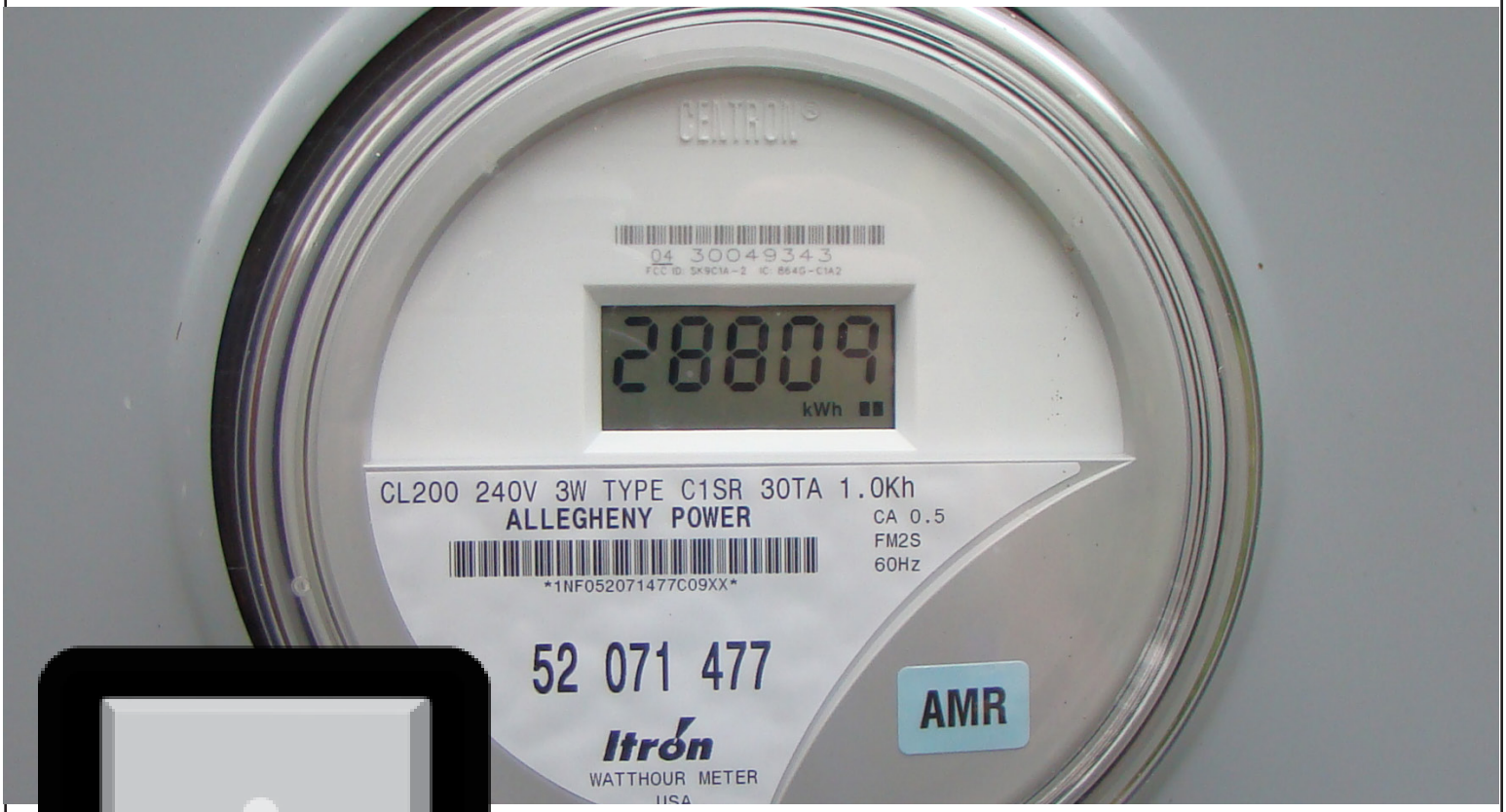
2019-2020

Using and Saving Energy

Primary students are introduced to how they use energy at home and school and simple ways to conserve energy.



Grade Level:

Pri Primary

Subject Areas:

Science

Social Studies

Language Arts

NEED National Energy Education Development Project

Teacher Advisory Board

NEED Mission Statement

The mission of The NEED Project is to promote an energy conscious and educated society by creating effective networks of students, educators, business, government and community leaders to design and deliver objective, multi-sided energy education programs.

Permission to Copy

Teacher Advisory Board

In support of NEED, the national Teacher Advisory Board (TAB) is dedicated to developing and promoting standards-based energy curriculum and training.

Energy Data Used in NEED Materials

NEED believes in providing teachers and students with the most recently reported, available, and accurate energy data. Most statistics and data contained within this guide are derived from the U.S. Energy Information Administration. Data is compiled and updated annually where available. Where annual updates are not available, the most current, complete data year available at the time of updates is accessed and printed in NEED materials. To further research energy data, visit the EIA website at www.eia.gov.

NEED
National Energy Education Development

1.800.875.5029
www.NEED.org

Using and Saving Energy

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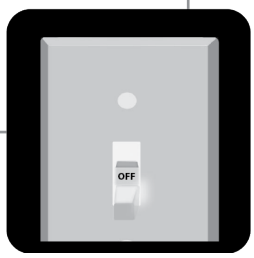


Standards Correlation Information

www.NEED.org/educators/curriculum-correlations/

Next Generation Science Standards

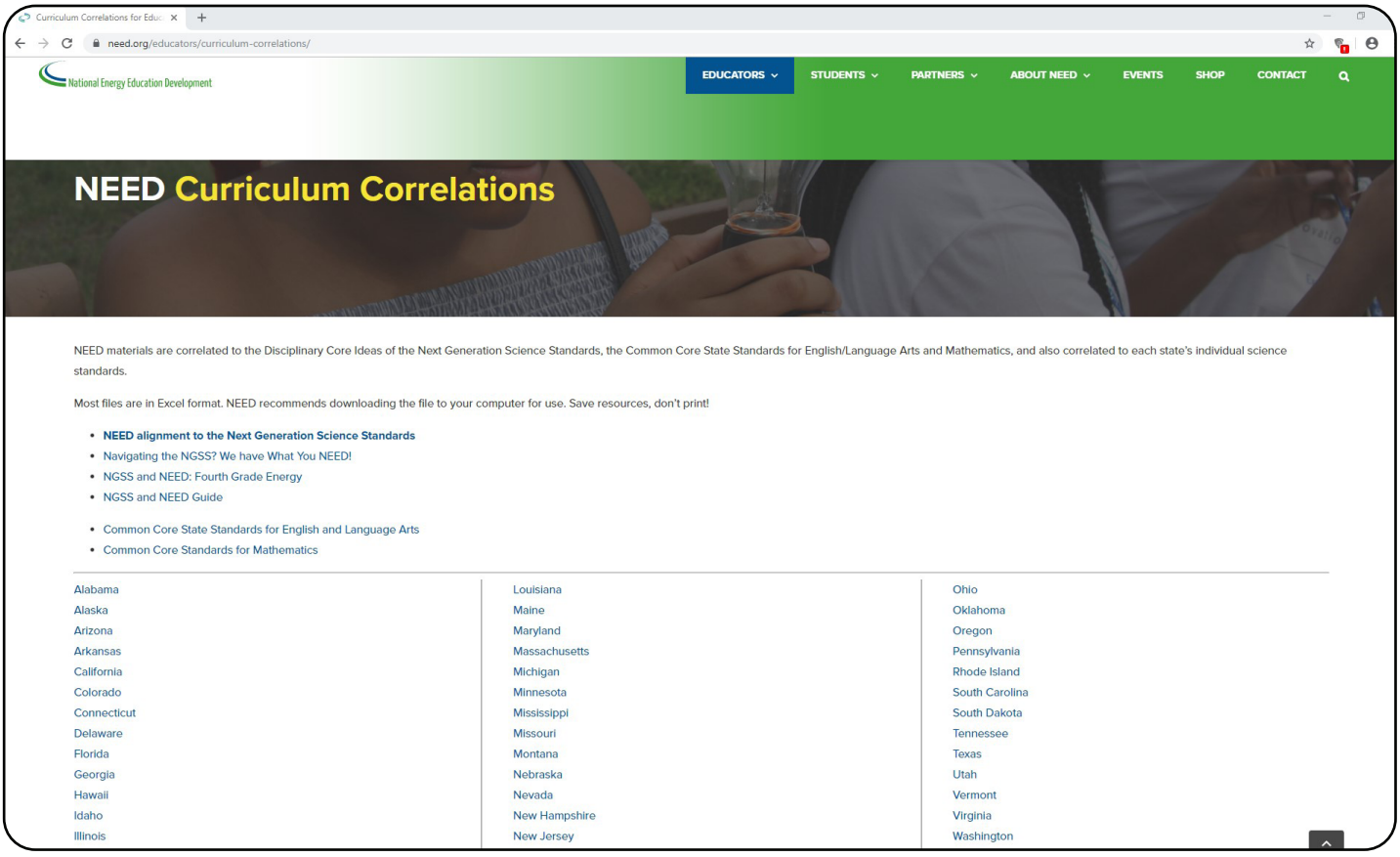
- This guide effectively supports many Next Generation Science Standards. This material can satisfy performance expectations, science and engineering practices, disciplinary core ideas, and cross cutting concepts within your required curriculum. For more details on these correlations, please visit NEED's curriculum correlations website.

Common Core State Standards

- This guide has been correlated to the Common Core State Standards in both language arts and mathematics. These correlations are broken down by grade level and guide title, and can be downloaded as a spreadsheet from the NEED curriculum correlations website.

Individual State Science Standards

- This guide has been correlated to each state's individual science standards. These correlations are broken down by grade level and guide title, and can be downloaded as a spreadsheet from the NEED website.



Teacher Guide

Background

Primary students are introduced to concepts of energy consumption and conservation at home and school with bold graphics and simple sentences. Students will enhance their nonfiction reading, vocabulary, comprehension, analysis, and critical thinking skills.

At the back of the guide, there are simple worksheets for student use that reinforce the knowledge presented in the text. Several hands-on activities are also included on the next page. Teacher background information on energy consumption and efficiency is also included.

Preparation

- Familiarize yourself with the format of, and information in, the guide.
- Read the *Teacher Informational Text* on pages 7-15 for an introduction to the unit.
- Make copies of the worksheets you want to use or laminate them and put them at centers with dry erase markers.
- Download and preview the *Primary Energy Infobook* from shop.NEED.org to use as a reference if needed.
- Prepare a digital copy or the e-publication of this guide to project so that students may read along as you read aloud.

✔Procedure

1. Introduce the subject to the students with a discussion of the ways students have used energy today at home and at school. Record their thoughts on the board or on chart paper. Use the introductory pages of the *Primary Energy Infobook* to introduce students to energy, if you have not already covered the topic.
2. Ask the students how they have wasted energy today. Ask the students if they consider themselves energy savers or energy wasters. Make a pie chart with the results, showing how many savers and wasters are in the classroom. You can use this pie chart to compare student attitudes about saving energy after the completion of the unit.
3. Read the student pages to the class one segment at a time as detailed below, having the students complete the designated worksheets after the segments and discussing the information presented.

SEGMENT	SUBJECT	WORKSHEET PAGES
Segment 1	Energy Sources and Energy Use (pages 16-40)	pages 80-81
Segment 2	Energy Tasks (pages 41-46)	pages 82-88
Segment 3	Saving Energy: Heating and Cooling (pages 47-53)	pages 89-92
Segment 4	Saving Energy: Lighting (pages 54-58)	page 93
Segment 5	Saving Energy: Appliances and Machines (pages 59-61)	
Segment 6	Saving Energy: Hot Water (pages 62-67)	
Segment 7	Using Energy (pages 68-69)	pages 94-95
Segment 8	Trash and Energy (pages 70-71)	
Segment 9	Saving Energy (pages 72-79)	pages 96-97

CONTINUED ON NEXT PAGE

Grade Level

- Primary, grades K-1

Time

- 10-12 30 minute sessions

Additional Resources

The following NEED resources may be downloaded for free from shop.NEED.org to enhance your energy unit:

- *Energy Stories and More*
- *Energy Games and Icebreakers*
- *NEED Songbook*
- *Primary Energy Infobook*
- *This Mine of Mine*

4. Take the students on a tour of the school with maintenance personnel showing them the boiler, air conditioning units, and water heaters. Ask what energy sources are used to power the machines. Point out all energy–consuming devices, including lights and other electrical devices, during the tour.
5. After reading the student text and completing the worksheets, ask students whether they want to be energy savers or energy wasters. Make a pie chart of the results and compare it to the original pie chart from the beginning of the unit.
6. Make one copy of the *Saving Energy at School* worksheet on page 97 for each day of one month (or for the entire year) and have the students complete it as a class at the end of each day. Alternatively, this page could be laminated and completed with a dry erase marker, or saved digitally and completed each day and saved in a digital file.

Supplemental Activities

- ***Today in Energy:*** Conduct NEED's *Today in Energy* activity to reinforce concepts on energy consumption, conservation, and trade-offs.
- ***Energy Story Time:*** Read stories from NEED's *Energy Stories and More* to expand knowledge of energy sources, electricity, and energy consumption.
- ***Energy Mural:*** Have the students cut energy-related pictures from print media and make a mural or collage for the classroom.
- ***Lighting:*** Using a desk lamp, demonstrate the light and heat from an incandescent bulb and an LED with the same lumen output. For example, place a pat of butter under each and observe.
- ***Insulation:*** Have the students insulate the outside of empty soda cans with different materials such as cotton, bubble wrap, and paper towels. Fill the cans with hot water, record the temperature of the water, place the cans in a refrigerator or ice bath for 30 minutes, then record the temperature of the water again. Discuss which materials were good insulators.
- ***Absorption/Reflection:*** Have the students explore how different colors absorb sunlight and turn it into heat. Have them put a white cloth on one hand and a black one on the other and place their hands in the sun. See which one feels hotter. (Or paint the backs of their hands with black and white paint.) Talk about what colors they should wear on hot and cold days.
- ***Cooling with Moving Air:*** Have students hold their hands in front of a fan and observe how it makes them feel cooler even though the temperature of the air remains the same. Have the students dip one of their hands in water, then hold both hands in the moving air and observe. Explain that water is a conductor and moves some of the heat from their hands to the air, so that the wet hands feel cooler.

☑ Evaluation

- Use the *Evaluation Form* on page 99 to evaluate the unit with your students. Send the completed form to The NEED Project.
- Evaluate student performance and increase in knowledge using class participation, completion of worksheets, and vocabulary development.

Teacher Informational Text

Introduction

The United States uses a lot of energy—almost two million dollars worth of energy each minute, 24 hours a day, every day of the year. With only 4.32 percent of the world's population, we consume over one-sixth (16.88 percent) of the world's energy.

The average American consumes 3.99 times the world average per capita consumption of energy. Every time we fill up our vehicles or open our utility bills, we are reminded of the economic impacts of energy.

Sources of Energy

We use many different energy sources to do work for us. They are classified into two groups—renewable and nonrenewable.

In the United States, most of our energy comes from nonrenewable energy sources. Coal, petroleum, natural gas, propane, and uranium are nonrenewable energy sources. They are used to make electricity, heat our homes, move our cars, and manufacture all kinds of products. These energy sources are called nonrenewable because their supplies are limited. Petroleum, for example, was formed hundreds of millions of years ago from the remains of ancient sea plants and animals. We can't make more crude oil deposits in a short time.

Renewable energy sources include biomass, geothermal energy, hydropower, solar energy, and wind energy. They are called renewable because they are replenished in a short time. Day after day, the sun shines, the wind blows, and the rivers flow. We use renewable energy sources mainly to make electricity.

