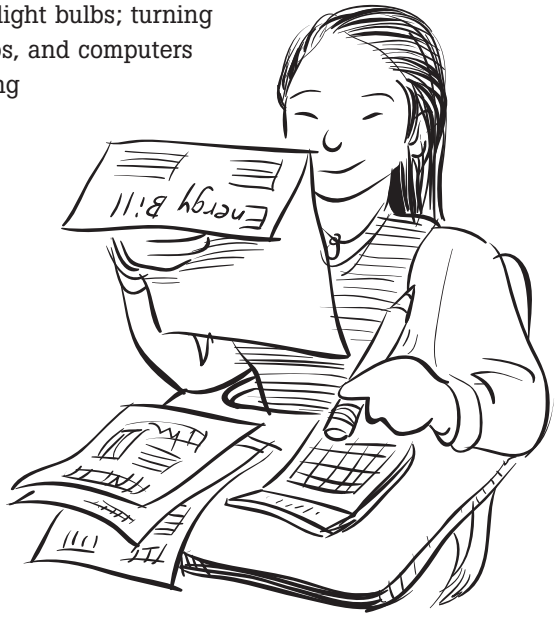
WHEN IT COMES TO ENERGY, you can make a difference, whether you are a student or the president of a country. Each individual counts when it comes to energy use. If five million of us turned off just one unneeded light all at the same time, for instance, we would reduce the demand for electricity by about 500 MW. This is the size of a typical large power plant. And during the summer, if only one family or small business adjusted its air conditioning thermostat up by 3°F, or about 2°C, it would keep about 470 pounds (213 kilograms) of carbon dioxide from being emitted into the air every year.

In many ways we are all connected to each other and to the environment in which we live. Our energy decisions affect our own quality of life and the lives of others. As individuals and collectively, we can pursue energy choices that benefit everyone.

CONSERVING ENERGY AND INCREASING EFFICIENCY: EVERYONE CAN MAKE A DIFFERENCE

We often hear about the need to save, or conserve, energy. This doesn't mean not *using* energy. It means not *wasting* energy. There are several important reasons not to waste energy. One is that, since much of our electricity is produced using nonrenewable fossil fuel resources, we want to make the best use of the fossil fuels we have left and save some for future generations. Another reason is that the less fossil fuel we use, the less pollution we produce.

Your home is a good place to start conserving energy. The biggest uses of energy in an average American home are for heating and cooling. These represent about 44 percent of energy used. Refrigerators consume almost 10 percent, and lighting, cooking, and other appliances use approximately 33 percent. Water heaters use up most of the rest. Buying appliances that are energy efficient is one way to reduce energy waste. (Perhaps it is time to replace that old energy-gobbling refrigerator.) However, there are many other low- or no-cost energy savers. These include turning up your thermostat several degrees in summer (if you have air conditioning) and down a few notches in winter; changing furnace air filters frequently; using shades or curtains to block the sun in summer; using compact fluorescent light bulbs; turning off lights, TVs, stereos, and computers when you aren't using them; and installing insulation in your attic and walls.



PEOPLE POWER

The people of Princeton, Massachusetts, have demonstrated more than once that ordinary citizens can make a difference in the quality of life in their community. In the mid-1980s, in order to meet an increasing demand for electricity, their local utility proposed buying electricity from a nearby nuclear power plant. Princeton residents voted instead to build their own wind farm, which they supported with a bond measure. Eight wind turbines were installed on a windy ridge of Mount Wachusett in 1984. Then, in 2003, Princeton residents once again spoke in favor of renewable energy. In another election, they voted to replace the eight older, less-efficient wind farm turbines with two tall, sleek, 1.5-megawatt turbines. In spite of some concerns about the "look" of the taller turbines, the majority of Princeton voters were proud to produce their own clean electricity from a local renewable resource.

