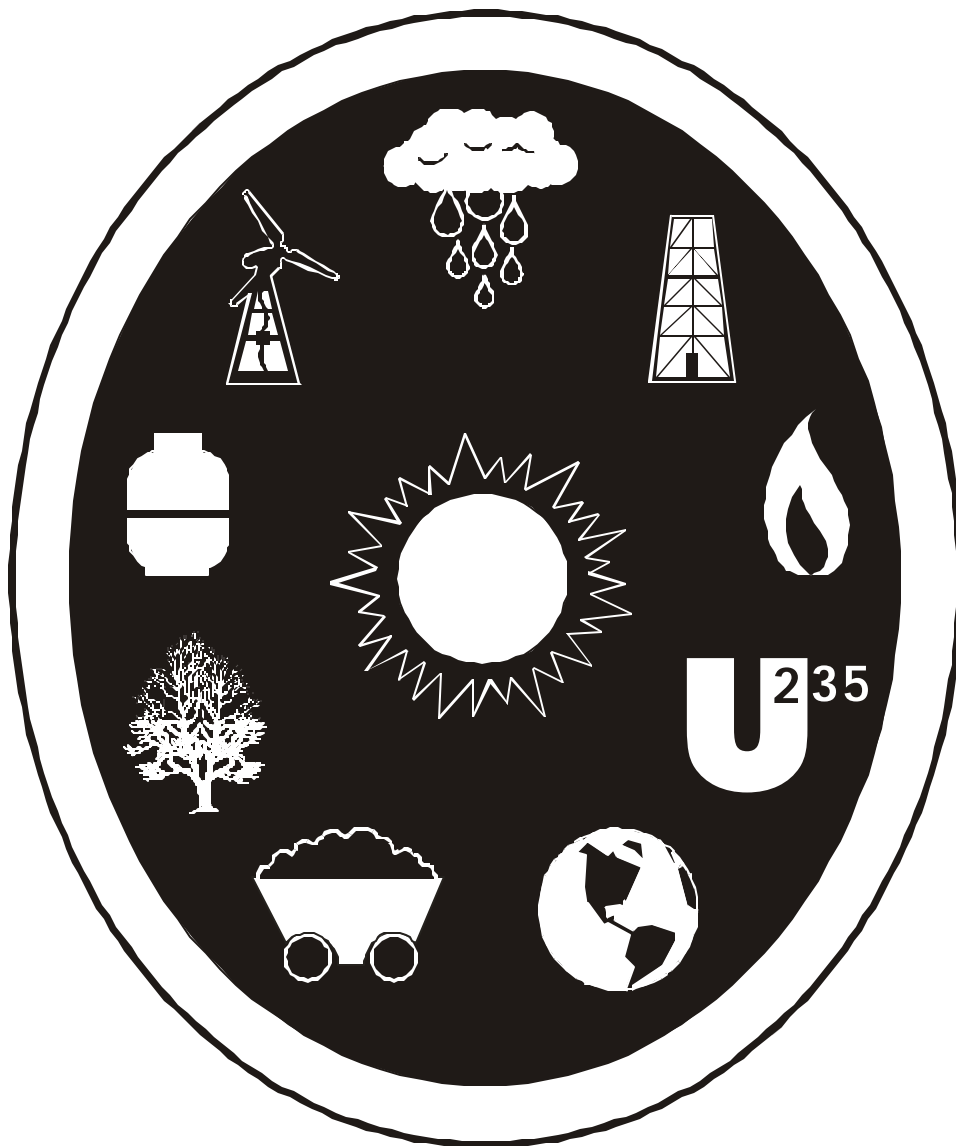


SECONDARY ENERGY ACTIVITIES

SECONDARY
ENERGY
ACTIVITIES



A QUICK LOOK
A companion to the
Secondary Energy
Infobooks—activities
to reinforce general
energy information
and facts about the
energy sources and
electricity.

GRADES
7-12

- Correlations to National Science Standards
- Teacher Guide
- Answer Sheets

The NEED Project
PO BOX 10101
Manassas, VA 20108
1-800-875-5029

TEACHER GUIDE

2001-2002

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SECONDARY ENERGY ACTIVITIES

Teacher Guide

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Applicable Science Standards

INT = Intermediate National Science Content Standards (Grades 5-8)