Electricity

Electricity is different from the other energy sources because it is a secondary source of energy. We must use another energy source to produce electricity. In the U.S., natural gas is the number one energy source used for generating electricity.

Electricity is sometimes called an energy carrier because it is an efficient and safe way to move energy from one place to another, and it can be used for so many tasks. As we use more technology, the demand for electricity grows.

Energy Efficiency and Conservation

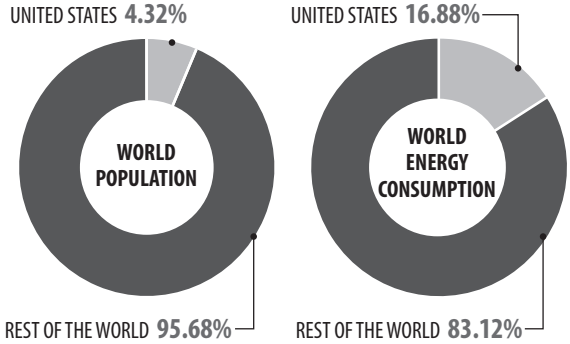
Energy is more than numbers on a utility bill; it is the foundation of everything we do. All of us use energy every day—for transportation, cooking, heating and cooling rooms, manufacturing, lighting, water heating, and entertainment. We rely on energy to make our lives comfortable, productive, and enjoyable. Sustaining this quality of life requires that we use our energy resources wisely. The careful management of resources includes reducing total energy use and using energy more efficiently.

The choices we make about how we use energy—turning machines off when not in use or choosing to buy energy efficient appliances—will have increasing impacts on the quality of our environment and lives. There are many things we can do to use less energy and use it more wisely. These things involve energy conservation and energy efficiency. Many people use these terms interchangeably; however, they have different meanings.

Energy conservation includes any behavior that results in the use of less energy. Energy efficiency involves the use of technology that requires less energy to perform the same function. A compact fluorescent light bulb that uses less energy to produce the same amount of light as an incandescent light bulb is an example of energy efficiency. The decision to replace an incandescent light bulb with a compact fluorescent is an example of energy conservation.

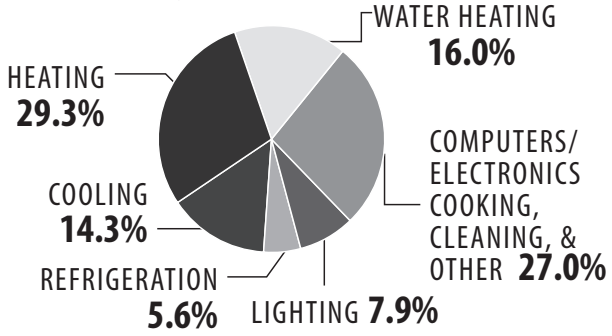
As individuals, our energy choices and actions can result in a significant reduction in the amount of energy used in each sector of the economy.

Population Versus Energy Consumption, 2017



Data: Energy Information Administration

Home Energy Expenditures



Data: EIA 2015 RECS

Residential/Commercial Sector of the U.S. Economy

The U.S. Department of Energy uses categories to classify energy users—residential, commercial, industrial, transportation, and electric power generation. These categories are called the sectors of the economy. Residential and commercial energy use are often lumped together because homes and businesses use energy in the same ways for heating, air conditioning, water heating, lighting, and operating appliances.

The graphic at right shows that electric power generation sector consumed the most primary energy in 2017. However, all of the other sectors consume electricity once it is generated. The residential, commercial, industrial, and transportation sectors are the end users of electricity. Total energy consumption shows us how each of the other four sectors used energy, and includes the electricity they used. The residential and commercial sector of the economy consumed more energy than either of the other sectors, with a total of 37.727 quads of energy when combined together and accounting for elecricity use. The residential portion of the sector consumed 19.805 quads (13.788 quads for electricity) and the commercial sector consumed 17.922 quads (13.534 for electricity).

Households use about one-fifth of the total energy consumed in the United States each year. The typical U.S. family may spend over $1,800 a year on utility bills. About 70 percent is in the form of electricity, the remainder is mostly for natural gas and oil for heating and cooling.

Much of this energy is not put to use. Heat, for example, pours out of homes through doors and windows and under-insulated attics, walls, floors, and basements. The amount of energy lost through air leaks and gaps around windows and doors as well as through poorly insulated attics and walls adds up to a significant percentage of all U.S. energy consumed each year.

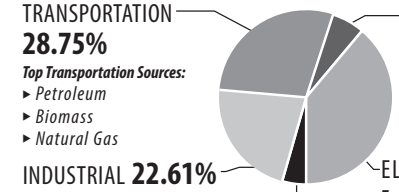
Energy efficient improvements cannot only make a home more comfortable, they can yield long-term financial rewards. Many utility companies and energy efficiency organizations provide energy audits to identify areas where homes are poorly insulated or energy inefficient. This service may be free or at low cost.

The residential and commercial sector is also responsible for greenhouse gas emissions that contribute to global climate change. The three main sources of greenhouse gas emissions from homes are electricity use, space heating, and waste. Using a few inexpensive, energy efficient measures can reduce your energy bill and, at the same time, reduce air pollution.

Heating and Cooling

The ability to maintain desired temperatures is one of the most important accomplishments of modern technology. Our ovens, freezers, and homes can be kept at any temperature we choose, a luxury that wasn't possible 100 years ago.

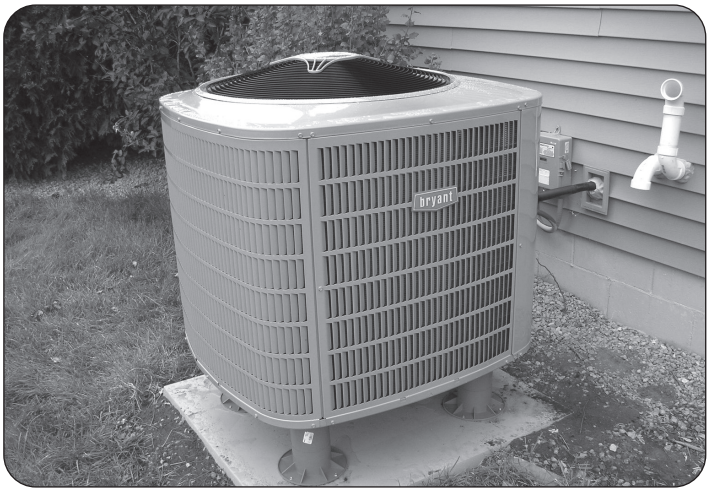
U.S. Energy Consumption by Sector, 2017



The residential, commercial, and industrial sectors use electricity. This graph depicts their energy source consumption outside of electricity.

Data: Energy Information Administration

AIR CONDITIONING SYSTEM



Keeping our living and working spaces at comfortable temperatures provides a healthier environment, but uses a lot of energy. About half of the average home's energy consumption is for heating and cooling rooms.

The three fuels used most often for heating are natural gas, electricity, and heating oil. Today, about half of the nation's homes are heated by natural gas. Natural gas is a clean-burning fuel. Most natural gas furnaces used in the 1970s and 1980s were about 60 percent efficient—they converted 60 percent of the energy in the natural gas into usable heat.

New furnaces manufactured today can reach efficiency ratings of 98 percent, since they are designed to capture heat that used to be lost up the chimney. These furnaces are more complex and costly, but they save significant amounts of energy and are often made to last as long as 20 years.

The payback period for a new high-efficiency furnace is between four and five years, resulting in considerable savings over the life of the furnace. Payback period is the amount of time a consumer must use a system before beginning to benefit from the energy savings because of the higher initial investment cost.

Electricity is the second leading source of energy for home heating and provides almost all of the energy used for air conditioning.

In the 1970s, air conditioners and heat pumps had an average Seasonal Energy Efficiency Ratio, or SEER, of 7.0. Today, the new units must have a SEER of 13, and high-efficiency units are available with SEER ratings as high as 18. These highly-rated units are more expensive to buy, but their payback period is only three to five years.

Heating oil is the third leading fuel for home heating and is widely used in northeastern states. In the early 1970's, the average home used 1,294 gallons of oil a year. Today, that number is less than half due to efficiency improvements and better construction of homes.

This decrease in consumption is a result of improvements in oil furnaces. Not only do today's burners operate more efficiently, they also burn more cleanly. According to the Environmental Protection Agency, new oil furnaces operate as cleanly as natural gas and propane burners. A new technology under development would use PV cells to convert the bright, white oil burner flame into electricity.

Saving Energy on Heating and Cooling

With all heating, ventilation, and air-conditioning systems, you can save money and increase comfort by installing proper insulation, maintaining and upgrading equipment, and practicing energy efficient behaviors. By combining proper maintenance, upgrades, insulation, weatherization, and thermostat management, you can reduce energy bills and emissions.

The four most important things a consumer can do to reduce heating and cooling costs are:

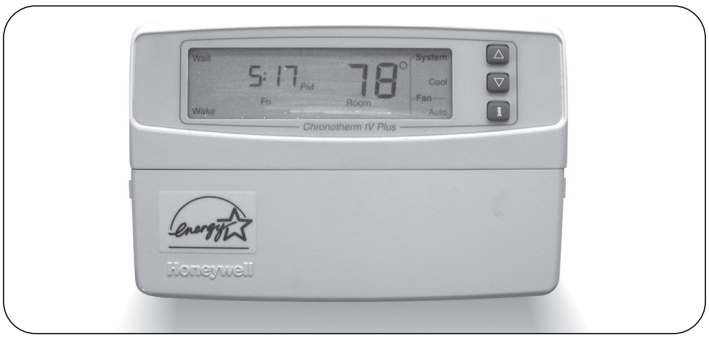
▪ Maintenance

Maintaining equipment in good working order is essential to reducing energy costs. A certified technician should service systems annually, and filters should be cleaned or replaced on a regular schedule by the homeowner.

▪ Programmable Thermostats

Programmable thermostats regulate indoor air temperature automatically, adjusting for time of day and season. They can be used with both heating and cooling systems and can lower energy usage appreciably. Proper use of pre-programmed settings on a programmable thermostat can save your family about $180 every year in energy costs.

PROGRAMMABLE THERMOSTAT



INSULATION

Image courtesy of Owens Corning

▪ Insulation and Weatherization

Warm air leaking into your home in cooling seasons and out of your home in heating seasons can waste a substantial amount of energy. You can increase home comfort and reduce heating and cooling costs by investing a few hundred dollars in proper insulation and weatherization products. Insulation is rated using an R-value that indicates the resistance of the material to heat flow. You need a minimum R-value of 30 in attics and R13 in walls. In very cold climates, a higher R-value is recommended. Insulation wraps your house in a nice warm blanket, but air can still leak in or out through small cracks.

▪ Caulking and Weather Stripping

Preventing the exchange of inside air with outside air is very important. Often the effect of the many small leaks in a home is equivalent to a wide open door. One of the easiest money-saving measures you can perform is to caulk, seal, and weather strip all seams, cracks, and openings to the outside. Home owners typically save up to $200 a year in heating and cooling costs by air sealing their homes and adding insulation. Keeping windows and doors closed when systems are operating is also a necessity.

Building Design

The placement, design, and construction materials used can affect the energy efficiency of homes and buildings. Making optimum use of the light and heat from the sun is becoming more prevalent, especially in commercial buildings.

Many new buildings are situated with maximum exposure to the sun, incorporating large, south-facing windows to capture the energy in winter, and overhangs to shade the windows from the sun in summer. Windows are also strategically placed around the buildings to make use of natural light, reducing the need for artificial lighting during the day. Using materials that can absorb and store heat can also contribute to the energy efficiency of buildings.

▪ Doors and Windows

Some of a home's heat loss occurs around and through the doors and windows. Energy efficient doors are insulated and seal tightly to prevent air from leaking through or around them. If your doors are in good shape and you don't want to replace them, make sure they seal tightly and have door sweeps at the bottom to prevent air leaks. Installing insulated storm doors provides an additional barrier to leaking air.

Most homes have more windows than doors. Replacing older windows with energy efficient ones can significantly reduce air leaks and utility bills. The best windows shut tightly and are constructed of two or more pieces of glass separated by a gas that does not conduct heat well. The National Fenestration Rating Council has developed a rating factor for windows, called the U-factor, that indicates the insulating value of windows. The lower the U-factor, the better the window is at preventing heat flow through the window.

Windows, doors, and skylights are part of the government-backed ENERGY STAR® program that certifies energy efficient products. To meet ENERGY STAR® requirements, windows, doors, and skylights must meet requirements tailored for the country's three broad climate regions. Windows in the northern states must have a U-factor of 0.30 or less; in the central climate, a U-factor of 0.35 or less; and in the southern climate, a U-factor of 0.60 or less. They must also meet other criteria that measure the amount of solar energy that can pass through them.

If you cannot replace older windows, there are several things you can do to make them more efficient. First, caulk any cracks around the windows and make sure they seal tightly. Add storm windows or sheets of clear plastic to create additional air barriers. You can also hang insulated drapes. During heating seasons, open them on sunny days and close them at night. During cooling seasons, close them during the day to keep out the sun.

WHERE WE LIVE

Our homes, whether a house or an apartment, provide shelter, safety, and comfort.

▪ Landscaping

Although it isn't possible to control the weather, certain landscape practices can modify its impact on home environments. By strategically placing trees, shrubs, and other landscape structures to block the wind and provide shade, residents can reduce the energy needed to keep their homes comfortable during heating and cooling seasons. If the landscaping is well done, residents receive the additional benefits of beauty and increased real estate values. A well-planned landscape is one of the best investments a homeowner can make.

Lighting

Lighting is essential to a modern society. Lights have revolutionized the way we live, work, and play. Lighting accounts for about 15 percent of the average home's electricity bill, or 8 percent of the total energy use in the home. For stores, schools, and businesses, the figure is a little higher. The commercial sector uses about 11 percent of its energy for lighting. About 17 percent of a schools electricity bill is for lighting.

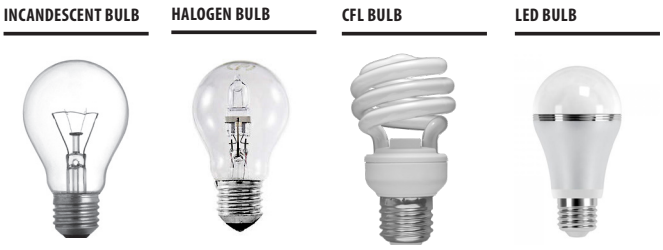
Some homes still use the traditional incandescent bulbs invented by Thomas Edison. These bulbs convert only 10 percent of the electricity they use to produce light; the other 90 percent is converted into heat. With new technologies, such as better filament designs and gas mixtures, these bulbs are more efficient than they used to be. However, to help combat this waste, legislation under the Energy Independence and Security Act changed the standards for the efficiency of light bulbs used most often. Since 2014, incandescent bulbs have been replaced by more efficient bulbs like, halogens, compact fluorescent light bulbs (CFL), and light emitting diodes (LEDs). Halogens are sometimes called energy-saving incandescent bulbs because they last slightly longer and use less energy than traditional incandescent bulbs. However, they can burn hotter than most bulbs, and still produce more heat than light.

Most commercial buildings have converted to linear fluorescent lighting, which costs more to install, but uses much less energy to produce the same amount of light. Buildings with fluorescent lighting already installed can lower lighting costs by updating to more efficient fluorescent systems.

CFLs are more common in homes now. They last up to ten times longer and use much less energy than halogen or incandescent bulbs, producing significant savings over the life of the bulb. New fluorescent bulb technology has made more dramatic advances in lighting efficiency. Some of the new fluorescent systems have increased the efficiency of these bulbs to as high as 70 lumens per watt.