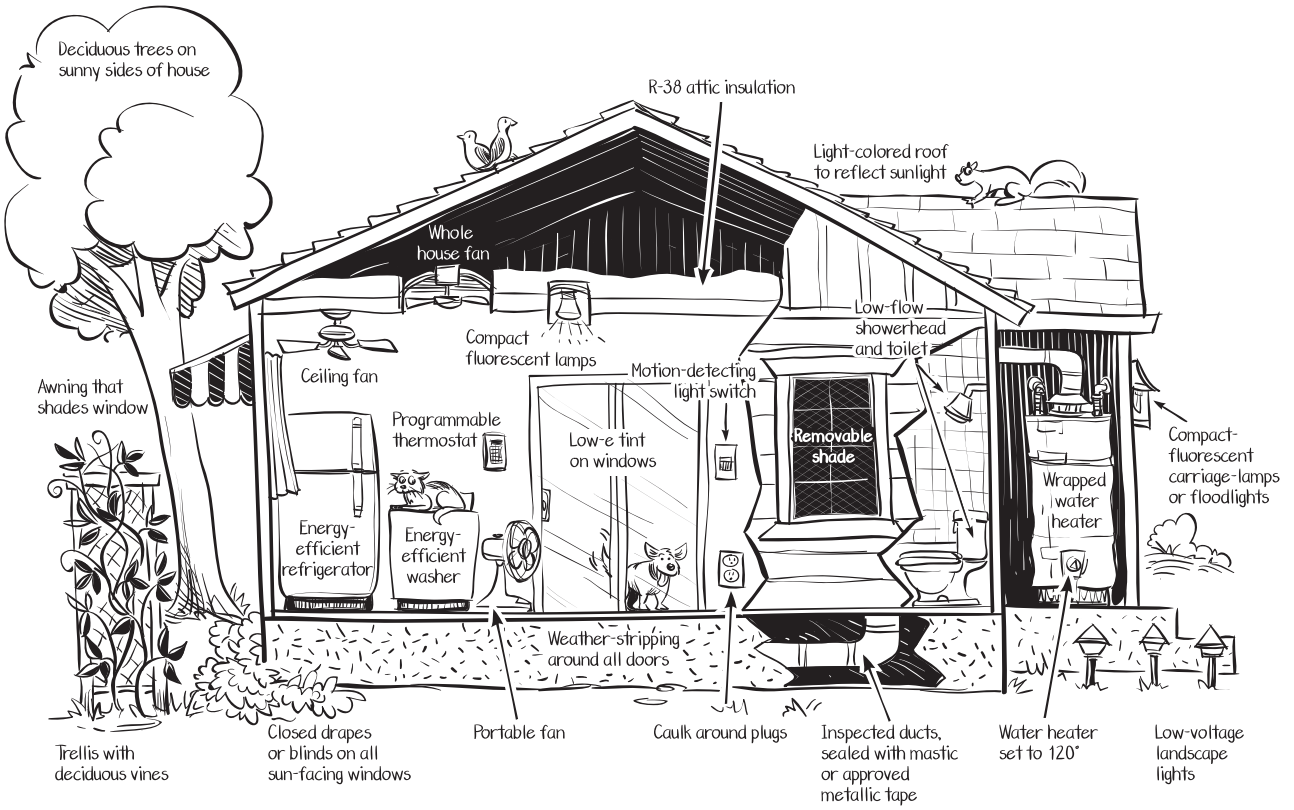
Another good energy-saving solution is to plant deciduous trees — trees that lose their leaves in winter. If you plant them along the sunny sides of your house (or ask your building manager or owner to consider doing so), you will have shade on those hot sides of your house in summer. In the winter, with the leaves gone, sun can reach through the bare branches to warm your house.

An Energy Efficient Home

Everyone can save energy at home; many methods and materials are shown below. Other approaches to conserving energy include the use of solar water heating systems and geothermal heat pumps. (See page 149.)

COOL ROOFS

Air conditioning makes a hot day the time of highest energy use. That's when peaking power, the most expensive electricity, is used — so that's when efficiency in building construction is most cost effective. Heat comes through the roof, raising the temperature of a dark roof to levels that can exceed 150°F (66°C). A light-colored roof will reflect heat and reduce the surface temperature dramatically, sometimes by over half. A cooler roof means cooler interiors and less electricity use.



