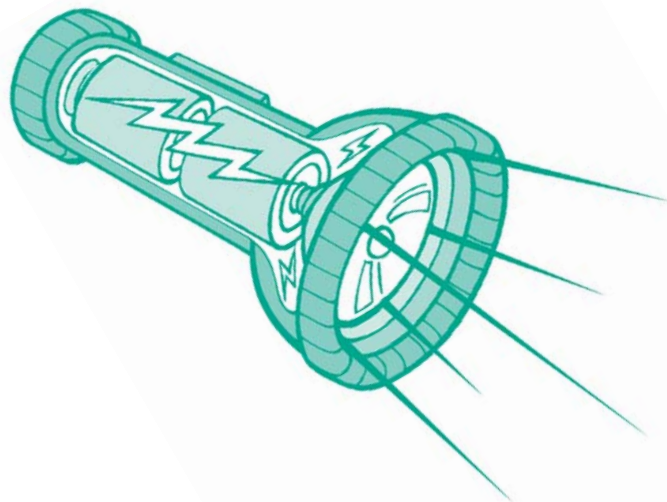


How Will We Power Our Future?

Overview

In this introduction to the eJourney, students begin to gain an understanding of the importance of energy (especially electricity) in our lives through relevant examples and classroom-based discussion. With the aid of illustrated definition cards (provided), the class reviews important vocabulary and concepts about renewable and nonrenewable energy sources. Using the definition cards as a guide, the class compares and contrasts today's energy sources. Accompanying this lesson is a short booklet, *Nonrenewable Energy Sources – Powering Our Past and Present, What About Our Future?*, which is provided as a follow-up reading assignment to enhance student learning and prepare students for their eJourney.



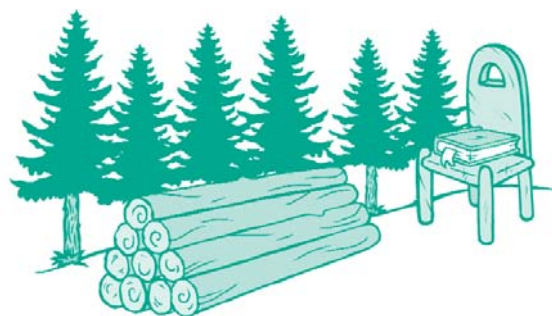
LESSON ONE

Core Concepts

Natural resources are the original source of all goods. Natural resources are raw materials and energy obtained from the environment for human purposes. Natural resources can be generally categorized as nonrenewable or renewable. Nonrenewable natural resources are not replenished through natural cycles or are replenished extremely slowly, on a geological time frame, and are thus strictly limited in quantity. Renewable natural resources are replenished through natural cycles, on a human time frame, but are still finite.

Renewable energy resources include the heat of the Earth (geothermal energy) and the energy in hydrogen, solar radiation, biomass, and the movement of water and wind. Nonrenewable energy resources include fossil fuels, such as coal, oil, and natural gas, and nuclear fuels.

Fossil fuels – coal, oil, and natural gas – are nonrenewable energy resources. Fossil fuels developed as a result of the decomposition and compression, under many layers of sediment, of plants and animals that lived and died hundreds of millions of years ago. Fossil fuels are the major source of energy



for the U.S., accounting for 85 percent of total energy use and, in Arizona, almost 60 percent of our electric generation.

All fossil fuels can be burned to produce electricity, with the heat used to create steam to rotate a turbine and activate a generator that produces electricity. Much of our society's energy use involves converting other forms of energy to electricity, which is a uniquely versatile and controllable form of energy. Electric energy may be generated in many ways and from many other forms of energy.

Magnetism produces electricity: Whenever an electrical conductor (such as a copper wire) is moved through a magnetic field, an electric current is produced. An electrical generator is a device that converts mechanical energy into electrical energy by moving a wire through a magnetic field. Most power plants use the energy of heat or flowing water to spin a turbine, which has a shaft connected to a generator that changes the kinetic spinning energy into electric energy.

Learning Objectives

Arizona Department of Education ACADEMIC STANDARDS

Science	SC04-S4C3-02; SC04-S5C3-03; SC06-S1C3-04; SC06-S4C3-01; SC06-S5C3-01; SC06-S5C3-03
Mathematics	M04-S2C1-03; M04-S2C1-04; M05-S2C1-03; M05-S2C1-04; M06-S2C1-03; M06-S2C1-04
Language Arts	R04-S1C4-02; R04-S1C6-01; R04-S3C1-01; R05-S1C4-02; R05-S1C6-01; R05-S3C1-01 R06-S1C4-02; R06-S1C6-01;
Workplace Skills	1WP-E4-04; 1WP-E7-02

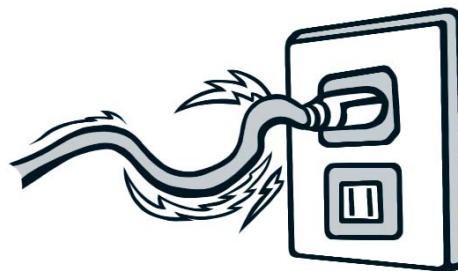
TIME NEEDED

One Class Period

After completing this lesson (including reading the accompanying student booklet), students will be able to:

- Define, compare and contrast the differences between renewable and nonrenewable resources.
- List at least four different renewable energy sources.
- List at least three nonrenewable energy sources.
- Define the term fossil fuels and list three commonly used fossil fuels.