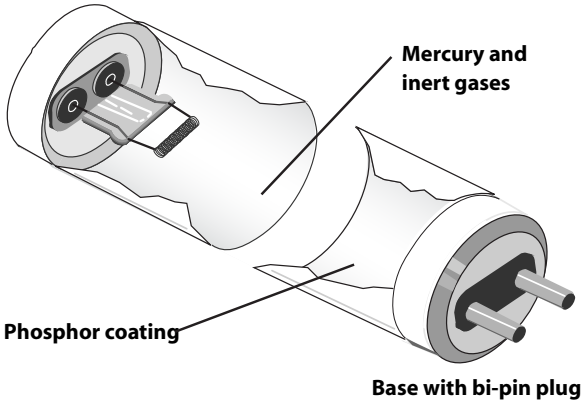
LEDs are readily becoming the most common efficient lighting choice. They use even less energy than a CFL and last 25 times longer than traditional incandescent bulbs. This means life cycle emissions for an LED will be far fewer than any other type of bulb. LEDs also have many tech-friendly applications.

Most light bulbs are used in some kind of fixture. The design of fixtures can have a major impact on the amount of light required in buildings. Good fixture designs that capture all of the light produced and direct it to where it is needed can reduce energy costs significantly.



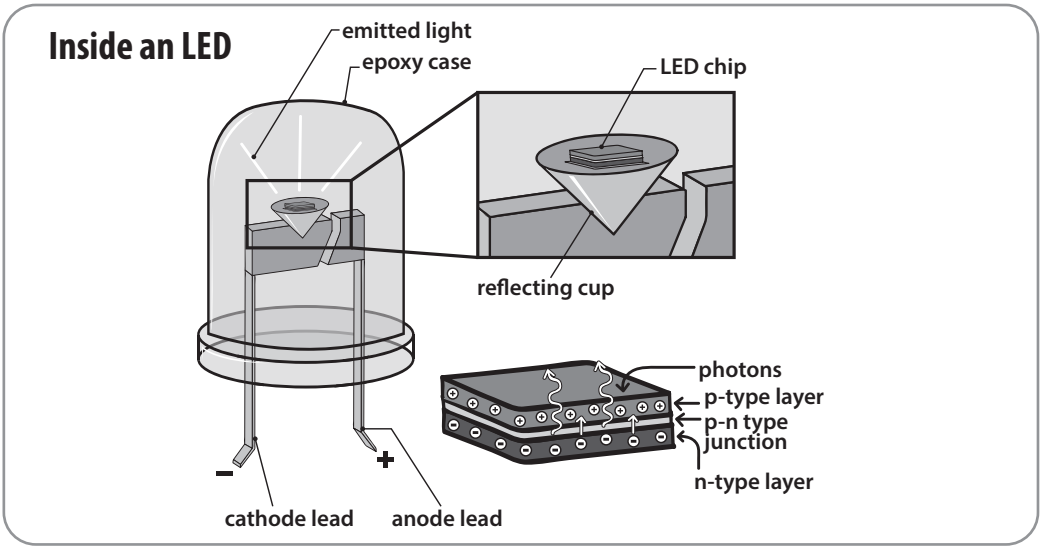
LEDs offer better light quality than incandescent bulbs and halogens, last 25 times as long, and use even less energy than CFLs. LEDs now have a wide array of uses because technology has improved and costs have decreased. CFL use is decreasing because LED costs are declining.

Fluorescent Tube Lamp



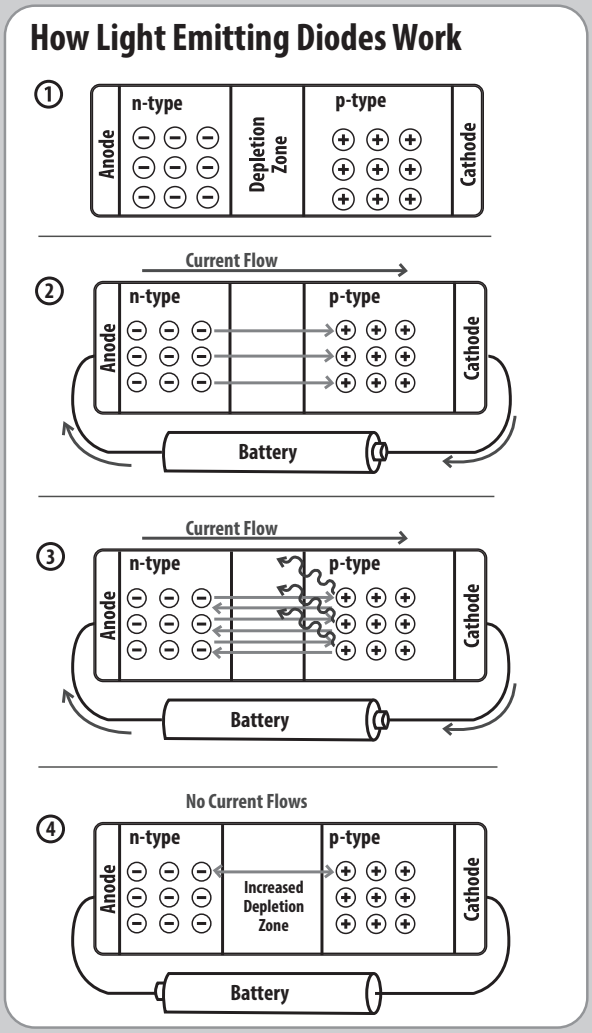
In fluorescent tubes, a very small amount of mercury mixes with inert gases to conduct the electric current. This allows the phosphor coating on the glass tube to emit light.

Outdoor lighting consumes a lot of energy, too. Most of our major highways and residential streets have streetlights, as well as many parking lots. In the 1970s, most streetlights were inefficient incandescent and mercury vapor lights. It was at this time that the Federal Government began replacing these lights with high-pressure sodium lights, which produce about three times as much light per watt. Automatic sensors also were installed to reduce energy use.



How Light Emitting Diodes Work

1. Diodes are made of semiconductors and conducting materials that need to be added to the semiconductor. In an LED the most common conductor added is aluminum-gallium-arsenide (AlGaAs). The AlGaAs is "doped" by adding small amounts of another material. One material will have more valence electrons than AlGaAs, and another doping material will have fewer electrons. The two doped materials are put together in a crystal. The material with more electrons is the "n-type" (n for negative) and the material with fewer electrons is the "p-type" (p for positive). When these materials are sandwiched together, the electrons move to balance themselves out. The area between the materials, called the p-n junction, is also called the "depletion zone."
2. Connecting a power source to the diode, such as a battery, provides electric current that carries electrical energy. The electrons in the n-type are repelled by the electric current, and move through the depletion zone to the p-type. They are energized, and will want to return to their original, unenergized state in the n-type.
3. When the electrons move back through the depletion zone to the n-type, they release energy as light. This is the light that we see from the LED. This process continues over and over again–electrons absorbing energy, moving, then moving back and releasing the energy, until the power supply is disconnected or depleted.
4. Connecting the power supply in the wrong orientation does not allow the LED to work. Instead, it merely increases the size of the depletion zone. Therefore, it is important that LED's be wired to their power supply in the correct orientation.



Appliances

In the last 100 years, appliances have revolutionized the way we spend our time at home. Tasks that used to take hours are now accomplished in minutes, using electricity most of the time instead of human energy. In 1990, Congress passed the National Appliance Energy Conservation Act, which requires appliances to meet strict energy efficiency standards. Today, appliances, machines, and electronic devices account for more than 30 percent of a typical household's energy consumption with laundry machines, cooking appliances, and refrigerators topping the list.

When you shop for new appliances, you should think of two price tags. The first one covers the purchase price—consider it a down payment. The second price tag is the cost of operating the appliance during its lifetime. You'll be paying that second price tag on your utility bill every month for the next 10 to 20 years, depending on the appliance. An energy efficient appliance will usually cost more, but it will save significant amounts of money in energy costs. Over the life of an appliance, an energy efficient model is always a better deal.

When you shop for a new appliance, look for the ENERGY STAR® label—your assurance that the product saves energy. ENERGY STAR® appliances have been identified by the U.S. Environmental Protection Agency and Department of Energy as the most energy efficient products in their classes. ENERGY STAR® appliances incorporate advanced technologies that use less energy and water than standard models. A list of these appliances and products can be found on the ENERGY STAR® website at www.energystar.gov.

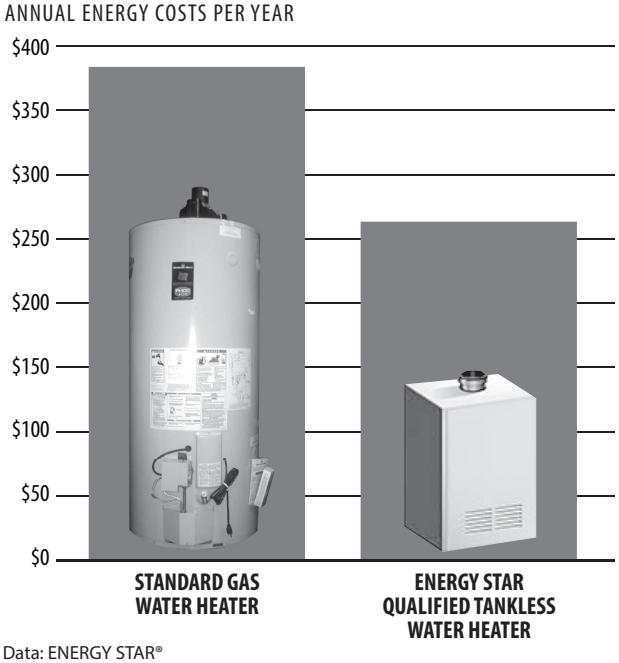
Another way to determine which appliance is more energy efficient is to compare energy usage using EnergyGuide labels. The Federal Government requires most appliances to display bright yellow and black EnergyGuide labels. Although these labels do not tell you which appliance is the most efficient, they will tell you the annual energy consumption and average operating cost of each appliance so you can compare them.

▪ Water Heating

Water heating is the second largest energy expense in most homes, accounting for 16 percent of energy use on average. Usually water is heated in a tank-type water heater that is fueled by natural gas or electricity. Heated water is used for showers, hand washing, dishwashing, and cleaning. The five main ways to reduce water heating bills are:

- Use less hot water.
- Make sure there are no water leaks or drips.
- Turn down the thermostat on the water heater.
- Insulate water heaters and water pipes.
- Choose an energy efficient water heater when yours needs replacing.

Water Heater Comparison



Data: ENERGY STAR®

The easiest way to cut the cost of heating water is to reduce the amount of hot water consumed. This can be done with little cost and minor changes in lifestyle. Water-saving faucet aerators (which diffuse the flow of water) can be installed in bathrooms and kitchens. Water-saving showerheads are also available. They limit the flow of water while providing adequate flow for washing.

Most water heater thermostats are set much higher than necessary. A setting of 120 degrees Fahrenheit provides hot water suitable for most uses. Decreasing the temperature by 10 degrees Fahrenheit can result in energy savings of $12 to $30 per year. Depending on the situation, installing a tankless water heater could also save energy. Instead of heating a large amount of water and keeping it hot in a tank, these appliances only heat the water as it is being used.

▪ Refrigerators

Refrigerators have changed the way we live and brought health benefits to our lives. With these appliances, we can safely store foods for long periods of time. Since refrigerators involve heat exchange, they also consume a significant amount of electricity each year.

New refrigerators are many times more efficient than early models. Manufacturers have improved the insulation and the seals, or gaskets, to hold in the cold air better. The industry has also made technological advances in defrost systems, as well as in more energy efficient motors and compressors.

The appliance industry has worked with the chemical industry to develop refrigerants that are not harmful to the ozone layer, as the early CFCs were. As with all appliances, the most efficient models are more expensive to purchase but produce energy savings over the life of the refrigerator.

With older models, a large amount of electricity can be saved by setting the refrigerator temperature at 37 degrees, the freezer temperature at five degrees, and making sure that the energy saver switch is operational and in use.

Refrigerators should also be airtight. Make sure the gaskets around the doors are clean and seal tightly. Close the door on a piece of paper—if you can easily pull out the paper when the door is closed, you need to replace the gaskets.

▪ Washers and Dryers

Before washers and dryers, doing the laundry meant hard physical work all day, no matter what the weather. Today, the most difficult thing about laundry is deciding which cycle to use. Today's machines have many innovations that save energy. Dryers with automatic sensors can tell when clothes are dry.

High-efficiency washing machines are available in both front-load and the traditional top-load design. These machines use 40 percent less water and 25 percent less energy than a regular washer. They also have a greater tub capacity, which means you can wash fewer loads to clean the same amount of laundry.

▪ Appliance Efficiency Ratings

We use many other appliances every day. Some use less than 10 cents worth of electricity a year, while others use much more. Have you noticed that those appliances that produce or remove heat require the most energy?

When purchasing any appliance, consumers should define their needs and pay attention to the Energy Efficiency Rating (EER) included on the yellow label of every appliance. The EER allows consumers to compare not just purchase price, but operating cost as well, to determine which appliance is the best investment.

Usually, more energy efficient appliances cost more to buy, but result in significant energy savings over the life of the appliance. Buying the cheapest appliance is rarely a bargain in the long run.

In the next few years, consumers will have the choice of many smart appliances that incorporate computer chip technology to operate more efficiently, accurately, and effectively.

Industrial Sector

Manufacturing the goods we use every day consumes an enormous amount of energy. The industrial sector of the U.S. economy consumes almost one-third of the nation's total energy demand when electricity is included. In the industrial sector, energy efficiency and conservation measures are not driven so much by consumers as by the market. Manufacturers know that they must keep their costs as low as possible to compete in the global economy.

Since energy is one of the biggest costs in many industries, manufacturers must use energy efficient technologies and conservation measures to be successful. Their demand for energy efficient equipment has driven much of the research and development of new technologies in the last decades as energy prices have fluctuated.

Individual consumers can, however, have an effect on industrial energy consumption through the product choices we make and what we do with the packaging and the products we no longer use.

A Consumer Society

Not only is America a consumer society, it is also a 'throw away' society. Americans produce more trash than any developed country. The average citizen generates about 1,600 pounds of trash each year.

The most effective way for consumers to help reduce the amount of energy consumed by the industrial sector is to decrease the amount of unnecessary products produced and to reuse items in their original form wherever possible. Purchasing only those items that are necessary, as well as reusing, repairing, and recycling products wherever possible, can significantly reduce energy use in the industrial sector. The 4 Rs of an energy-wise consumer are easy to put into practice.

▪ Reduce

Reducing waste saves money, energy, and natural resources, and it helps protect the environment. Buy only what you need. Purchasing fewer goods means less to throw away. It also results in fewer goods being produced and less energy being used in the manufacturing process. Buying goods with minimal packaging also reduces the amount of waste generated and the amount of energy used.

▪ Reuse

Buy products that can be used repeatedly. If you buy things that can be reused rather than disposable items that are used once and thrown away, you will save natural resources. You'll also save the energy used to make them, and reduce the amount of landfill space needed to contain the waste. Savings also result when you buy things that are durable. They may cost more initially, but they last a long time and don't need to be replaced often, saving money and energy.

▪ Repair

Many people throw away products when they break and buy new ones. Many of these products could be easily and cheaply repaired. Always consider repairing a product before throwing it away. It saves energy, money, and natural resources.

▪ Recycle

Make it a priority to recycle all materials that you can. Using recycled material as the feedstock for manufacturing almost always consumes less energy than using virgin (new) materials. Reprocessing used materials reduces the energy needed for mining, refining, and many other manufacturing processes.