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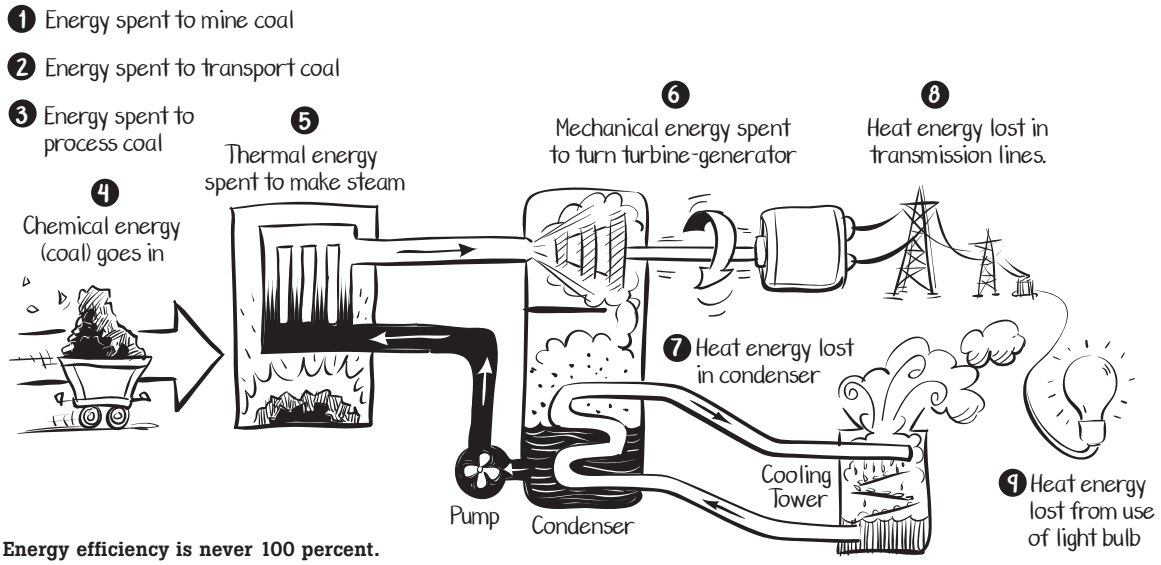
WHAT'S THE BIG DEAL WITH ENERGY EFFICIENCY?



Energy efficiency is never 100 percent.

When a device performs work for us, some of the energy is lost (wasted) as heat. Some processes and appliances waste more energy than others. In a standard, incandescent electric light bulb (the kind some of us still use at home) only 5 percent of the energy entering the bulb is converted to light! Most of the energy is lost as waste heat from the filament that glows to produce the light. (Compact fluorescent light bulbs are up to 75 percent more efficient and last 10 times longer.) Older models of refrigerators, other appliances, and gasoline and electric motors also waste a great deal of energy. Newer models use less, but still get the job done.

An energy system — such as a power plant — can also be thought of in terms of efficiency. At each step in such a system — from creation to use — some energy is lost, mostly as heat. Say, for example, we light that incandescent light bulb with electricity from a traditional coal-fired power plant. During the many steps required to make electricity at such a plant (mining, transporting, processing, burning, spinning the turbine and waste disposal), about 65 percent of the coal's energy is lost. Next, about 10 percent more of the remaining 35 percent is lost as heat when the electricity moves along transmission lines. Then the electricity is used to light our inefficient light bulb. That's a lot of wasted energy! Luckily, many of our renewable energy technologies use more energy efficient systems.

IMPROVING GRID EFFICIENCY

Electric power grids have been in place as long as telephone systems have, but advances for electricity have come more slowly. Our aging grids don't respond efficiently to part-time electricity sources such as sun and wind. Upgrading to "smart" grids and "micro" grids can save energy, reduce cost, and increase reliability.

Smart Grids

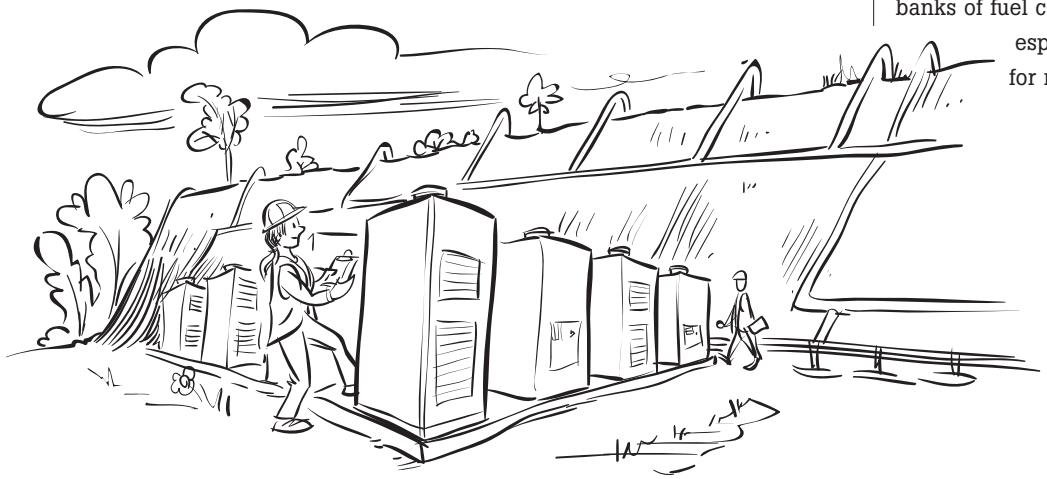
New "intelligent" two-way tracking systems can share information about electricity flow among power providers, grid operators, and consumers. That will conserve grid space and improve use of generation capacity. A *smart grid* will be able, in the future, to send power to and from advanced storage devices, which can include electric fuel cell cars.