- INT-B: 3.a Energy is a property of many substances and is associated with heat, light, electricity, mechanical motion, sound, nuclei, and the nature of a chemical.
- INT-B: 3.b Energy is transferred in many ways.
- INT-B: 3.c Heat moves in predictable ways, flowing from warmer objects to cooler ones, until both reach the same temperature.
- INT-B: 3.d Light interacts with matter by transmission (including refraction), absorption, or scattering (including reflection).
- INT-B: 3.e Electrical circuits provide a means of transferring electrical energy.
- INT-B: 3.f In most chemical and nuclear reactions, energy is transferred into or out of a system. Heat, light, mechanical motion, or electricity might all be involved in such transfers.
- INT-B: 3.g The sun is the major source of energy for changes on the earth's surface. The sun loses energy by emitting light. A tiny fraction of that light reaches earth, transferring energy from the sun to the earth. The sun's energy arrives as light with a range of wavelengths.
- INT-C: 4.a For ecosystems, the major source of energy is sunlight. Energy entering ecosystems as sunlight is transferred by producers into chemical energy through photosynthesis. The energy then passes from organism to organism in food webs.
- INT-D: 1.a The solid earth is layered with a lithosphere; hot, convecting mantle; and dense, metallic core.
- INT-D: 1.b Water, which covers the majority of the earth's surface, circulates through the crust, oceans, and atmosphere in what is known as the water cycle.
- INT-D: 2.a Gravity governs the motion in the solar system. Gravity explains the phenomenon of the tides.
- INT-D: 2.b The sun is the major source of energy for phenomena on the earth's surface, such as growth of plants, winds, ocean currents, and the water cycle.
- INT-E: 2.c Technological solutions are temporary and have side effects. Technologies cost, carry risks, and have benefits.
- INT-E: 2.d Many different people in different cultures have made and continue to make contributions to science and technology.
- INT-E: 2.e Science and technology are reciprocal. Science helps drive technology, as it asks questions that demand more sophisticated instruments and provides principles for better instrumentation and technique. Technology is essential to science, because it provides instruments and techniques that enable observations of objects and phenomena that are otherwise unobservable due to quantity, distance, location, size, and/or speed.
- INT-E: 2.f Perfectly designed solutions do not exist. All technological solutions have trade-offs, such as safety, cost, efficiency, and appearance. Risk is part of living in a highly technological world. Reducing risk often results in new technology.
- INT-E: 2.g Technological designs have constraints. Some constraints are unavoidable, such as properties of materials, or effects of weather and friction. Other constraints limit choices in design, such as environmental protection, human safety, and aesthetics.
- INT-F: 1.a Food provides energy and nutrients for growth and development.
- INT-F: 1.b Natural environments may contain substances that are harmful to human beings. Maintaining environmental health involves establishing or monitoring quality standards related to use of soil, water, and air.

- INT-F: 2.b Causes of environmental degradation and resource depletion vary from region to region and from country to country.
- INT-F: 3.a Internal and external processes of the earth system cause natural hazards, events that change or destroy human and wildlife habitats, damage property, and harm or kill humans.
- INT-F: 3.b Human activities can induce hazards through resource acquisition, urban growth, land-use decisions, and waste disposal.
- INT-F: 3.c Hazards can present personal and societal challenges because misidentifying the change or incorrectly estimating the rate and scale of change may result in either too little attention and significant human costs or too much cost for unneeded preventive measures.
- INT-F: 4.b Students should understand the risks associated with natural hazards, chemical hazards, biological hazards, social hazards, and personal hazards.
- INT-F: 4.c Students can use a systematic approach to thinking critically about risks and benefits.
- INT-F: 4.d Important personal and social decisions are made based on perceptions of benefits and risks.
- INT-F: 5.a Science influences society through its knowledge and world view. The effect of science on society is neither entirely beneficial nor entirely detrimental.
- INT-F: 5.b Societal challenges often inspire questions for scientific research, and societal priorities often influence research priorities.
- INT-F: 5.c Technology influences society through its products and processes. Technological changes are often accompanied by social, political, and economic changes that can be beneficial or detrimental to individuals and to society. Social needs, attitudes, and values influence the direction of technological development.
- INT-F: 5.d Science and technology have contributed enormously to economic growth and productivity among societies and groups within societies.
- INT-F: 5.e Science cannot answer all questions and technology cannot solve all human problems or meet all human needs. Students should appreciate what science and technology can reasonably contribute to society and what they cannot do. For example, new technologies often will decrease some risks and increase others.
- INT-G: 2.c It is normal for scientists to differ with one another about the interpretation of new evidence. It is part of scientific inquiry to evaluate the results and explanations of other scientists. As scientific knowledge evolves, major disagreements are eventually resolved through such interactions between scientists.

SEC = Secondary Science Content Standards (Grades 9-12)

- SEC-B: 1.a Matter is made of minute particles called atoms, which are composed of even smaller components. These components have measurable properties, such as mass and electrical charge.
- SEC-B: 1.b Each atom has a positively charged nucleus surrounded by negatively charged electrons. The electric force between the nucleus and electrons holds the atom together.
- SEC-B: 1.c The atom's nucleus is composed of protons and neutrons, which are much more massive than electrons. When an element has atoms that differ in the number of neutrons, these atoms are called isotopes of the element.
- SEC-B: 1.f Fission is the splitting of a large nucleus into smaller pieces.
- SEC-B: 1.g Fusion is the joining of two nuclei at extremely high temperature and pressure and is the process responsible for the energy of the sun and other stars.
- SEC-B: 1.h Radioactive isotopes are unstable and undergo spontaneous nuclear reactions, emitting particles and/or wavelike radiation.
- SEC-B: 2.e Carbon atoms can bond to one another in chains, rings, and branching networks to form a variety of structures, including synthetic polymers, oils, and the large molecules essential to life.