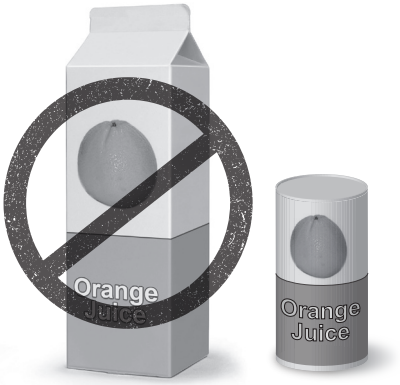
Recycling steel saves 75 percent of the energy needed to make new products from raw iron ore. Recycling aluminum cans saves 92 percent of the energy required to produce aluminum from bauxite. Many other products can also be recycled and contribute to savings in energy and resources.

Energy Sustainability

Efficiency and conservation are key components of energy sustainability—the concept that every generation should meet its energy needs without compromising the needs of future generations.

Sustainability focuses on long-term energy strategies and policies that ensure adequate energy to meet today's needs as well as tomorrow's. Sustainability also includes investing in research and development of advanced technologies for producing conventional energy sources, promoting the use of new and renewable energy sources, and encouraging sound environmental policies and practices.

Reduce



Buy a small can of juice concentrate instead of a large carton.

Reuse or Repair

A lunchbox can be used repeatedly, and repaired when broken.

Recycle

Recycle all products you can.

Solar

Native Americans in the southwestern United States used the sun's energy to dry corn and bake pottery.

Native Americans used the sun's energy for light and heat. Energy from the sun is called solar energy.

Solar panels on a house transform the sun's energy to electricity.

Today, we use solar energy to generate electricity, and to heat water and homes.

Biomass

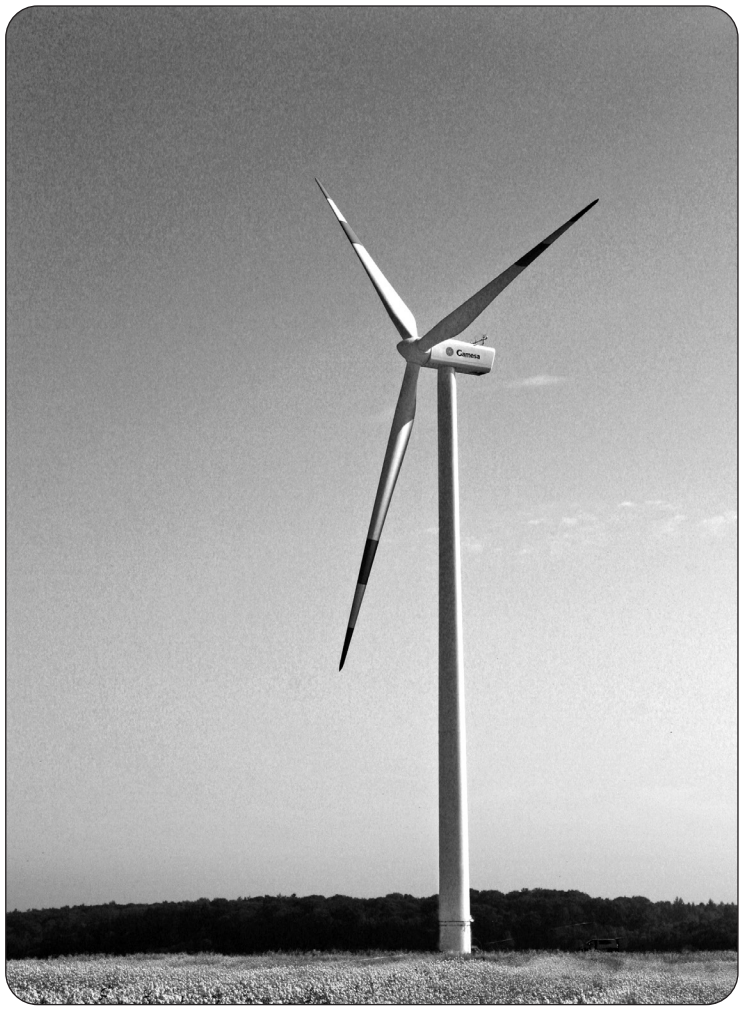
Native Americans burned wood and dung to cook food and stay warm. They ate biomass for energy to live and grow. Wood, plants, and waste are biomass energy.

We use biomass, such as corn, to make ethanol, which can be used to fuel some vehicles.

Today we still use biomass energy for heat and food. We also use it to make fuel for vehicles and to generate electricity.

Wind

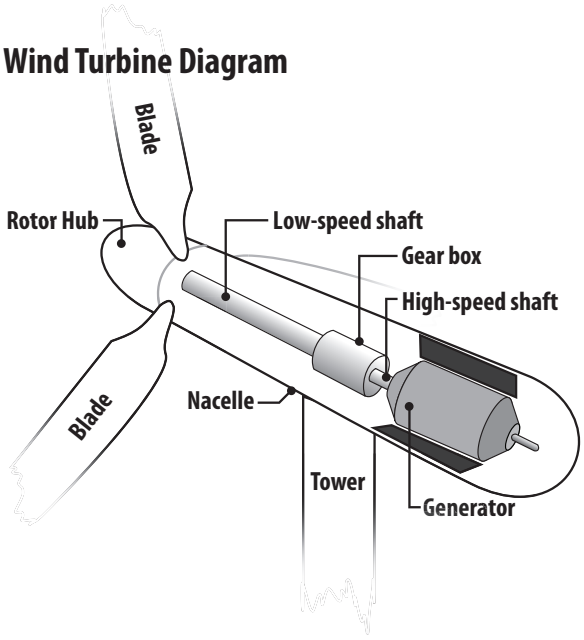
Settlers arrived in America on sailing ships. They used wind energy to move the ships.



Wind turbine

Parts of a Wind Turbine

We use machines called wind turbines to turn wind energy into electricity.



Today, we use wind power to generate electricity using wind turbines.

Hydropower

Water wheel

The settlers used water wheels to grind grain and run sawmills. The energy in moving water is hydropower.

Glen Canyon Dam, Arizona

Today, we use hydropower to generate electricity.

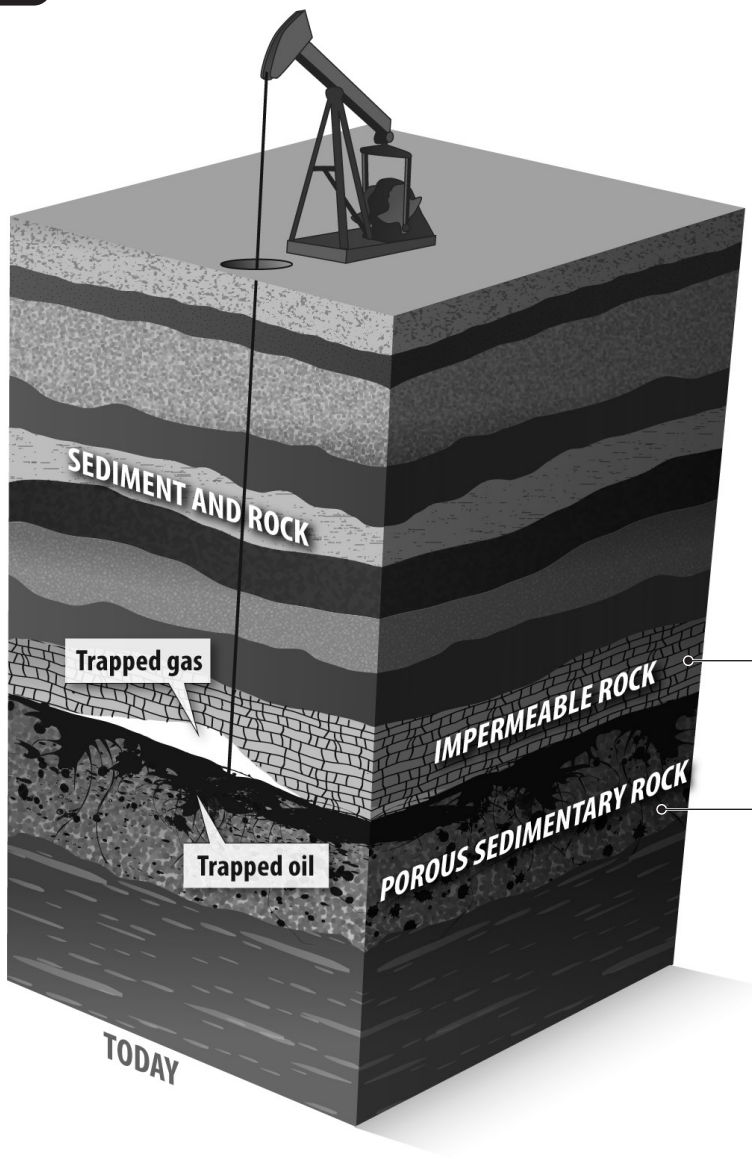
Coal

As the years passed, people found coal under the ground. They discovered they could burn it to make heat.

A coal power plant

Today, some power plants burn coal to generate electricity.

Petroleum



Impermeable Rock: A layer of underground rock that liquids cannot pass through.

Porous Rock: A layer underground that can hold liquids and that liquids can pass through.

People found petroleum, or oil, deep under the ground. They discovered they could use it as a fuel and to heat homes.

Image courtesy of BP

Today, we use petroleum to make fuel for our vehicles and also to make plastics and other everyday goods.

Natural Gas

People found natural gas under the ground. They discovered natural gas could be burned to make heat.

Image courtesy of U.S. Environmental Protection Agency

Today, we use natural gas to generate electricity, cook food, to heat our homes, and even as fuel in some vehicles.

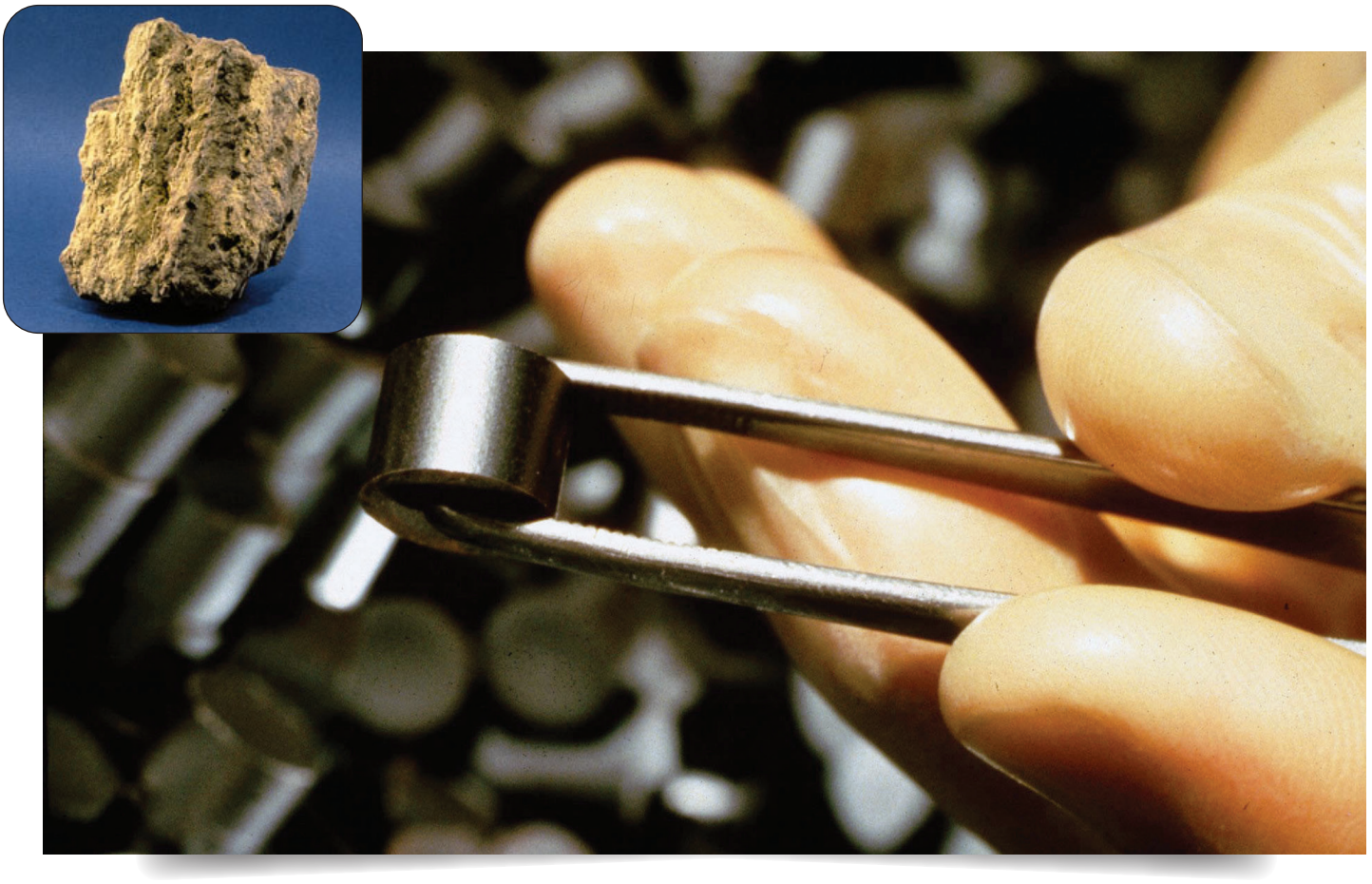
Propane

Scientists discovered propane a little over 100 years ago. Propane is a gas that can be burned to make heat.

Today, we use propane to cook and to heat our homes.

Uranium

Uranium ore



Uranium is made into fuel pellets, which are used in a nuclear reactor.

Geologists and scientists also discovered uranium buried in the ground.Uranium is a mineral that has energy in it.

Diablo Canyon Nuclear Power Plant in California.

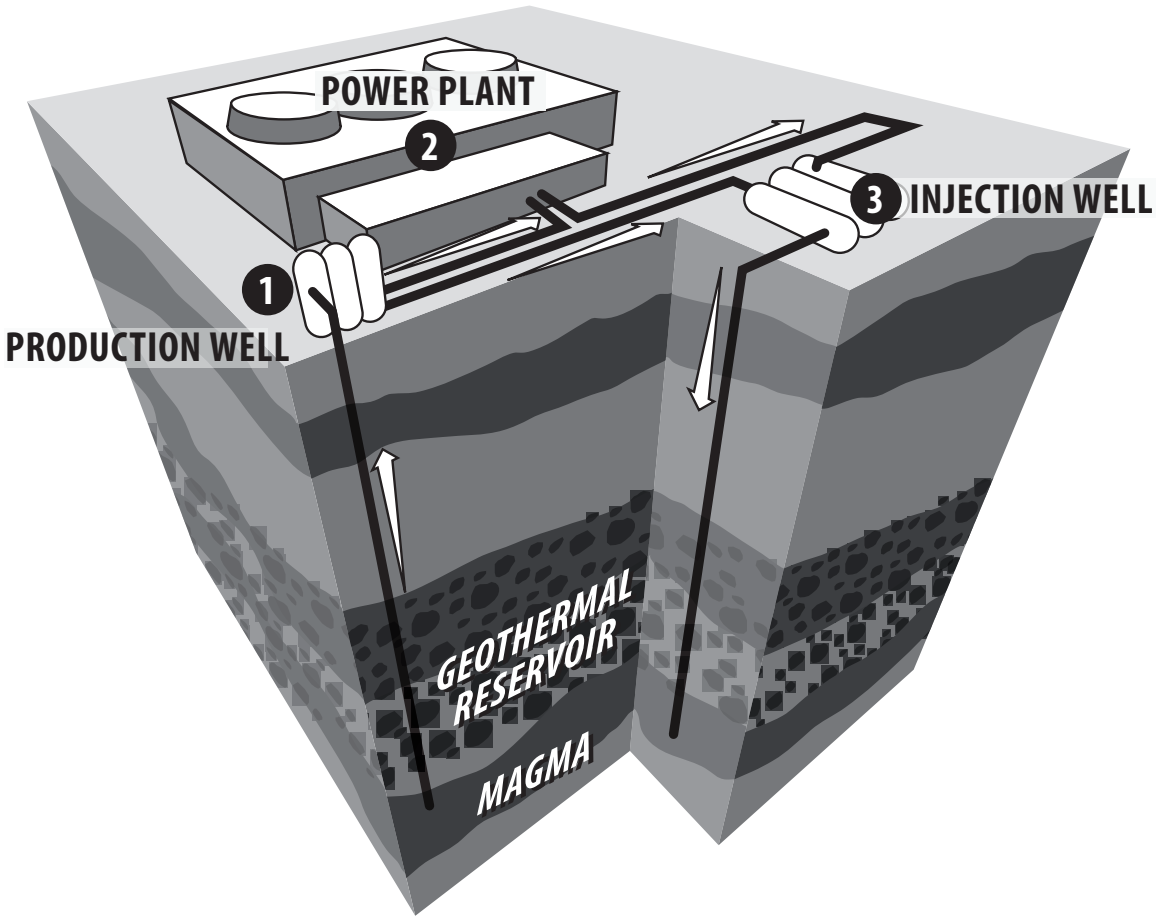
Today, we use uranium in nuclear power plants to make electricity.