Microgrids

Large size can be a disadvantage for a grid. Distance brings power loss. And disruptions, whether by bottleneck or by malfunction, can cause widespread effects, even brownouts or blackouts. An alternative is to use *microgrids*, small and operated locally. A microgrid can be linked with other grids for shared power; or it can be "islanded" (walled off) for protection from others' disruptions. Another important use is in remote areas with no nearby large grid.

DISTRIBUTED GENERATION

Another way to make energy more efficient is to generate power closer to where it will be used. Distributed Generation (DG) avoids the long distance transmission line power losses — which can be as high as 15 percent. The first DG photovoltaic and wind systems were installed in remote off-grid locations. DG is also now supplied to the grid by small power plants built to serve particular large businesses, or sited near the end of distribution lines. It is also useful as back-up power for hospitals, television stations, internet servers or other critical facilities. These mini power plants can be energy-efficient natural gas micro-turbines, small hydropower plants, modular binary geothermal units, photovoltaics, landfill gas, wind turbines, or banks of fuel cells. They are especially well suited for microgrids.



An example of distributed generation: microbe-eating bacteria in the adjacent landfill produce methane as fuel for these micro-turbines.

THE RIGHT SOURCE FOR THE RIGHT USE

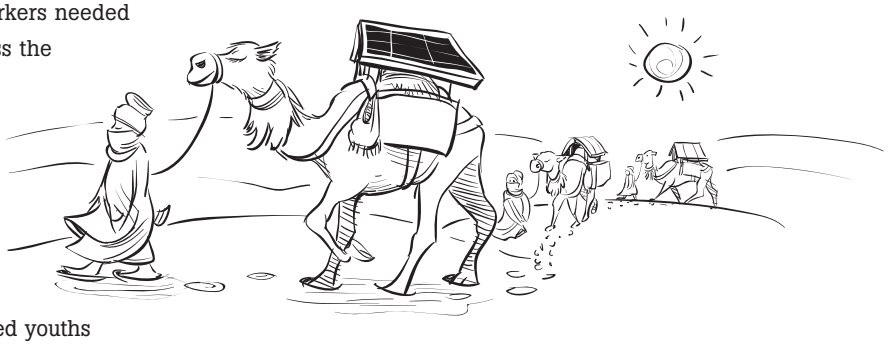
One way to get the most out of the energy we use is to match the right source with the right use. For example, if we need heat, then we can use a source that is already hot, such as solar or geothermal energy. Or, we can use the waste heat from power plants or industrial processes. That way we don't need to use electricity or burn fuel to produce heat. These approaches save resources, are energy- and cost-efficient, and are easier on the environment. Here are some of the ways we do this.

Active and Passive Solar Heating

Active solar heating systems absorb heat using solar collectors (often found on rooftops) that are filled with water or another liquid. Pumps can move the heated liquid through equipment to warm a building, take the chill from a swimming pool, or preheat water for a water heater. Buildings with *passive* solar systems naturally collect the sun's heat during the day, using thick walls or large tile or brick floors in the sunny areas, and expansive south-facing windows. Rooms with these features are sometimes called sunspaces. These "solar collectors" then slowly release the heat at night, when temperatures dip and the heat is usually needed. In summer, deciduous trees or awnings can shade the windows or walls from the sun.

PORTABLE POWER IN AFRICA

In Africa's Sahara Desert, health care workers needed a way to carry perishable vaccines across the hot, sandy desert to remote health clinics. The workers decided to make use of the best options available to them: camel caravans and the sun. The vaccines traveled in style, safely carried in small refrigerators powered by solar charged batteries — all sitting atop the camels!