Science Standards *continued*

SEC = Secondary Science Content Standards (Grades 9-12)

- SEC-B: 3.b Chemical reactions may release or consume energy. Some reactions, such as the burning of fossil fuels, release large amounts of energy by losing heat and by emitting light.
- SEC-B: 3.c Light can initiate many chemical reactions such as photosynthesis and the evolution of urban smog.
- SEC-B: 3.d A large number of important reactions involve the transfer of electrons or hydrogen ions. In other reactions, chemical bonds are broken by heat or light to form very reactive radicals with electrons ready to form new bonds. Radical reactions control many processes such as the presence of ozone and greenhouse gases in the atmosphere, burning and processing of fossil fuels, the formation of polymers, and explosions.
- SEC-B: 4.c The electrical force is a universal force that exists between two charged objects.
- SEC-B: 4.e Electricity and magnetism are two aspects of a single electromagnetic force. Moving electric charges produce magnetic forces, and moving magnets produce electric forces.
- SEC-B: 5.a The total energy of the universe is constant. Energy can be transferred by collisions in chemical and nuclear reactions, by light waves and other radiations, and in many other ways. However, it can never be destroyed. As these transfers occur, the matter involved becomes steadily less ordered.
- SEC-B: 5.b All energy can be considered either kinetic energy--the energy of motion; potential energy--which depends on relative position; or energy contained by a field, such as electromagnetic waves.
- SEC-B: 5.c Heat consists of random motion and the vibrations of atoms, molecules, and ions. The higher the temperature, the greater the atomic or molecular motion.
- SEC-B: 5.d Everything tends to become less organized and less orderly over time. Thus, in all energy transfers, the overall effect is that the energy is spread out uniformly. Examples are the transfer of energy from hotter to cooler objects by conduction, radiation, or convection and the warming of our surroundings when we burn fuels.
- SEC-B: 6.a Waves, including sound and seismic waves, waves on water, and light waves, have energy and can transfer energy when they interact with matter.
- SEC-B: 6.d In some materials, such as metal, electrons flow easily, whereas in insulating materials such as glass, they can hardly flow at all.
- SEC-C: 1.a Plants and many microorganisms use solar energy to combine molecules of carbon dioxide and water into complex, energy rich organic compounds and release oxygen to the environment. This photosynthesis provides a vital connection between the sun and the energy needs of living systems.
- SEC-C: 4.b Energy flows through ecosystems in one direction, from photosynthetic organisms to herbivores to carnivores to decomposers.
- SEC-C: 4.c Humans modify ecosystems as a result of population growth, technology, and consumption. Human destruction of habitats through harvesting, pollution, atmospheric changes, and other factors is threatening global stability, and if not addressed, ecosystems will be irreversibly affected.
- SEC-C: 5.a All matter tends toward more disorganized states. Living systems require a continuous input of energy to maintain their chemical and physical organizations.
- SEC-C: 5.b The energy for life primarily derives from the sun. Plants capture energy by absorbing light and using it to form strong chemical bonds. The energy stored in the bonds (chemical energy) can be used as sources of energy for life processes.
- SEC-C: 5.c The chemical bonds of food molecules contain energy. Energy is released when the bonds are broken and new compounds with lower energy bonds are formed.

- SEC-C: 5.e As matter and energy flows through different levels of organization of living systems—cells, organs, organisms, communities—and between living systems and the physical environment, chemical elements are recombined in different ways. Each recombination results in storage and dissipation of energy into the environment as heat. Matter and energy are conserved in each change.
- SEC-D: 1.a Earth systems have internal and external sources of energy, both of which create heat. The sun is the major external source of energy. Two primary sources of internal energy are the decay of radioactive isotopes and the gravitational energy from the earth’s original formation.
- SEC-D: 1.b The outward transfer of earth’s internal heat drives convection circulation in the mantle.
- SEC-D: 1.c Heating of earth’s surface and atmosphere by the sun drives convection within the atmosphere and oceans, producing winds and ocean currents.
- SEC-D: 1.d Global climate is determined by energy transfer from the sun at and near the earth’s surface.
- SEC-D: 4.a Stars produce energy from nuclear reactions, primarily the fusion of hydrogen to form helium.
- SEC-F: 3.a Human populations use resources in the environment to maintain and improve their existence.
- SEC-F: 3.b The earth does not have infinite resources; increasing human consumption places severe stress on the natural processes that renew some resources, and depletes those resources that cannot be renewed.
- SEC-F: 3.c Humans use many natural systems as resources. Natural systems have the capacity to reuse waste but that capacity is limited. Natural systems can change to an extent that exceeds the limits of organisms to adapt naturally or humans to adapt technologically.
- SEC-F: 4.a Natural ecosystems provide an array of basic processes that affect humans. Those processes include maintenance of the quality of the atmosphere, generation of soils, control of the hydrologic cycle, disposal of wastes, and recycling of nutrients. Humans are changing many of these basic processes, and the changes may be detrimental to humans.
- SEC-F: 4.b Materials from human societies affect both physical and chemical cycles of the earth.
- SEC-F: 4.c Many factors influence environmental quality. Factors that students might investigate include population growth, resource use, population distribution, overconsumption, the capacity of technology to solve problems, poverty, the role of economic, political, and religious views, and different ways humans view the earth.
- SEC-F: 5.b Human activities can enhance potential for hazards. Acquisition of resources, urban growth, and waste disposal can accelerate rates of natural change.
- SEC-F: 5.c Some hazards are rapid and spectacular, others are slow and progressive.
- SEC-F: 5.d Natural and human-induced hazards present the need for humans to assess potential danger and risk. Many changes in the environment designed by humans bring benefits to society, as well as cause risks. Students should understand the costs and trade-offs of various hazards—ranging from those with minor risk to a few people to major catastrophes with major risk to many people.
- SEC-F: 6.b Understanding basic concepts and principles of science and technology should precede active debate about the economics, policies, politics, and ethics of various science and technology related challenges. However, understanding science alone will not resolve local, national, and global challenges.
- SEC-F: 6.c Individuals and society must decide on proposals involving new research and the introduction of new technologies into society.
- SEC-F: 6.d Humans have a major effect on other species.
- SEC-G: 1.a Individuals and teams contribute to the scientific enterprise.
- SEC-G: 1.c Scientists are influenced by societal, cultural, and personal beliefs and ways of viewing the world. Science is not separate from society, but a part of it.