Geothermal Energy

A geyser releases hot water and steam into the air.

People use steam from the Earth for bathing. Geothermal energy is heat inside the Earth. Often this heat causes water nearby to turn to steam.

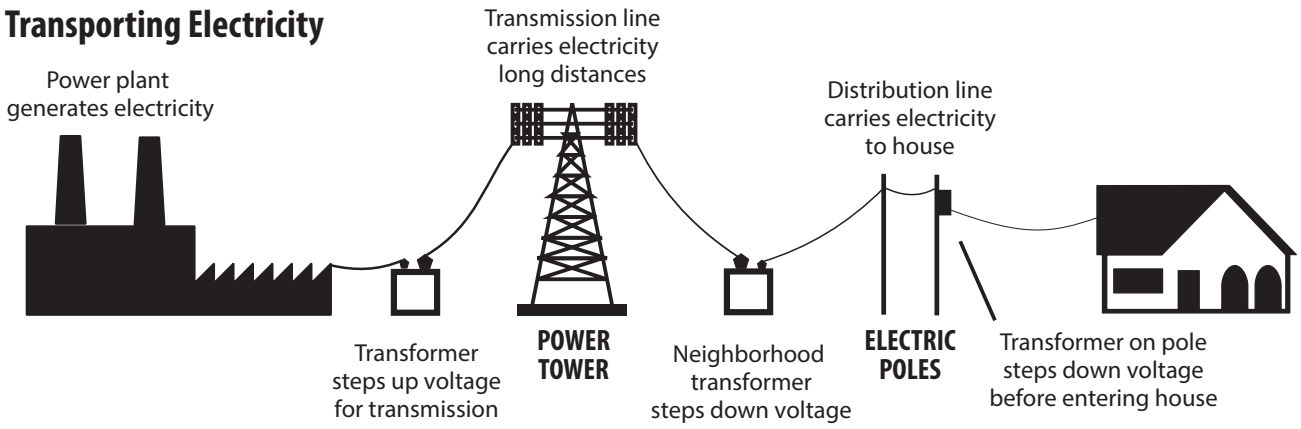
Geothermal Power Plant

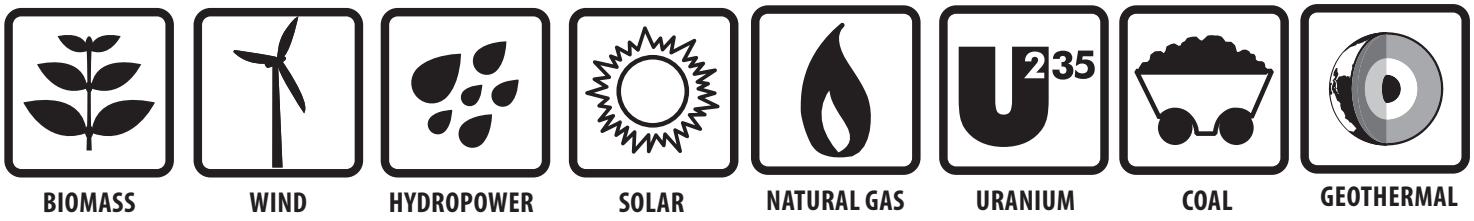


1. **Production Well:** Geothermal fluids, such as hot water and steam, are brought to the surface and piped into the power plant.
2. **Power Plant:** Inside the power plant, the geothermal fluid turns the turbine blades, which spin a shaft, which spins magnets inside a large coil of wire to generate electricity.
3. **Injection Well:** Used geothermal fluids are returned to the reservoir.

Today, we use geothermal energy in power plants to make electricity and to heat our homes and water.

Electricity





We use many energy sources to make electricity. Electricity makes it easy to use energy to do many jobs.

Electricity powers many of the machines we use every day.

Renewable

Re - NEW - a - ble

Able to be NEW again

Some energy sources are renewable. They can be replenished and used over and over again.

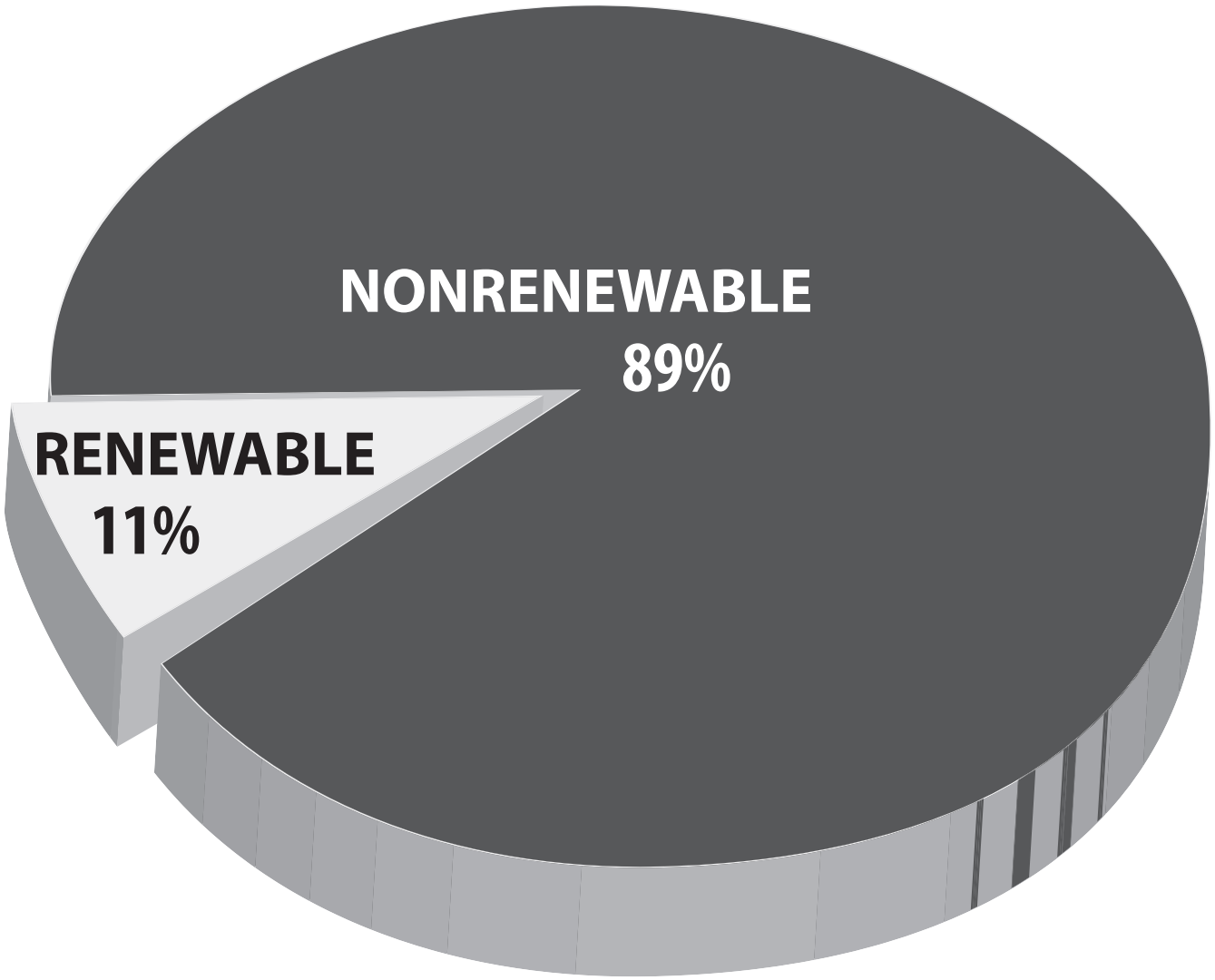
Nonrenewable

NON - re - NEW - a - ble

NOT able to be NEW again

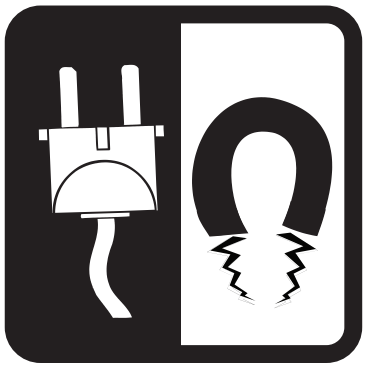
Some energy sources are nonrenewable. They take millions of years to form.

Energy Use



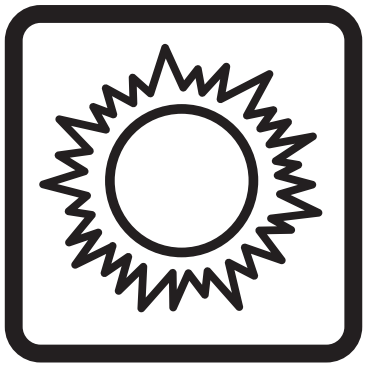
Most of the energy we use is nonrenewable. We cannot make more. We need to save energy whenever we can.

Heating



ELECTRICITY

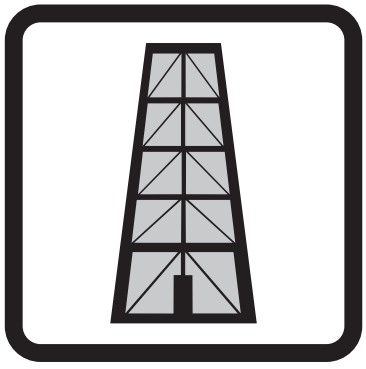
NATURAL GAS



SOLAR

BIOMASS

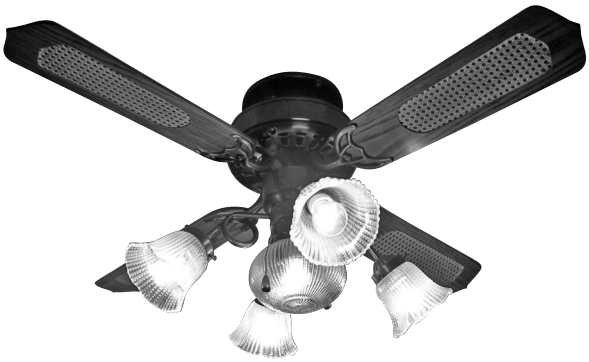
PROPANE



PETROLEUM

Many homes and schools use electricity and natural gas for heating, but other sources can also be used by themselves.

Cooling



Ceiling Fan

Fan

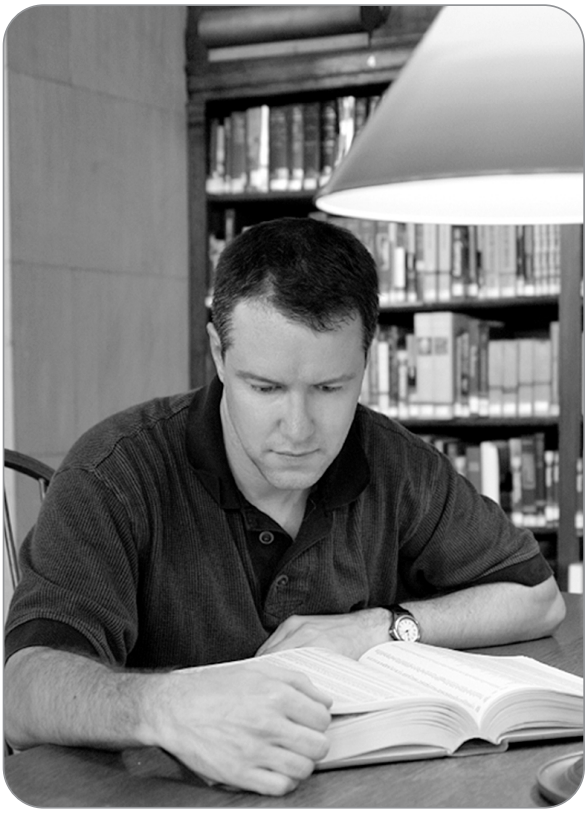
Air Conditioner

Many homes and schools use energy to cool buildings. We use electricity to cool most buildings.

Lighting

Compact Fluorescent Light Bulb

Light Emitting Diode Bulb



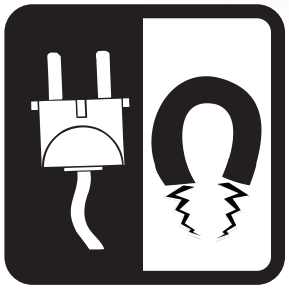
Reading Lamp

Fluorescent Tube Lights

Overhead Light

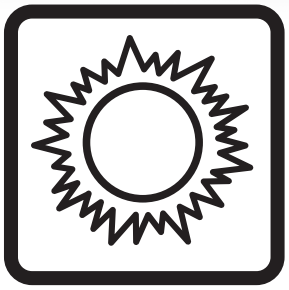
Homes and schools use energy for lighting. We use electricity to light most buildings.