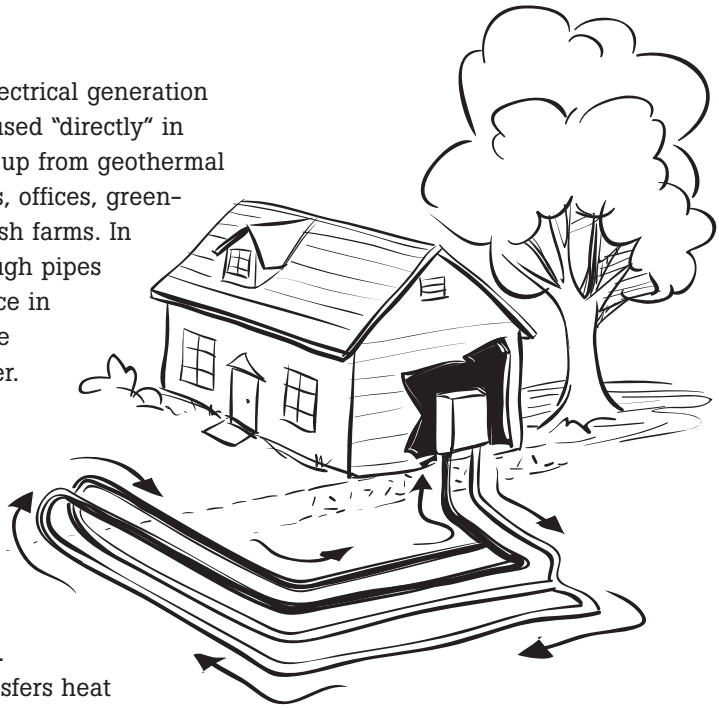


Farther south, in Rwanda, many orphaned youths are receiving much-needed schooling, news, and lifesaving medical advice by listening to solar-powered radios, gifts from a South African foundation seeking to improve the lives of children of this formerly war-torn region.

Direct Use Geothermal

Geothermal water that is not hot enough for electrical generation can still be very handy. Around the world it's used "directly" in many different ways. After pumping the water up from geothermal reservoirs, people use it to heat homes, schools, offices, greenhouses, swimming pools, and even water for fish farms. In some places, hot geothermal water is run through pipes under sidewalks and roads to melt snow and ice in winter. It also provides heat for industry, where it's used to dry agricultural products and lumber.

We can also heat (and even cool) buildings using a geothermal heat pump — without a geothermal reservoir. A geothermal heat pump takes advantage of the relatively constant temperatures of the earth just a few feet underground. With a geothermal heat pump, water or another liquid circulates through loops of pipe buried next to a building. During cold weather, the circulating liquid transfers heat from the ground to help warm the building. During hot weather, the liquid carries the heat from the building into the ground.



A geothermal heat pump system

Cogeneration

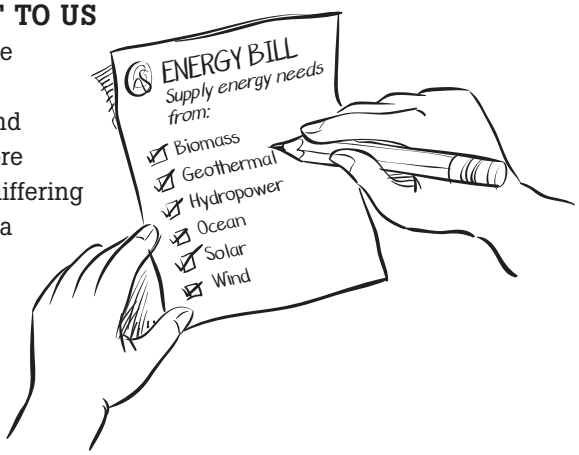
Cogeneration, also referred to as combined heat and power (CHP), is another way to use energy more efficiently — reducing costs, saving energy, and cutting back on pollution. It means producing electricity and heat at the same time, from the same fuel or energy source.

Facilities using cogeneration produce their own electricity and then use the resulting "waste" heat for another use. For example, a pulp and paper mill might produce its own electricity using a steam-driven turbine-generator, then use the waste heat to help produce paper products.

If it's a power plant that uses cogeneration, the waste heat that is captured after producing electricity can be used to produce even more electricity, to heat power plant offices, or to be sent right next door for use at a fruit-drying plant, for example.

A wide variety of power plant types can make use of cogeneration, including geothermal, solar thermal, landfill gas and other biomass plants, hydrogen combustion, fossil fuel, nuclear, or even fuel cell power plants. A "combined cycle" power plant (see page 122) is actually a cogeneration power plant.

ENERGY POLICIES: DECIDING WHAT'S IMPORTANT TO US



Policies are the guidelines or principles that we use when we make choices. They can be simple or complex.