Teacher Guide

BACKGROUND

Secondary Energy Activities is a series of student worksheets designed to reinforce the vocabulary, concepts and information in the **Secondary Energy Infobooks**.

TIME

Approximately 30 minutes per topic for the students to read the selected infosheet and complete the worksheets.

SKILLS

- Nonfiction Reading
- Critical Thinking
- Vocabulary
- Graphing

PROCEDURE

Step One—Preparation

- Obtain class sets of **Secondary Energy Infobooks** and **Secondary Energy Activities**, or make copies as necessary. Many other NEED activities also reinforce and synthesize the information in the infobooks, such as **Energy Jeopardy**, **Great Energy Debate Game**, **Transparent Energy**, **Mission Possible**, and **Energy Enigma**.
- Decide which infosheets and worksheets you will use with your class.

Step Two—Procedure

- Distribute one **Secondary Energy Infobook** and **Secondary Energy Activities** workbook to each student.
- Have the students read the selected infosheet. Discuss the concepts and new vocabulary in the infosheet.
- Have the students complete the selected worksheet.
- Once students have read all of the energy source infosheets and completed the worksheet for each source, have the students complete the worksheets on pages 8-9 of the workbook. These worksheets reinforce and synthesize the information in the source infosheets. Pages 10-11 are companion worksheets to the Electricity infosheet.
- Use the Evaluation Form on page 19 of the **Teacher Guide** to evaluate the activities.

FORMS OF ENERGY

Fill in the blanks with the words at the bottom of the page. You can use words more than once.

1. Stored energy and the energy of position are potential energy.
2. Compressed springs and stretched rubber bands are stored mechanical energy.
3. The vibration and movement of the atoms and molecules within substances is called heat or thermal energy.
4. The energy stored in the center of atoms is called nuclear energy.
5. The scientific rule that states that energy cannot be created or destroyed is called the Law of Conservation of Energy.
6. The movement of energy through substances in longitudinal waves is sound.
7. The energy of position - such as a rock on a hill - is gravitational energy.
8. The movement of objects and substances from place to place is motion.
9. Electromagnetic energy traveling in transverse waves is radiant energy.
10. Energy stored in the bonds of atoms and molecules is chemical energy.
11. The movement of atoms, molecules, waves, and electrons is kinetic energy.
12. The movement of electrons is electrical energy.
13. The amount of useful energy you get from a system is its energy efficiency.
14. The energy in petroleum and coal is stored as chemical energy.
15. X-rays are an example of radiant energy.
16. Fission and fusion are examples of nuclear energy.
17. A hydropower reservoir is an example of gravitational energy.
18. Wind is an example of the energy of motion.

radiant	gravitational	chemical	thermal	nuclear	electrical	mechanical
kinetic	potential	sound	motion	conservation of energy	energy efficiency	

BIOMASS



Description of biomass, where it is located and how it is recovered:

Biomass is any organic material that can be used as an energy source. It is located anywhere that can sustain plant growth or produces organic waste. It is collected from anywhere it is produced.

How the energy in biomass is stored and converted into usable energy:

The energy in biomass is stored as chemical energy and can be burned, or converted to ethanol or methane.

What/who uses biomass and for what purposes:

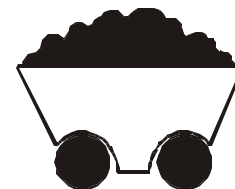
Industry is the biggest user - burning wood to make products. It is burned in waste-to-energy plants to produce electricity. It is converted into ethanol for use as a vehicle fuel. Residences burn biomass for heat. In other countries it is turned into biogas for heat. Landfills capture methane produced by decaying garbage.

Advantages and disadvantages of using biomass:

Biomass is renewable and readily available. Using biomass does not increase the net amount of carbon dioxide in the atmosphere. Using biomass for energy reduces the amount sent to landfills and captures the stored energy. Land not needed for food production can be used to grow energy crops.

Burning biomass produces some pollutants and can produce foul odors. There is not as much energy per pound in biomass as in fossil fuels, so more must be burned.

COAL



Description of coal, where it is located and how it is recovered:

Coal is a solid fossil fuel formed by heat and pressure from the remains of ancient plants in swampy areas. Coal is buried underground in many areas of the country - especially the Appalachian Mountains, Wyoming, and Texas. Shallow coal is recovered with surface mines, deeper coal with underground mines.

How the energy in coal is stored and converted into usable energy:

The energy in coal is stored as chemical energy and is released by burning or by conversion to methanol.

What/who uses coal and for what purposes:

Most coal is used by utilities to produce electricity. Industry burns coal to manufacture products. Some homes burn coal for heat. Coal can be converted into methanol and used as a vehicle fuel.