Heating Water



ELECTRICITY

NATURAL GAS

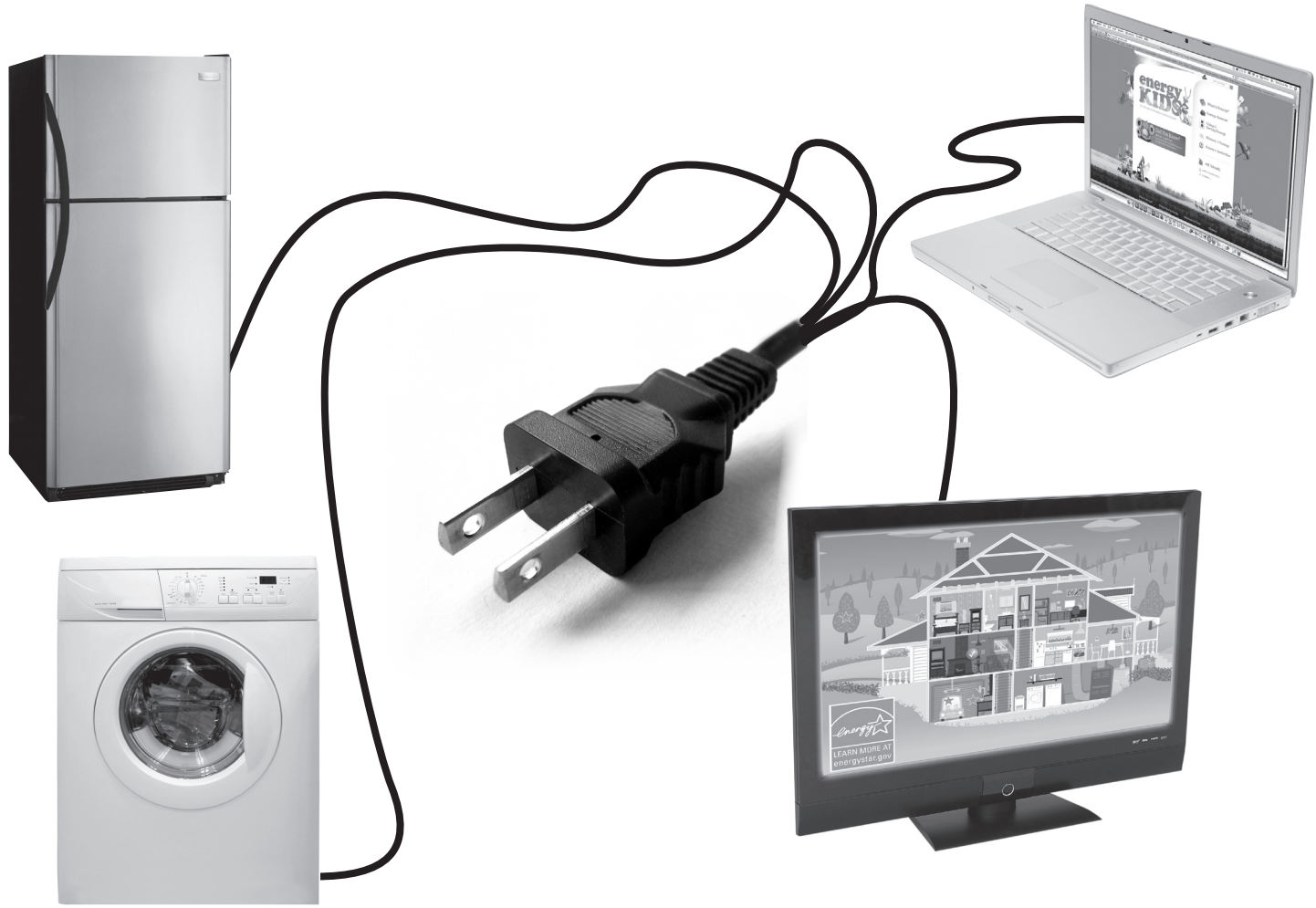


SOLAR

PROPANE

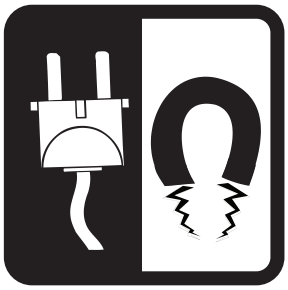
Most homes and schools use energy to heat water. We use electricity and other energy sources to heat water.

Machines and Appliances



Homes and schools use energy to run machines and appliances. Machines and appliances use electricity for energy.

Cooking



ELECTRICITY

NATURAL GAS

PROPANE

Most homes and schools use energy to cook food. We use electricity and other energy sources to cook food.

Save Energy
Heating and Cooling

Keep windows and doors closed when heating or cooling a home.

Save Energy
Heating and Cooling

Open blinds on cold, sunny days and close them at night.

Save Energy
Heating and Cooling

Close blinds on hot, sunny days.

Save Energy
Heating and Cooling

Dress warmly in cold weather so that you lose less heat.

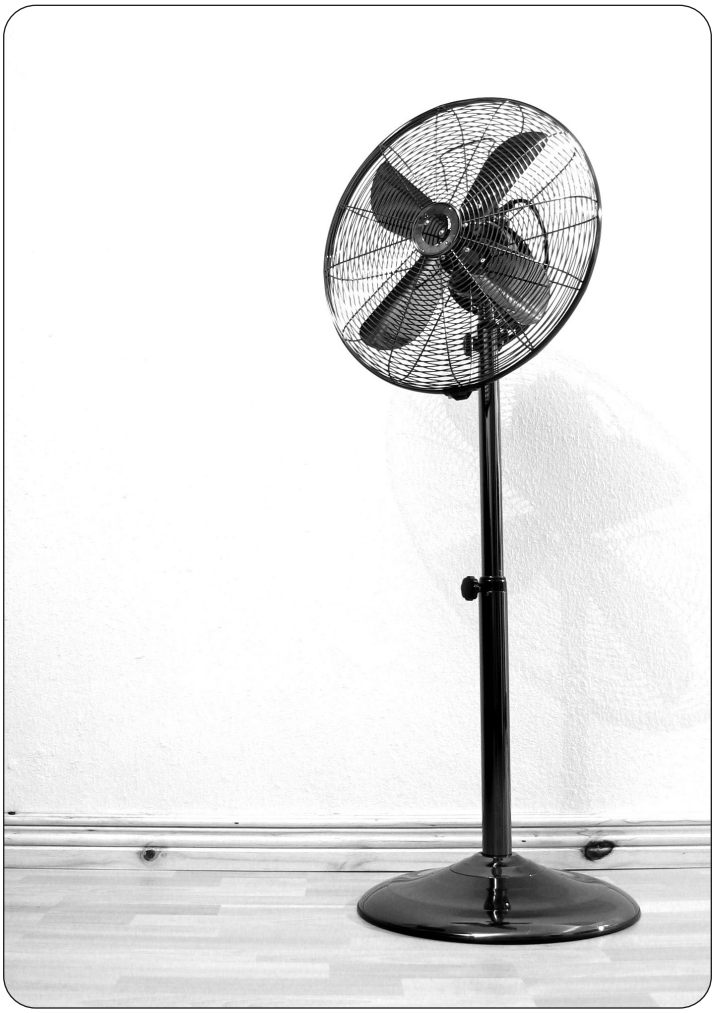
Save Energy
Heating and Cooling

Dress in light clothes in hot weather to stay cooler.

Save Energy
Heating and Cooling

Use warm blankets and turn down the heat when it is cold.

Save Energy
Heating and Cooling



In warm weather, open windows and use fans instead of air conditioning.

Save Energy
Lighting

Turn off the lights when you leave a room.

Save Energy
Lighting

Use the sun's light whenever you can. It is free!

Save Energy
Lighting

Turn on outdoor lights only when you need them.

Save Energy
Lighting

Use only the light you need. To read, use a reading lamp, not an overhead light.

Save Energy
Lighting

Compact Fluorescent Light Bulb

LED Bulb

Use energy-saving compact fluorescent light bulbs (CFLs) and light emitting diodes (LEDs). They save energy and money.

Save Energy
Appliances and Machines

Turn off televisions, radios, computers, video games, and other machines when you are not using them.

Save Energy
Appliances and Machines

Decide what you want before opening the refrigerator or freezer door. Do not leave the door open for a long time.

Save Energy

Appliances and Machines

Use the microwave instead of the oven to cook food whenever you can. Microwaves use less energy because they cook food more quickly.

Save Energy
Hot Water

Take short showers instead of baths. Heating water takes energy!

Save Energy
Hot Water

Wash your hands with warm water, not hot.

Save Energy

Hot Water

Never leave warm water running or dripping.

Save Energy
Hot Water

Do not wash dishes under hot running water. Fill the sink with warm water to wash. Use cool water to rinse.

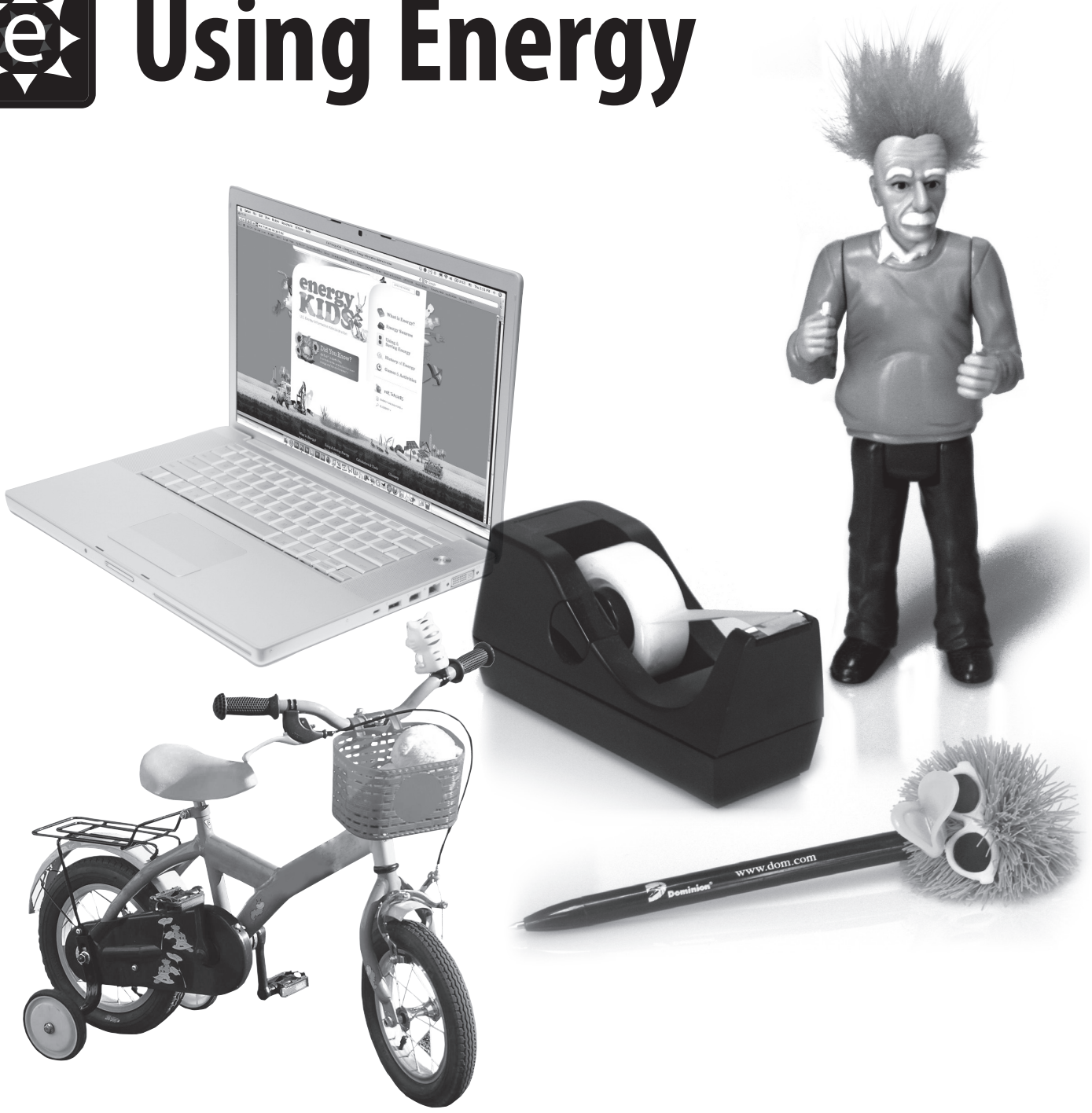
Save Energy
Hot Water

Rinse dishes in a sink of cool water before putting them in the dishwasher.

Save Energy
Hot Water

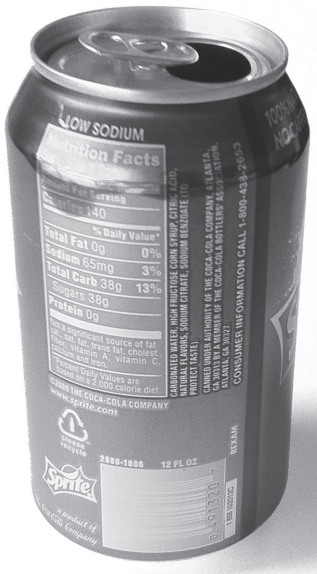
Wash clothes in warm or cold water and rinse in cold water.

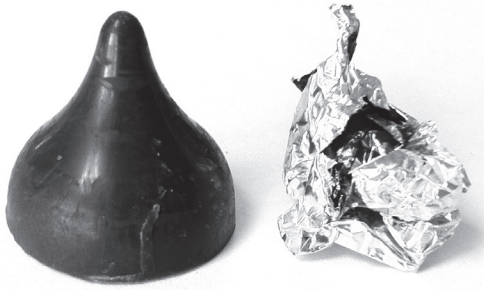
Using Energy



It takes energy to make the things we use every day.

Using Energy





It takes energy to take care of the trash we throw away.

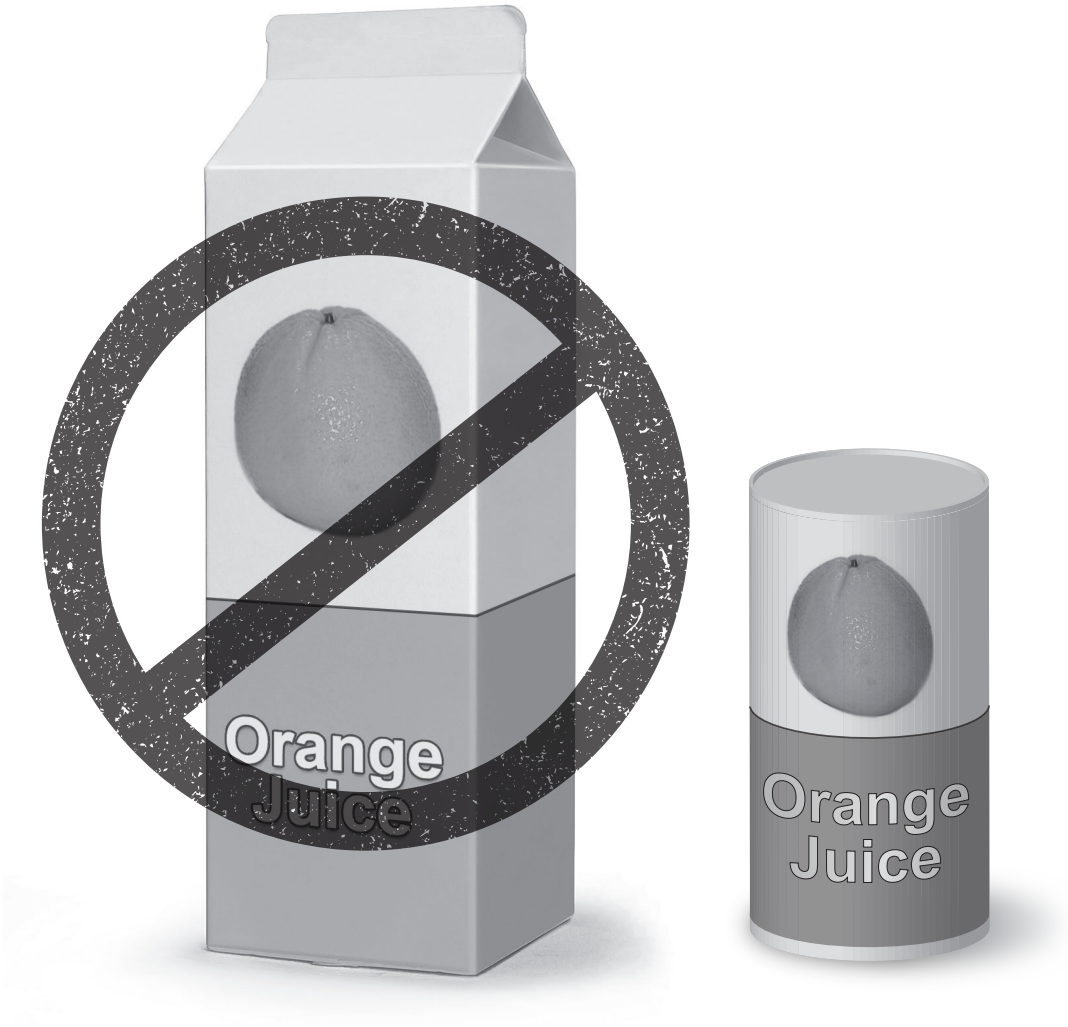
Trash and Energy

We throw away a lot of trash. We waste energy when we do that.