Our personal policies reflect our own individual beliefs and goals; they are relatively simple. Policies for groups are far more complicated. They must reflect shared goals arrived at from differing interests and points of view. Whether for a family, a business, a school, a community, or a nation, policy-making requires shared information, consideration of needs, and compromise.

Individuals, businesses, and governments can all have their own energy policies, but it is the energy policies of state and national governments that affect our lives the most. Governments have a big say in which energy sources are developed, how much energy is imported, and even how much we pay for energy. Government energy policies affect public health, the environment, the economy of a region, the security of a nation, and the energy choices available to all of us and to future generations.

Government Power Policies

Before the mid-1970s, most of the electricity in the U.S. came from large centralized power plants owned by huge utilities regulated directly by government agencies. These utilities generated all the electricity within their service territories. They were the only ones allowed to build power plants. There was no competition. When our imported oil supplies were threatened in the 1970s, Congress wanted to encourage the development of new energy sources and greater energy efficiency, and businesses that consumed a lot of energy also began demanding more choice in power providers.

Federal laws were passed in 1978 requiring certain utilities to use electricity from independent producers. The electricity market was opened up for these independent power companies, many of which began producing electricity from renewable energy resources. Though regulations have evolved, independent power producers remain and have become a permanent part of our energy scene.

More than half of new electric generation in the U.S. now comes from these independent power producers. This allows many utilities to offer their customers choices that include electricity from renewable energy sources. Sometimes the utilities buy this electricity from independent power producers, and sometimes they generate their own.

DEREGULATION

Deregulation literally means elimination of regulation from a previously regulated industry. Many states are deregulating the electricity and natural gas industries to make electricity sales less a utility monopoly and more an open market. But it doesn't mean there are no rules. It just means the rules are changing. One common way to deregulate, also known as restructuring, is to make it possible for large businesses, a group of small customers, or an entire city to join together to buy their electricity directly from a supplier rather than from a regional utility. (See "A Local Voice on Electricity Choices," page 154.) The electricity industry in the U.S. will continue to change as new models are tried and either work or fail.

WEIGHING IN ON FEDERAL POLICY

A balancing act of decision-making goes on every working day for our elected officials in Congress. Public health and the environment must be balanced with economic concerns and other interests of voters. You can influence these public policy decisions by contacting your representatives in Congress to let them know what's important to you.

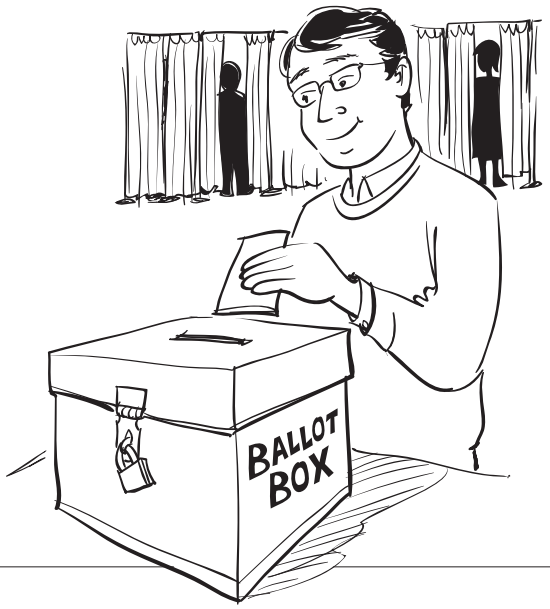
One important example to consider is the Clean Air Act (CAA). Originally passed in 1970, the CAA is a Federal law designed to protect public health. It requires the U.S. Environmental Protection Agency (EPA) to set air pollution standards and enforce regulations for industry and power plants.

Some industries and energy producers have not liked this regulation. They say it costs too much to use all the pollution controls required. However, other businesses have found that by using energy efficient measures and cleaner energy sources, they have not only met pollution standards, but have actually increased their profits.

Some people have pressed to repeal the CAA. Others wish to keep it in place, but would like to change the specific ways the regulations are put into action. Over the years, however, the basic intentions of the CCA have remained in place.

Policies such as these have had notable success in controlling pollution. For example, air quality in the Los Angeles area of southern California has improved dramatically due to the efforts of local agencies, such as the Air Quality Management District, which makes sure that both the CAA and state pollution regulations are being enforced.

With a complex issue such as the CAA, members of Congress need to be informed about all sides. The opinions of their citizenry — young and old — add weight to one side or the other of an argument. Therefore it is in everyone's own best interest to be informed and vocal about what happens at our nation's capital, especially when such important matters hang in the balance.