Advantages and disadvantages of using coal:

Coal is nonrenewable. It is the U.S.'s most abundant resource and produces more than half of our electricity. Coal is an inexpensive and efficient fuel for producing electricity. It is also valuable to industry because it produces a very high heat.

Burning coal can produce air pollution and chemicals that cause acid rain. Mining coal can pollute water and damage the land.

GEO THERMAL



Description of geothermal energy, where it is located and how it is recovered:

Geothermal energy is heat produced in the earth's core from the radioactive decay of natural elements. Low-temperature geothermal resources are almost everywhere. High-temperature resources are mostly along the Ring of Fire. It is recovered with wells or pipes placed under the ground.

How geothermal energy is stored and converted into usable energy:

Geothermal energy is thermal energy. The heat can be used to heat buildings or to produce electricity.

What/who uses geothermal energy and for what purposes:

Power plants use high temperature steam to produce electricity. Buildings use geo exchange units to heat and cool interior spaces.

Advantages and disadvantages of using geothermal energy:

Geothermal energy is renewable; radioactive decay within the earth will continue for as long as the earth exists. It produces almost no air or water pollution. The water and steam that are extracted are reinjected into the ground.

High-temperature resources are not uniformly distributed. Geo exchange units are expensive to install but cheap to maintain and last a long time.

HYDROPOWER



Description of hydropower, where it is located and how it is recovered:

Hydropower is the energy in flowing water caused by the force of gravity. Hydro resources are everywhere there is precipitation and moving water. Usually dams are built across fast-moving rivers to harness the power of the water to turn turbines.

How hydropower is stored and converted into usable energy:

Hydropower is stored mechanical energy. Dams control the flow of the water, converting the energy into electricity.

What/who uses hydropower and for what purposes:

Power plants build dams across rivers to harness the energy in moving water and convert it into electricity. The dams form a reservoir to hold the water. The dams have tubes called penstocks that direct the water through turbine generators to convert mechanical energy into electricity.

Advantages and disadvantages of using hydropower:

Hydropower is renewable; the water cycle will continue as long as the sun shines. Hydro dams produce no air pollution and are very cheap producers of electricity.

Large amounts of land are disturbed when dams are built. Wildlife habitats can be changed. Fish may have trouble getting to spawning grounds. Few places remain where dams can be built in the United States.

NATURAL GAS



Description of natural gas, where it is located and how it is recovered:

Natural gas is a fossil fuel - a colorless, odorless gas - formed from ancient sea plants and animals. It is located in sedimentary basins on and off shore and is recovered by drilling wells and piping the natural gas.

How the energy in natural gas is stored and converted into usable energy:

The energy in natural gas is stored chemical energy. It is usually burned to produce heat.

What/who uses natural gas and for what purposes:

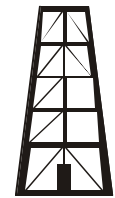
Industry is the largest user, burning natural gas to manufacture products. More than 60% of residences and commercial buildings use natural gas to heat indoor spaces and water. Natural gas can also be compressed and used as a transportation fuel or burned in power plants to produce electricity.

Advantages and disadvantages of using natural gas:

Natural gas is a nonrenewable fossil fuel. It can produce air pollution and carbon dioxide, a greenhouse gas, when burned. It is a good fuel for peak demand power plants.

Natural gas is cleaner-burning than coal or petroleum. It is relatively inexpensive and the United States has adequate reserves for the next 25 - 50 years.

PETROLEUM



Description of petroleum, where it is located and how it is recovered:

Petroleum is a liquid hydrocarbon fossil fuel formed from ancient sea plants and animals. It is located in sedimentary basins on and off shore. Wells are dug and the crude oil is pumped through pipelines.

How the energy in petroleum is stored and converted into usable energy:

The energy in petroleum is stored as chemical energy. Petroleum is usually burned to produce heat.

What/who uses petroleum and for what purposes:

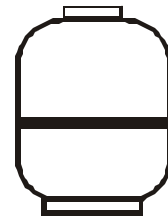
Petroleum is mainly a transportation fuel - it is refined into gasoline, jet fuel, diesel fuel, heating oil, and kerosene. Heating oil is burned to heat buildings and petroleum can be burned to produce electricity. Petroleum is also used to produce heat and as a feedstock to manufacture products.

Advantages and disadvantages of using petroleum:

Petroleum products fuel almost our entire transportation system and are essential to the manufacture of plastics and many other products.

Petroleum is a nonrenewable fossil fuel. It can pollute the air when burned and produces carbon dioxide, a greenhouse gas. It can also pollute land and water if it spills while being transported. The United States must import about two-thirds of the petroleum it uses. Much of the country's reserves are in sensitive environmental areas.

PROPANE



Description of propane, where it is located and how it is recovered:

Propane is a colorless, odorless, gaseous fossil fuel found in natural gas and petroleum deposits. It is recovered from petroleum refining and natural gas processing.

How the energy in propane is stored and converted into usable energy:

The energy in propane is stored as chemical energy and burned to produce heat.

What/who uses propane and for what purposes:

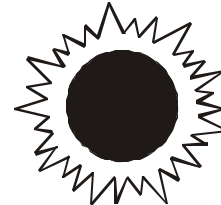
Industry is the largest user, burning propane to make products and fuel indoor vehicles. Farms and rural consumers use propane for heat. Backyard grills and recreational vehicles use propane as fuel. Some fleet vehicles use propane as a transportation fuel. Campers use propane for light and for cooking.