Kinds of Trash

Trash can be paper, glass, plastic, wood, metal, or food and yard waste.

Save Energy
Reduce Trash



Save energy by reducing the amount of trash you throw away.

Save Energy
Reuse

Save energy by using things again instead of throwing them away.

Save Energy
Repair

Save energy by having things repaired instead of throwing them away.

Save Energy

Recycle

Save energy by recycling things instead of throwing them away.

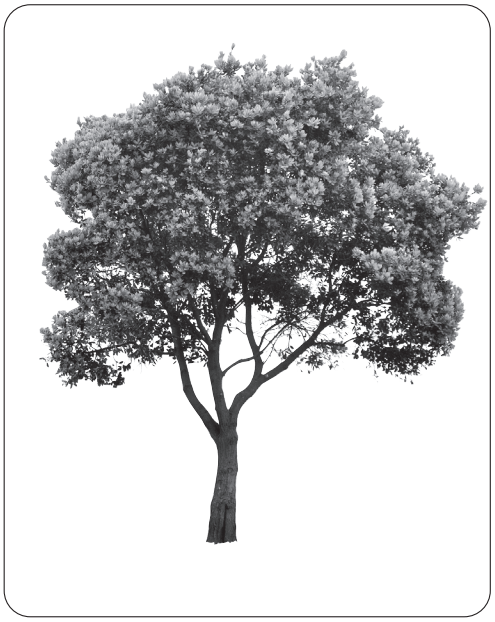
Save Energy
Compost

Save energy by composting food and yard waste.

Saving Energy Saves Money

When you save energy you save money.

Saving Energy Saves Resources



Biomass

Oil

Coal

When you save energy you save our natural resources.

Saving Energy Helps the Earth

When you save energy you protect our environment.

Energy Source Matching

Draw a line from the energy source to its symbol.

Natural Gas

Petroleum

Coal

Uranium

Goethermal

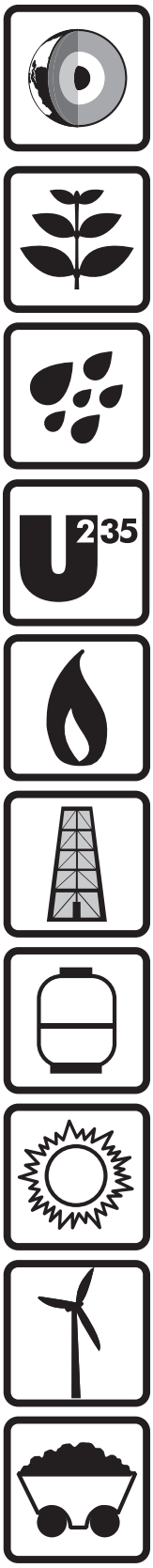
Hydropower

Solar

Biomass

Propane

Wind



Renewable and Nonrenewable

Draw circles around the **renewable** sources of energy.

Draw boxes around the **nonrenewable** sources of energy.

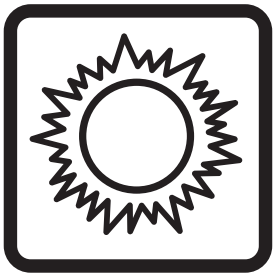
PETROLEUM

URANIUM

BIOMASS

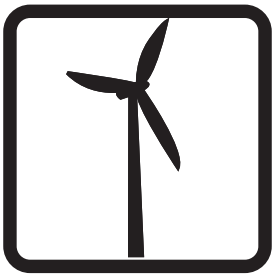
HYDROPOWER

COAL



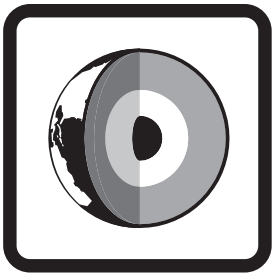
SOLAR

PROPANE



WIND

NATURAL GAS

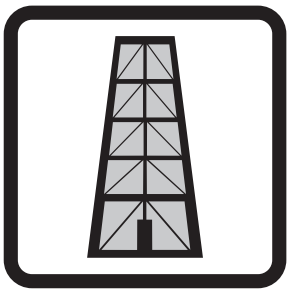


GEOTHERMAL

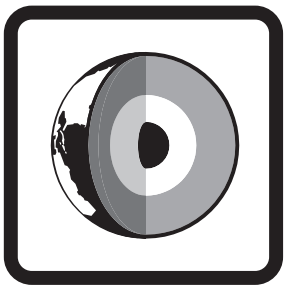
Heating

Draw circles around the energy sources used to heat your **home**.

Draw boxes around the energy sources used to heat your **school**.



PETROLEUM

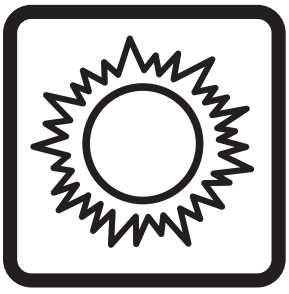


GEOTHERMAL

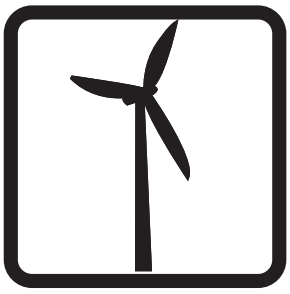
BIOMASS

COAL

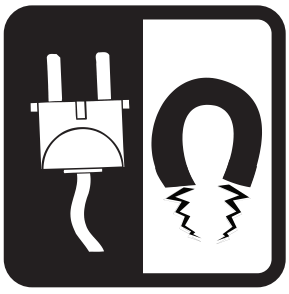
PROPANE



SOLAR



WIND



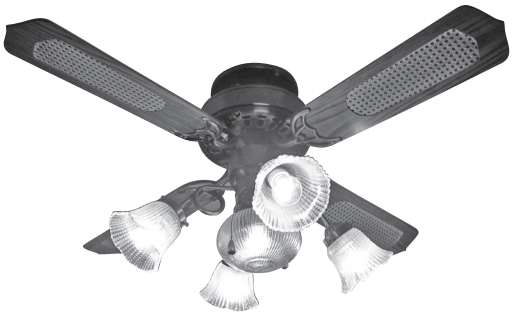
ELECTRICITY

NATURAL GAS

Cooling

Draw circles around the ways your **home** is cooled.

Draw boxes around the ways your **school** is cooled.



Ceiling Fans

Room Fans

Open Windows and Doors

Central Air Conditioner

Window Air Conditioners

Lighting

Draw circles around the lights in your **home**.

Draw boxes around the lights in your **school**.

Exit Sign

Light Emitting DIode Bulb

LED Fixture

Incandescent Light Bulb

Candle

Flashlight

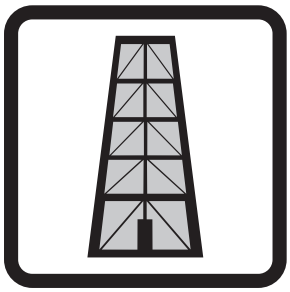
Compact Fluorescent Light Bulb

Fluorescent Tube Lights

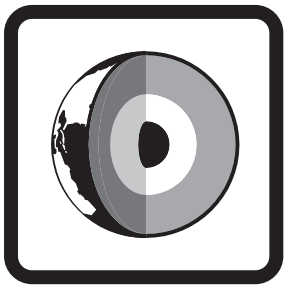
Heating Water

Draw a circle around the energy source that heats water at your **home**.

Draw a box around the energy source that heats water at your **school**.



PETROLEUM

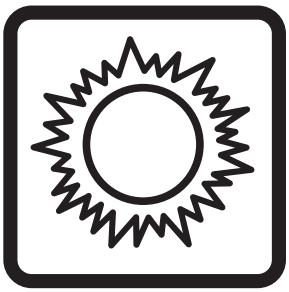


GEOTHERMAL

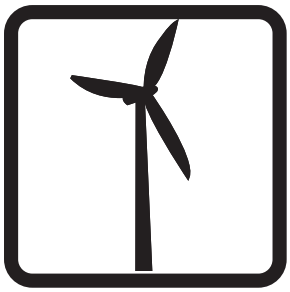
BIOMASS

COAL

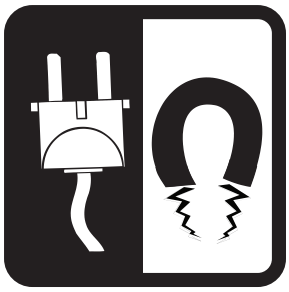
PROPANE



SOLAR



WIND



ELECTRICITY

NATURAL GAS

Machines

Draw a picture of your classroom. Cut out pictures of all the things in your classroom that use energy and paste them on your picture.

Computer

Video Games

Projector

Fan

Printer

Television

Clock

Smart Board

Pencil Sharpener

Appliances

Draw circles around the appliances that use energy in your home.

Microwave

Clothes Washer

Refrigerator

Dishwasher

Toaster

Oven

Hair Dryer

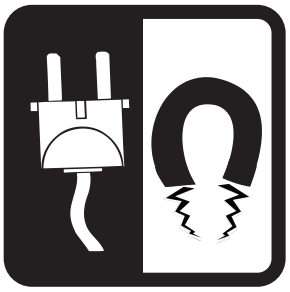
Coffee Maker

Blender

Cooking

Draw a line from each cooking appliance to the energy source it can use.

PROPANE



ELECTRICITY

NATURAL GAS

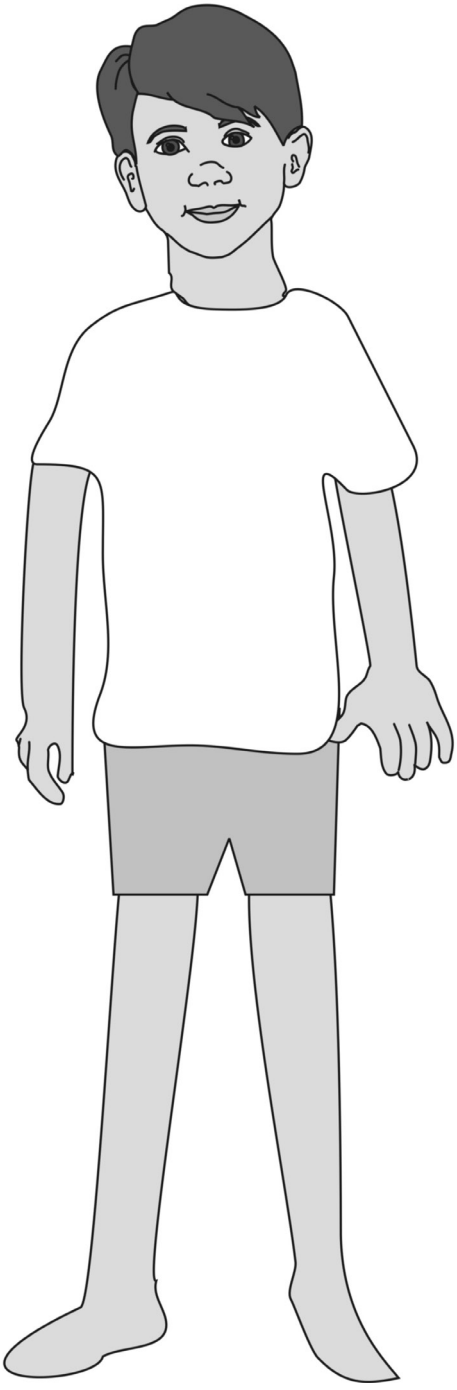
Save Energy When Heating

Circle the house that is wasting energy when the heat is on.
Make an X on every part of the house that is wasting energy.

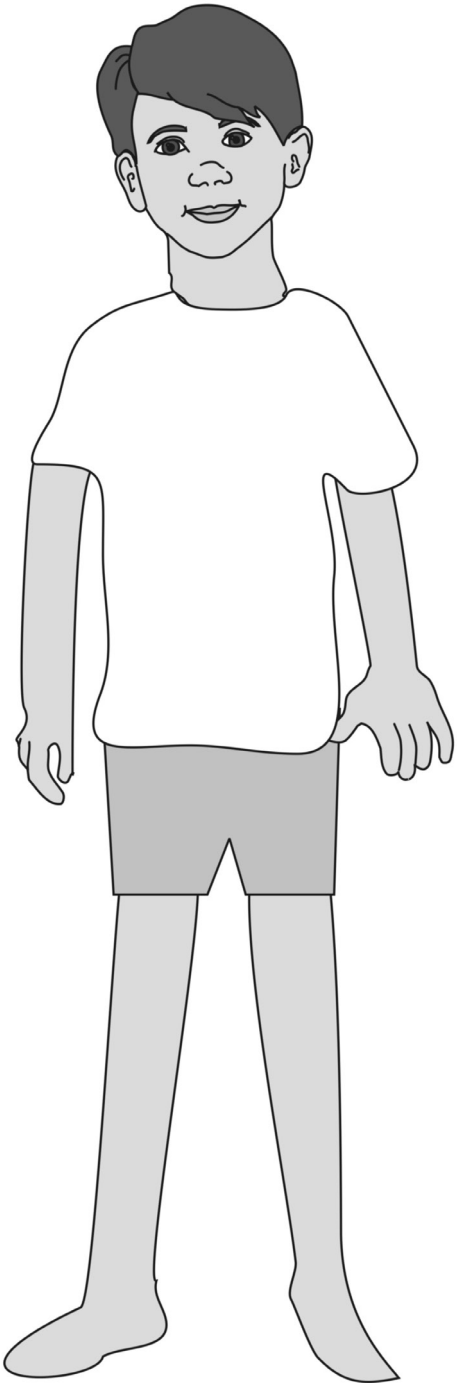
Save Energy When Heating and Cooling

How should you dress …

… when the heat is on?

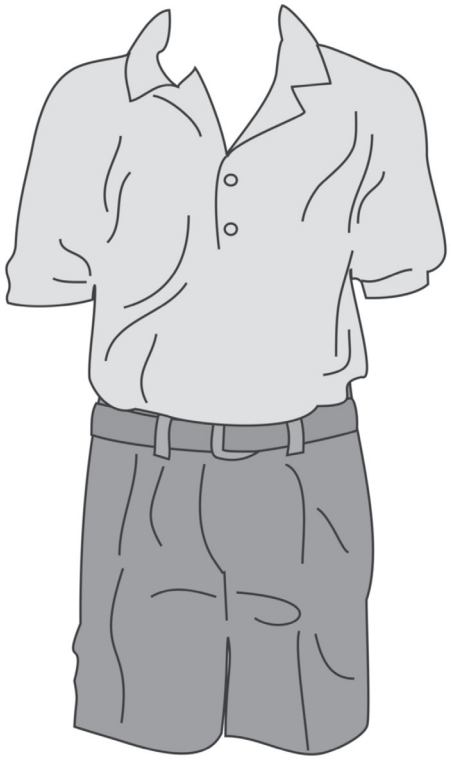


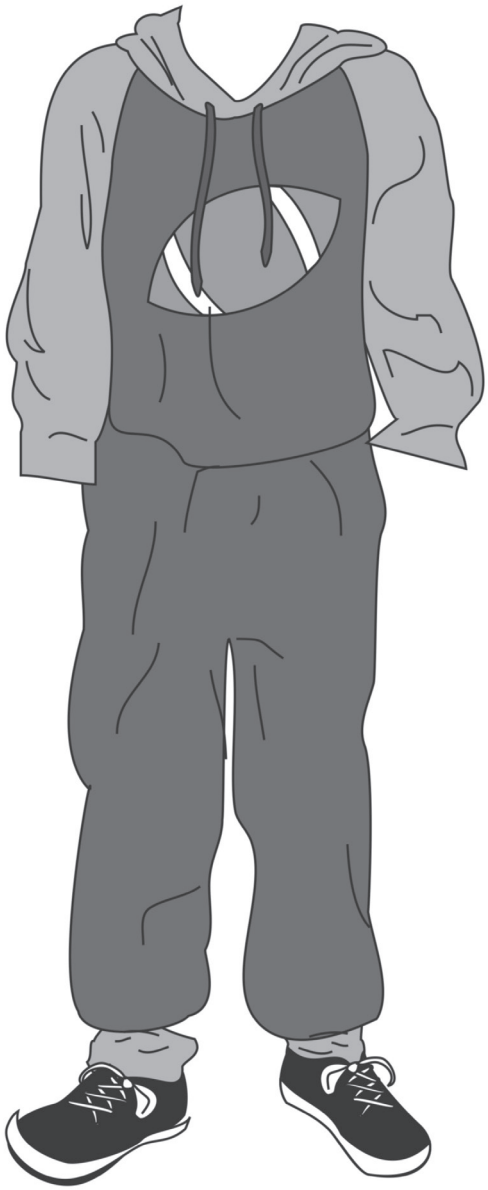
… when the air conditioning is on?