IMPLEMENTING ENERGY MANAGEMENT STRATEGIES

Energy policies are implemented by an energy management program — plans of action, or strategies. In this section you will find examples of energy management strategies, some of which can be pursued or are already being implemented by you, your family, business, school, utility, or local, state and federal governments.

Shifting the Load

There are times when everyone in a region uses a lot of electricity, all at once. You'll recall from Chapter 2 that this is called a peak load. In general, people use more electricity (especially in the summer on particularly hot days) between 12 noon and 6 P.M.— the peak hours. Sometimes there just isn't enough electricity for everyone, all at the same time. For example, this can happen during a heat wave when everyone wants to run air conditioners. Because of stresses on the electricity grid, certain areas may end up going without electricity for a specific period (usually several hours), which is commonly called a blackout. Blackouts or brownouts (meaning reduced power) may also occur when something damages the production equipment or wires.

We can all pitch in to help prevent blackouts and brownouts by using our major appliances at "off-peak" times when possible. We can also pay closer attention to how much we use our air conditioning and heaters.

Time of Use Pricing

To encourage load shifting (i.e., shifting the times customers use their electricity), some power providers can now install "time of use" meters that record both the kilowatt-hours used and the time of use. Customers are then charged more for electricity used during peak hours (when the cost of electricity is higher to the power provider and the most-polluting plants are turned on). Customers with time of use metering or rates can reduce their bills by doing laundry, for instance, during off-peak hours. Some utilities go further to spread their power efficiently. A utility in Idaho, for example, pays ranchers to turn off their electric water pumps at peak hours.

Net Metering

This is a program that encourages residences and business to generate some of their own electricity from specified renewable sources like solar PV or wind. If consumers need more electricity than they can generate at any point in time, they can draw on energy from the grid. If they generate an excess of electricity, some utilities buy the excess.

Incentives for Renewables

A number of state energy agencies and utilities give cash rebates for the purchase and installation of certain renewable energy systems, such as PV, small wind, fuel cells, and small biomass systems. Some cities even give homeowners the money to pay up front for such projects and let them pay it back through installments on their property tax bills.

ENERGY STAR Program

The U.S. Environmental Protection Agency established ENERGY STAR in 1992 to identify and promote energy-efficient products. ENERGY STAR–rated products have superior energy efficiency and now include office equipment, home appliances, heating and cooling equipment, lighting, home electronics, and even new homes and offices.

Efficiency Standards and Assistance

Federal and state governments also establish energy efficiency standards — laws setting standards for new products or for entire buildings. There are also programs that assist people who want to make older homes or other buildings more energy efficient. Even government buildings are being made more efficient under these programs.

Demand Response

Transmission line operators and utilities must sometimes respond quickly to unanticipated changes in electricity demand often caused by the weather, breakdowns at power plants, or stresses on transmission line capacity. "Demand Response" is a method for responding to such changes. It simply means that the utility calls customers (usually large businesses for factories) and asks them to reduce their electricity use. The technology is now available to implement Automated Demand Response technologies (AutoDR), which would make it possible to reduce a customer's electricity use automatically (with their prior permission), with control in the hands of the utilities.

TRUE-COST PRICING

Traditionally, the price of a product reflected only the cost of making and delivering it. If a factory polluted the air and people got sick, those costs and losses were borne by the community, not the company that did the damage. These are called hidden, or "external" costs.

Electricity also has hidden costs. Health and environmental costs, for example, result from burning fossil fuels. Air pollution causes ailments, especially of the lungs, which can require costly treatment and lost work days. And there are risks in importing fuels, the costs of which are covered in military and defense budgets (our tax dollars), not in our electric bills.

With renewable energy, we get added value without paying for it — such as reducing the cost of waste disposal to landfills by using biomass for electricity, improving our "balance of trade" by importing less fuel, and increasing our energy security by using more numerous, small distributed power plants.

When the true costs are considered, renewable energy can be more cost-effective than electricity from fossil fuels. Understanding this, consumers are often willing to pay a bit more for renewable energy, knowing they are actually getting good value.

Green Tags and Green-E

A widely used program to promote cleaner energy uses renewable energy certificates (RECs), also known as tradeable renewable energy credits (TRECs) or "green tags." When a utility or customer buys RECs, the purchase price goes to the construction of renewable power facilities, either locally or at a distance. The task of determining if a plant is truly renewable and qualified for REC treatment is delegated to a number of agencies — such as California's Center for Resource Solutions, which administers the Green-E program.