Advantages and disadvantages of using propane:

Propane is a clean-burning fossil fuel, but it can pollute the air and produces carbon dioxide, a greenhouse gas. Propane is nonrenewable.

Propane is easily compressed into a liquid, in which state it can be easily transported. Propane is a good fuel for areas that do not have natural gas pipelines.

SOLAR



Description of solar energy, where it is located and how it is recovered:

Solar energy is radiant energy produced by fusion in the sun's core.

How the energy in solar energy is stored and converted into usable energy:

Radiant energy can be converted into heat when it is absorbed by substances or converted directly into electricity by PV cells. Radiant energy as visible light is used for daylighting.

What/who uses solar energy and for what purposes:

Everyone uses daylighting to see, though we don't capture or harness it. Homes and buildings use solar collectors to heat interior spaces and water. Buildings and small appliances such as calculators and roadside telephones use PV cells to produce electricity. Remote areas use PV cells where there are not power lines.

Advantages and disadvantages of using solar energy:

Solar energy is renewable. It is also non-polluting and available to almost everyone.

Solar energy is difficult to harness because it is spread over a wide area and is not concentrated. PV technology is expensive at this time.

URANIUM



Description of uranium, where it is located and how it is recovered:

Uranium is a metallic ore that is abundant in the United States and around the world. Uranium ore is mined, milled and enriched before it can be used in power plants.

How the energy in uranium is stored and converted into usable energy:

The energy in uranium is stored as nuclear energy. The energy is released through fission.

What/who uses uranium and for what purposes:

Nuclear power plants fission enriched uranium to produce heat to produce electricity.

Advantages and disadvantages of using uranium:

Nuclear power plants do not burn fuel, so there is little air or water pollution. Nuclear power is an efficient, cost-effective method of producing electricity.

Uranium is nonrenewable, though abundant. Nuclear power plants produce radioactive waste that can be very dangerous. Radioactive waste must be carefully stored for thousands of years. Right now, there is not a permanent repository in the United States.

WIND



Description of wind energy, where it is located and how it is recovered:

Wind is moving air caused by the uneven heating of the earth's surface by the sun. Many places have wind resources powerful and steady enough to harness. Wind machines can harness the energy in the wind.

How the energy in wind is stored and converted into usable energy:

Wind energy is motion - mechanical energy. The blades of wind machines slow the speed of the wind and use the energy to produce electricity.

What/who uses wind energy and for what purposes:

Electric utilities and independent power producers use wind energy to produce electricity.

Advantages and disadvantages of using wind energy:

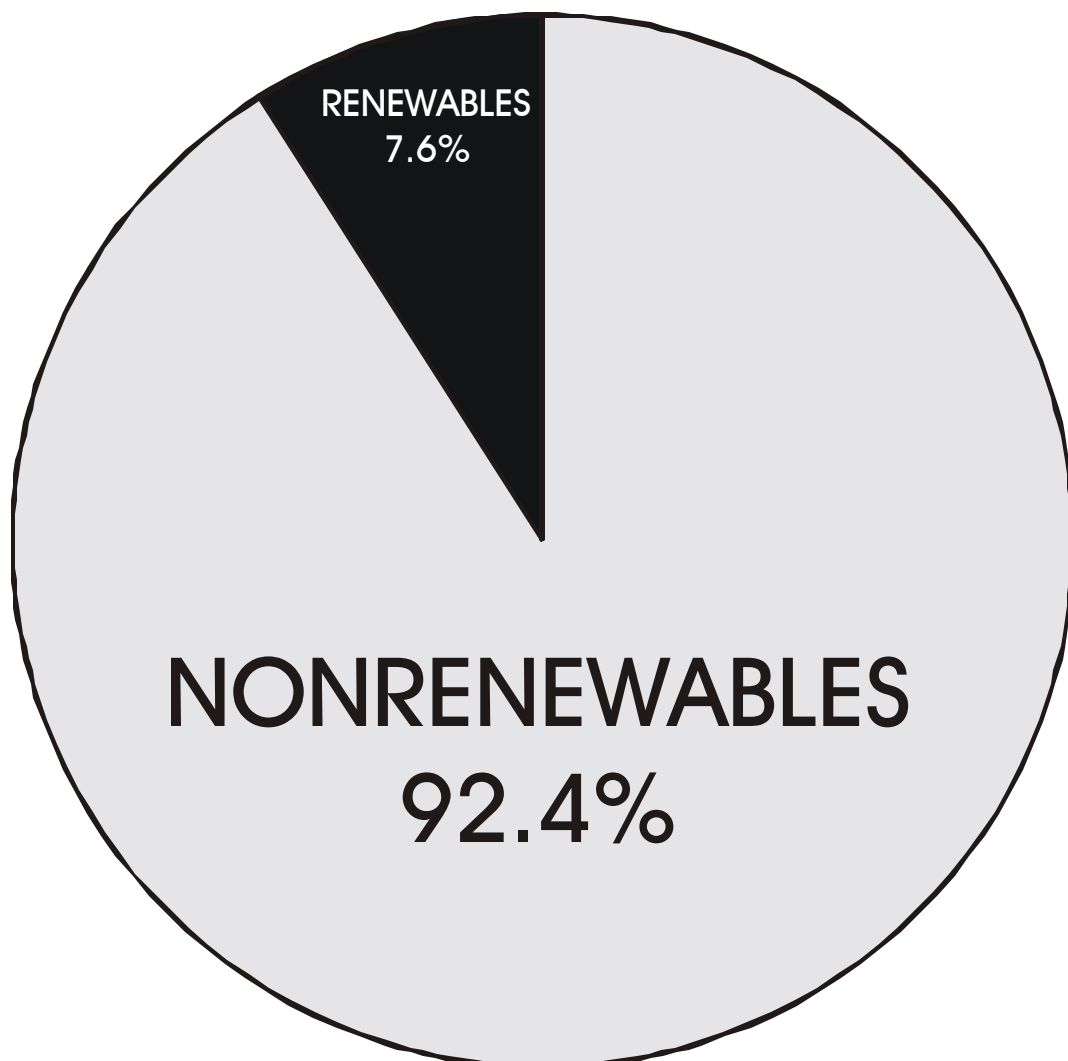
Wind energy is renewable. It is a non-polluting source of energy. It is an inexpensive way to produce electricity.