Save Energy When Heating and Cooling

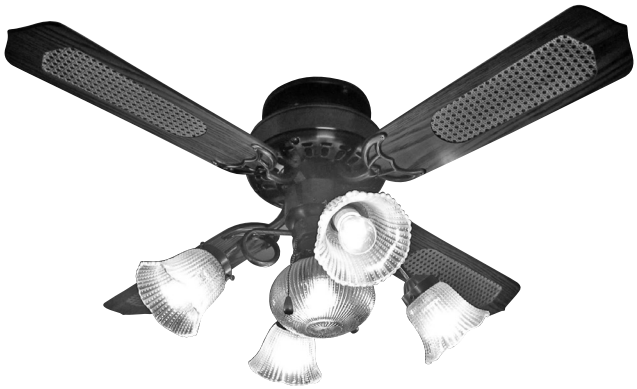
Cut out the clothes and paste on the correct child.





Save Energy When It's Warm

Make an X on the object that uses the most energy.



Ceiling Fans

Room Fans

Open Windows And Doors

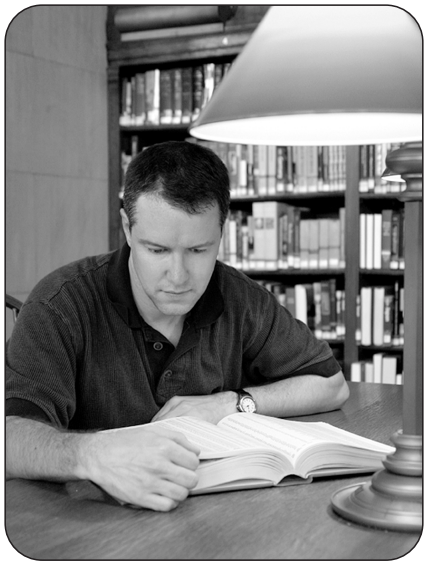
Window Air Conditioners

Save Energy for Light

Circle the pictures that show how energy for lighting can be saved.

Reading Outside

Using Overhead Lighting



Using a Reading Light

Using Incandescent Bulbs

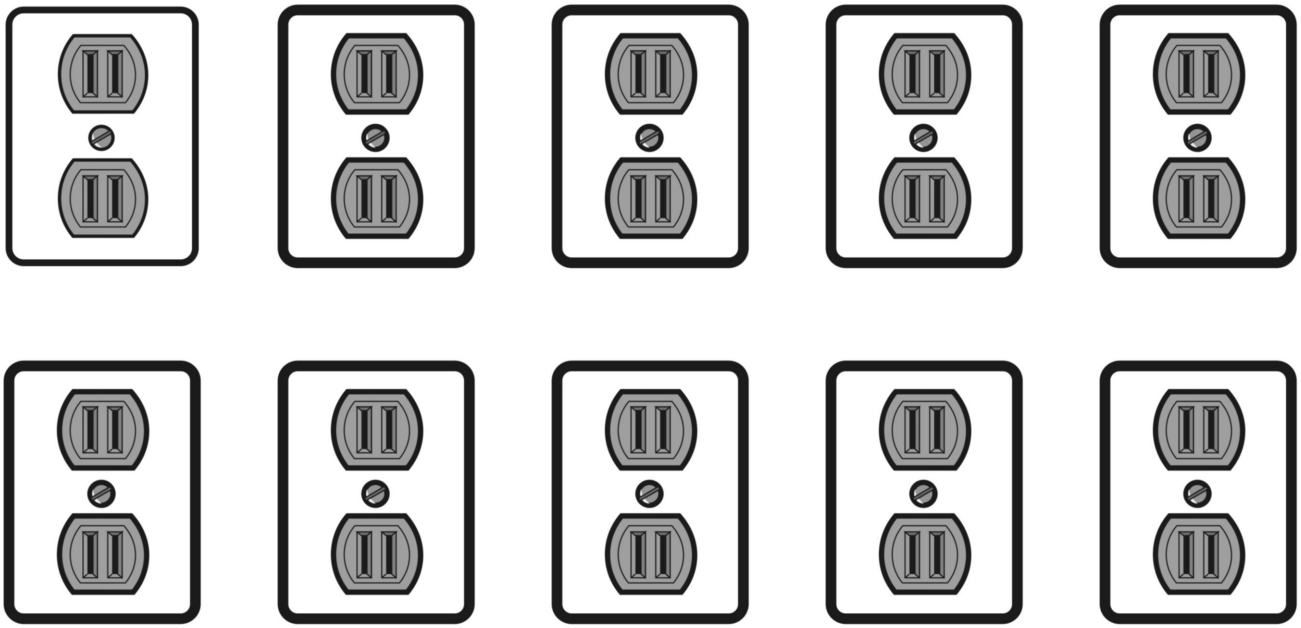
Using LED Bulbs

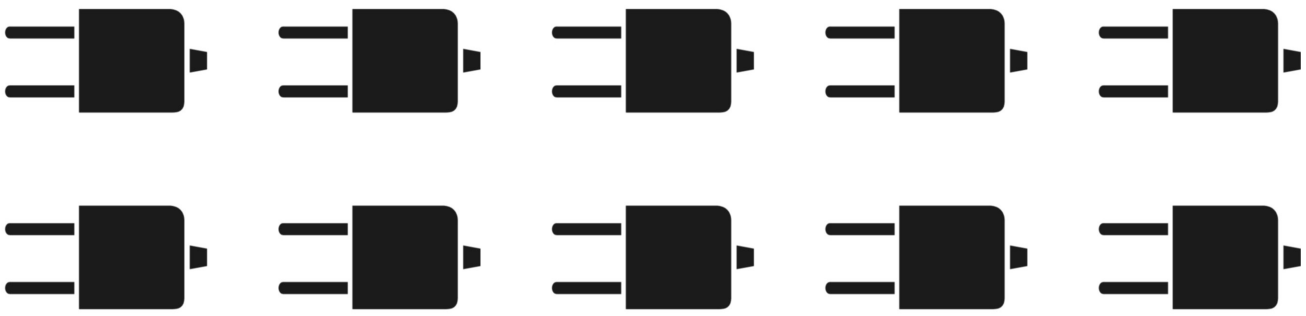
Leaving Lights On

Turning Lights Off

Energy Use at School

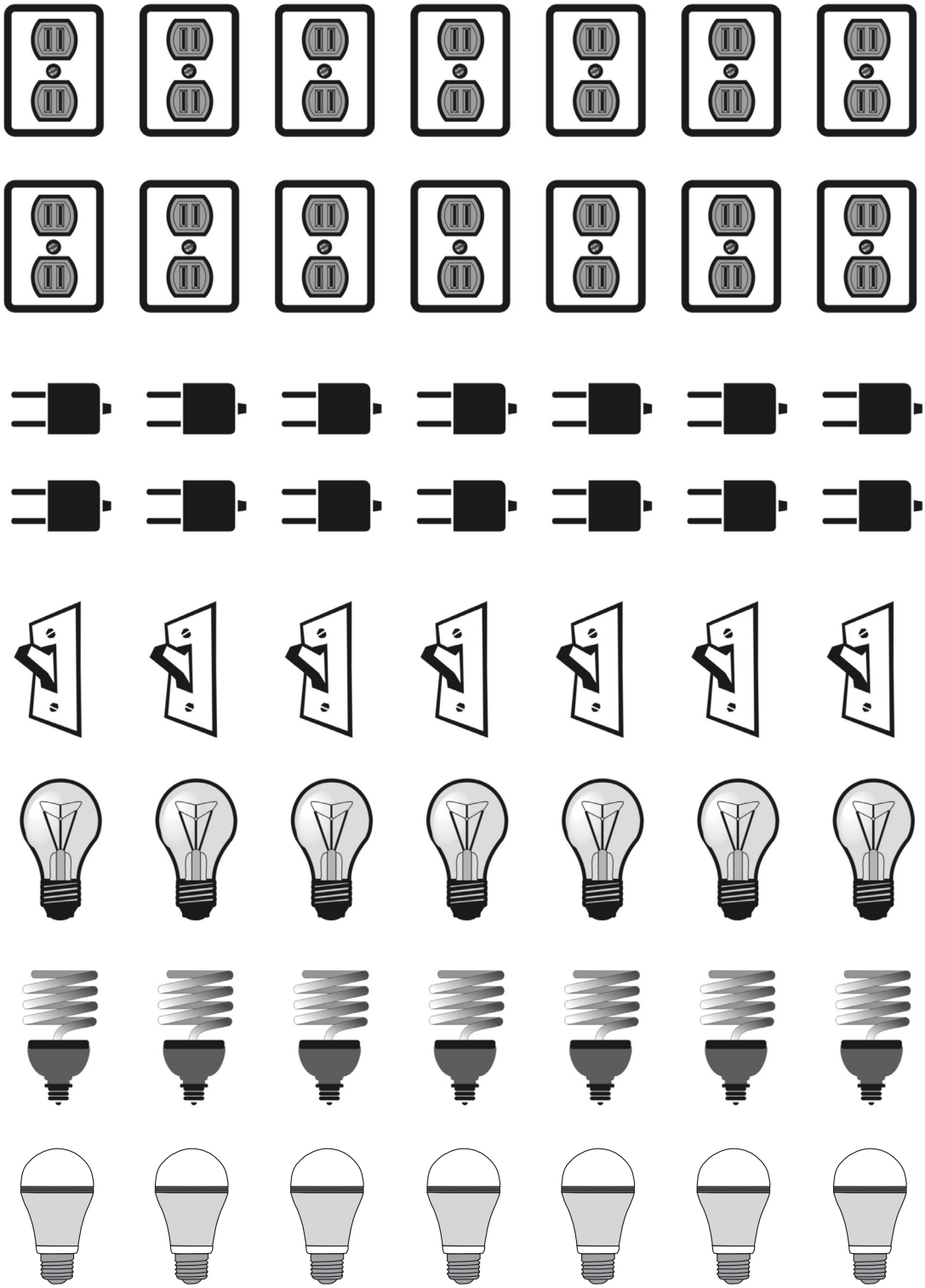
In the Classroom: Count the outlets, devices with plugs, and switches.
Make an X on the pictures below for each item.





Energy Use at Home

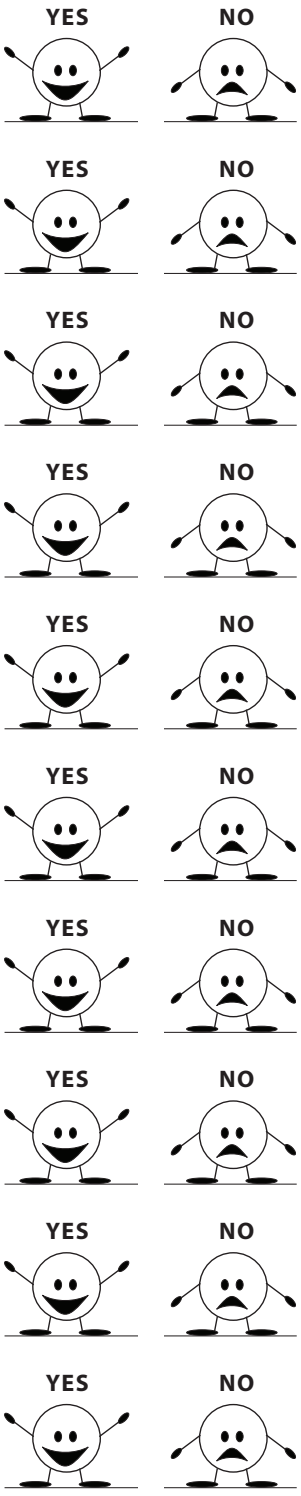
In the Kitchen: With an adult, count the outlets, devices with plugs, switches, incandescent bulbs, CFLs, and LEDs. Make an X on the pictures below for each item you see.



Saving Energy at Home

Are you an **energy saver** or an **energy waster** at home?
Circle the happy face or the sad face.

1. I close the doors and windows when the heat is on.
2. I wear warm clothes when the heat is on.
3. I turn off lights when I leave a room.
4. I use the sun's light whenever I can.
5. I use only the light I need for a job.
6. I turn off machines when I'm not using them.
7. I take short showers instead of baths or long showers.
8. I recycle everything I can.
9. I think saving energy is important.
10. I remind my family and friends to save energy.

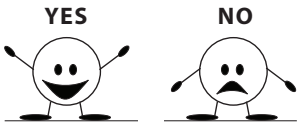


Saving Energy at School

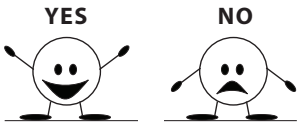
Are you an **energy saver** or an **energy waster** at school?
Circle the happy face or the sad face.

Today we:

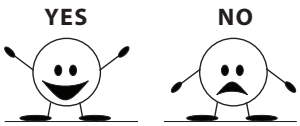
1. Turned off the lights when we left the room.



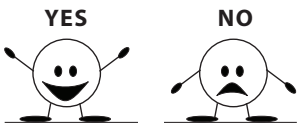
2. Used only the light we needed.



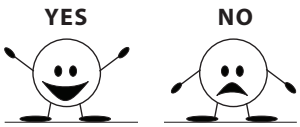
3. Turned off machines when we were not using them.



4. Recycled our trash.



5. Used only the energy we needed.



Games, Puzzles, and Activities

Looking for some fun energy activities? There are plenty of fun games, puzzles, and activities available at www.NEED.org/need-students/games-puzzles-activities/.

Using and Saving Energy Evaluation Form

State: _____ **Grade Level:** _____ **Number of Students:** _____

1. Did you conduct the entire unit?	❑ Yes	❑ No
2. Were the instructions clear and easy to follow?	❑ Yes	❑ No
3. Did the activities meet your academic objectives?	❑ Yes	❑ No
4. Were the activities age appropriate?	❑ Yes	❑ No
5. Were the allotted times sufficient to conduct the activities?	❑ Yes	❑ No
6. Were the activities easy to use?	❑ Yes	❑ No
7. Was the preparation required acceptable for the activities?	❑ Yes	❑ No
8. Were the students interested and motivated?	❑ Yes	❑ No
9. Was the energy knowledge content age appropriate?	❑ Yes	❑ No
10. Would you teach this unit again?	❑ Yes	❑ No

Please explain any 'no' statement below.

How would you rate the unit overall?	❑ excellent	❑ good	❑ fair	❑ poor
How would your students rate the unit overall?	❑ excellent	❑ good	❑ fair	❑ poor

What would make the unit more useful to you?

Other Comments:

Please fax or mail to: **The NEED Project**
8408 Kao Circle
Manassas, VA 20110
FAX: 1-800-847-1820

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National Ocean Industries Association
National Renewable Energy Laboratory
NC Green Power
Nebraskans for Solar
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Nicor Gas
Nisource Charitable Foundation
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