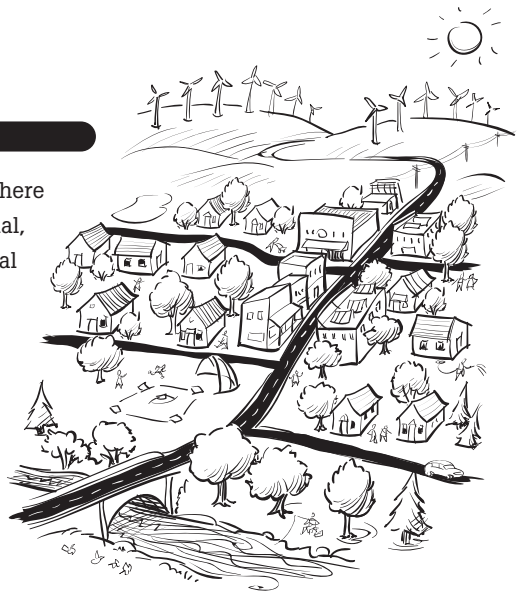
Renewable Portfolio Standards (RPS)

Most states are adopting standards for the minimum amount of renewable energy that must be included in the utilities' mix (portfolio) of electricity resources. As of 2010, more than half of the states have enacted laws to specify that a portion of their electricity must come from renewable energy. (States can define renewables differently.) In some states, the standard can be met by a utility purchase of green tags. Many environmentalists and business leaders are also working to have a set of national renewable portfolio standards established in the near future.

A LOCAL VOICE ON ELECTRICITY CHOICES

Cities and counties in a few states can decide for themselves where to get their electricity. They can buy electricity from geothermal, wind, solar — or whatever they want — without forming a municipal utility. Under this "community choice aggregation" (CCA), a local agency buys power from the producer it chooses, and the area's utility is required to deliver it for a regulated charge.

If the agency chooses less polluting sources than the utility was providing, the CCA process can allow a community to help clean the air. In Ohio, for example, 200 small towns "aggregated" their power purchases and cut harmful emissions by an estimated 50 percent.



Feed-In Tariffs

Many countries in Europe and several U.S. states are implementing a "feed-in tariff" policy. Under a feed-in tariff program, a utility must buy all renewable power offered (if it meets established rules) at a price set by a governing agency. In some cases, even if the utility has to shut down fossil fuel plants in order to take the renewable power, they must do so or pay a penalty. This policy provides a guaranteed market for renewable power developers. It helps keep their costs down by avoiding expensive bidding competition and it gets more renewable electricity into the grid.

Government Research and Tax Policies

Government assistance has had a large influence on growth in U.S. energy production. Sometimes the assistance takes the form of research and development funds; examples are U.S. Department of Energy (DOE) programs to promote cleaner coal, safer nuclear technology, and more efficient renewable production. Other assistance has been in the form of tax benefits; an example is the Production Tax Credit, which has assisted renewable energy developers.

In 2009, assistance to energy development was taken to a new level by the American Recovery and Reinvestment Act (ARRA). ARRA provides a temporary 30 percent tax credit for developers of specified renewable energy technologies. Further, for the benefit of developers who don't owe that much tax, ARRA provides that (on completion of a qualifying project) the U.S. Treasury will pay cash in the amount of the credit.

Tax benefits for specific industries are controversial. Lawmakers disagree over what projects deserve benefit, and some promote a strictly free market approach in which the government avoids picking winners. The result of the controversy is a package of tax compromises, enacted into legislation once every two years or so, that benefit favored energy sources, usually for a limited time.

ECOLOGICAL FOOTPRINTS

When we walk on a beach or in the snow we leave footprints. Less visible, but much more important, are the ecological footprints we leave when our activities alter the environment or result in the overuse of our natural resources. An ecological footprint is a measure of how much of nature's resources we use to sustain our lifestyles. We all have footprints; however, some are far bigger than others.

Our footprints grow as the economy, the world's population, and our use of natural resources grow. Sometimes the resources we use are renewable — like the trees that supply the wood for building houses or for biomass energy. In other cases — for instance, the consumption of oil — the resources diminish over time. Either way, our footprints may become permanent if we exceed nature's ability to regenerate itself.

We have choices to make — about how much electricity we use, when we use it, and the energy resources we use to generate it. These choices are becoming more important every day.

—Chapter 2, *Energy for Keeps*