Wind machines cannot operate all the time - only when the wind is blowing at constant speeds of about 14 mph or higher. Wind farms take up a lot of land. Wind machines can be noisy.

RENEWABLES AND NONRENEWABLES
















Convert the quads into percentages and make a pie chart showing how much of the energy the U.S. consumed in 2000 came from renewable sources and how much came from nonrenewable sources (Q = quad or quadrillion Btu).

PETROLEUM	36.9 Q = 38.2%
COAL	21.7 Q = 22.4%
NATURAL GAS	21.3 Q = 22.0%
URANIUM	7.7 Q = 8.0%
BIOMASS	3.5 Q = 3.6%
HYDROPOWER	3.4 Q = 3.5%
PROPANE	1.7 Q = 1.8%
GEOHERMAL, SOLAR, WIND	0.5 Q = 0.5%



HOW WE USE OUR ENERGY SOURCES

In the boxes, explain how the sources on the left are used for the tasks along the top. Star the main use of each source.

	 TRANSPORTATION	 MANUFACTURING	 HEATING/COOLING	 LIGHTING	 ELECTRICITY
	<i>turned into ethanol - mixed with gasoline to make gasohol</i>	<i>*burned to make heat to manufacture products</i>	<i>burned to heat homes; converted to biogas to heat homes</i>	<i>burned to produce light (candles and biogas)</i>	<i>burned in waste-to-energy plants</i>
	<i>turned into methanol</i>	<i>burned to make heat to manufacture products</i>	<i>burned to heat homes</i>		<i>*burned to make heat to produce electricity</i>
			<i>used in geothermal exchange systems to heat and cool homes</i>		<i>*heat used to produce electricity</i>
					<i>*mechanical energy used to produce electricity</i>
	<i>compressed to make CNG for fleet vehicles</i>	<i>*burned to make heat to manufacture products</i>	<i>burned to heat homes and commercial buildings</i>	<i>burned in some lanterns and street lights</i>	<i>burned to make heat to produce electricity</i>
	<i>*refined into gasoline, jet fuel, diesel fuel</i>	<i>burned to make heat to manufacture products and as a feedstock</i>	<i>refined into heating oil and burned to heat homes</i>	<i>refined into kerosene and burned in lanterns</i>	<i>burned to make heat to produce electricity</i>
	<i>pressurized for fleet and indoor vehicles</i>	<i>*burned to make heat to manufacture products</i>	<i>pressurized and burned to heat homes, barns, and buildings</i>	<i>pressurized and burned in lanterns</i>	
			<i>used to heat homes and buildings</i>	<i>provides daylighting</i>	<i>*converted into electricity with PV cells</i>
					<i>*fissioned to make heat to produce electricity</i>
					<i>*mechanical energy turned into electricity</i>

ELECTRICITY

Write the correct word for each definition in the blank space.

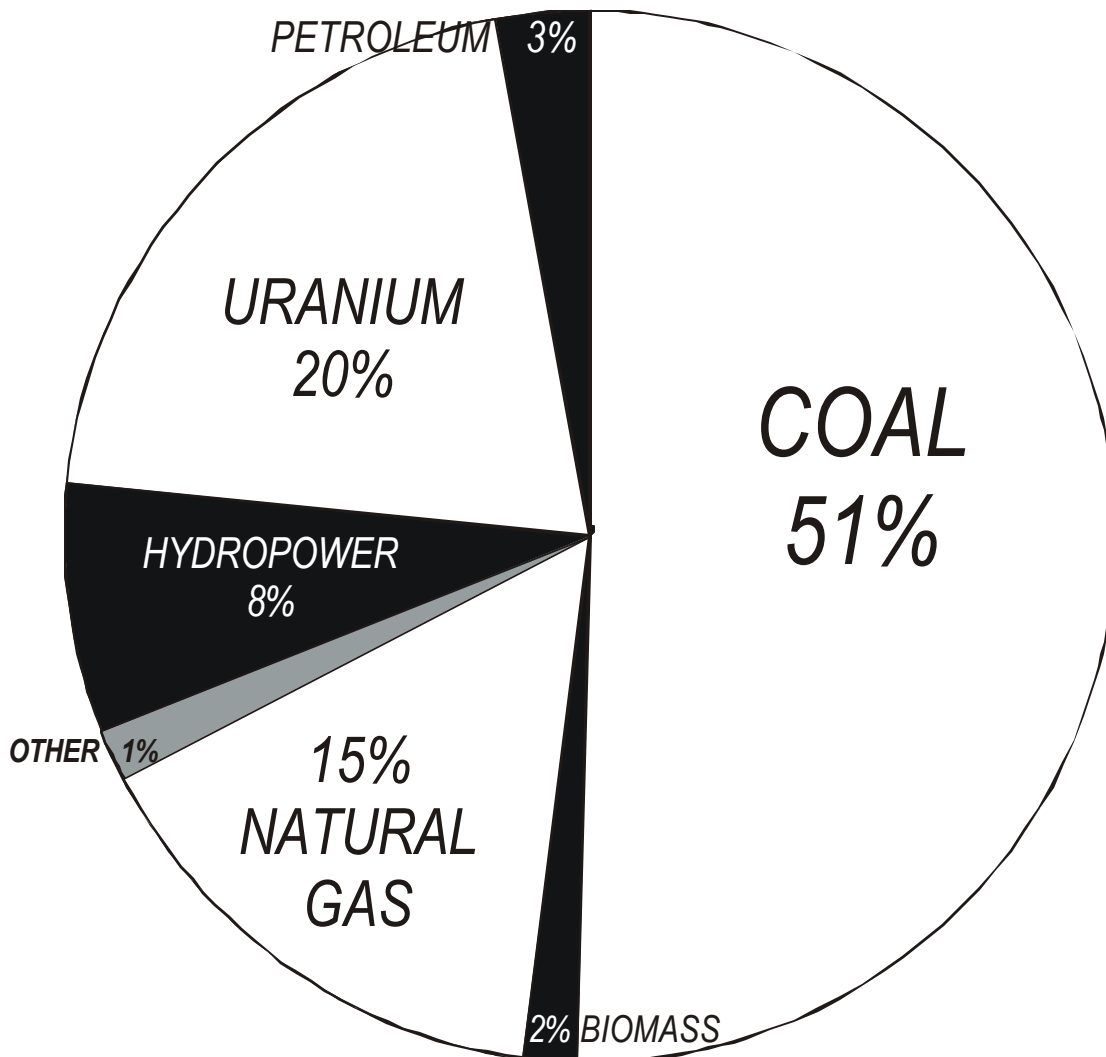
1. A device that changes voltage. transformer
2. A device that changes linear motion into circular motion. turbine
3. Allowing competition in the power industry. deregulation
4. Managing how and when consumers use electricity. demand-side management
5. The total amount of electricity a power plant can deliver. capacity
6. Times when many customers need electricity. peak demand
7. A device that turns mechanical energy into electricity. generator
8. How well a utility delivers electricity at all times. reliability
9. Electricity produced at all times to meet basic demand. base-load
10. A merged network of electric utilities. power pool
11. Reducing energy usage through behavioral changes. conservation
12. A measurement of the amount of electricity used by consumers. kilowatt-hour
13. Power plants that burn fuel to produce electricity. thermal
14. A material with little resistance to electric current. superconductor
15. Combining the nuclei of atoms to produce energy. fusion
16. A source of energy that requires another source to produce it. secondary
17. Manufacturing a product and also producing electricity. cogeneration
18. Reducing the amount of energy consumed by devices through advances in technology. efficiency

capacity	reliability	base-load	peak demand	secondary	transformer	fusion
turbine	generator	conservation	efficiency	demand-side management		
kilowatt-hour	deregulation	cogeneration	superconductor	thermal	power pool	

ELECTRIC POWER GENERATION

Convert the bkWh into percentages and make a pie chart showing how much of the electricity the U.S. consumed in 2000 came from each energy source (bkWh = billion kilowatt-hours).

PETROLEUM	116 bkWh	=	$\frac{3}{100}$	%
COAL	1,891 bkWh	=	$\frac{51}{100}$	%
NATURAL GAS	546 bkWh	=	$\frac{15}{100}$	%
URANIUM	728 bkWh	=	$\frac{20}{100}$	%
BIOMASS	64 bkWh	=	$\frac{2}{100}$	%
HYDROPOWER	306 bkWh	=	$\frac{8}{100}$	%
OTHER	25 bkWh	=	$\frac{1}{100}$	%



Secondary Energy Activities

Evaluation Form

Please take a few minutes to evaluate these activities so that we can revise them to better meet your needs. Thank you.

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

- | | | |
|--|-----|----|
| 1. Did you conduct all of the activities in the workbook? | Yes | No |
| 2. Were the instructions clear and easy for students 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. Was the workbook easy to use? | Yes | No |
| 7. Were the students interested and motivated? | Yes | No |
| 8. Was the energy content age-appropriate? | Yes | No |
| 9. Would you use the workbook again? | Yes | No |
| Would you use the workbook if you didn't have a class set? | Yes | No |

How would you rate the workbook overall?

How would your students rate the workbook overall?

What would make the workbook more useful to you?

Other Comments:

Please fax or mail to:

The NEED Project
PO Box 10101
Manassas, VA 20108
FAX: (703) 257-0037

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