Advance Preparation



MATERIALS ✂

- ▶ Student Handout: *Defining Energy Cards*
- ▶ Transparency Master: *Natural Resources Used to Generate Electricity in Arizona*
- ▶ Teacher Instructions: *How to Construct the Nonrenewable Energy Sources Booklet*
- ▶ Student Booklet: *Nonrenewable Energy Sources – Powering Our Past and Present, What About Our Future?*
- ▶ flashlight or candle
- ▶ electrical items for demonstration (see below)
- ▶ overhead projector

GENERAL PREP

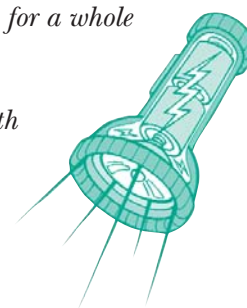
- ▶ download and print the *Defining Energy Cards* and cut into cards where indicated (there are 12 cards in all)
- ▶ download and prepare an overhead transparency from the Transparency Master: *Natural Resources Used to Generate Electricity in Arizona*
- ▶ download and print a copy of *How to Construct the Nonrenewable Energy Sources Booklet*
- ▶ download and make copies of the student booklet: *Nonrenewable Energy Sources – Powering Our Past and Present, What About Our Future?* (Note: Make as many copies as you feel necessary to ensure that all students have a chance to read the booklet. You may choose to have them read the booklet in small teams or individually.)
- ▶ follow the instructions from *How to Construct the Nonrenewable Energy Sources Booklet* to assemble the student booklets
- ▶ collect several items that require electricity to operate and have them ready for a class demonstration (suggested items include a hairdryer, CD player (not battery powered), electric pencil sharpener, small desk lamp, etc.)

Suggested Procedure

Note: The suggested procedure for introducing this lesson involves turning the classroom lights out in order to catch the students' attention. Depending on your teaching style, you may further dramatize this lesson with additional props and ideas to capture student intrigue and emphasize our reliance on electrical energy.

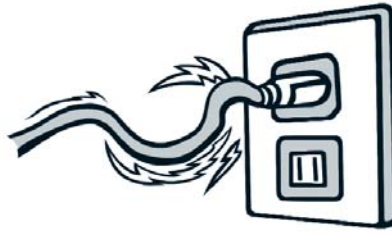
1 Introduce this lesson by turning off the classroom lights to catch the students' attention. Have a flashlight or candle in hand as your light source. Suggest that there is no electricity available in the classroom for the day and ask how that might change the school day. Engage students in a discussion about electricity in our lives. The following questions might help guide your class discussion:

- ▶ *Suppose we had no electricity for a day, a week, a month, for a whole year — how might our lives be different?*
- ▶ *What would a day without electrical power be like — both here in the classroom and at home?*
- ▶ *What kinds of things would we not be able to do?*
- ▶ *What things could we still do?*
- ▶ *What might we do instead of using the things that need power to operate?*



2 Bring out the items requiring electricity which you have set aside as your demonstration props. Before bringing each item out, ask students to name some things that need electricity to operate. As students mention items, bring out various props to enliven the discussion about all of the things we use in our everyday lives that need electricity to operate.



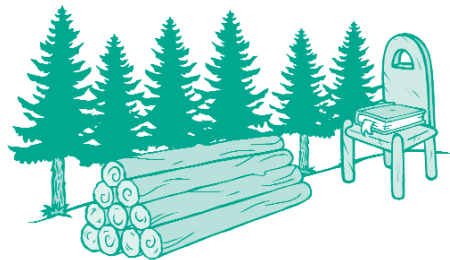


3 Next point out that plugging any of the items into the wall outlet gives them the electrical energy they need to operate, but from where does our electricity come?

4 As students come up with responses, explain that ultimately, all of our energy, including electricity, comes from natural resources.

5 Pass out the *Defining Energy Cards*. Ask the student who has the Natural Resources card to read the definition. Ask if any students have a card that might be an example of a natural resource. All of the other cards are actually natural resources.

6 Explain that *we get all our energy, including electricity, from natural resources*, some from renewable and some from nonrenewable natural resources. Have students with the *Renewable Natural Resources* and *Nonrenewable Natural Resources* cards read their definitions. Discuss renewable and nonrenewable natural resources and ask if students can think of examples of each.



7 Have the students with the cards labeled: *Uranium, Coal, Oil, Natural Gas, Sun, Wind, Water, and Biomass* stand up and one by one read their cards. As they read the definitions, ask the rest of the class whether they think the resource is renewable or non-renewable.

Suggested Procedure

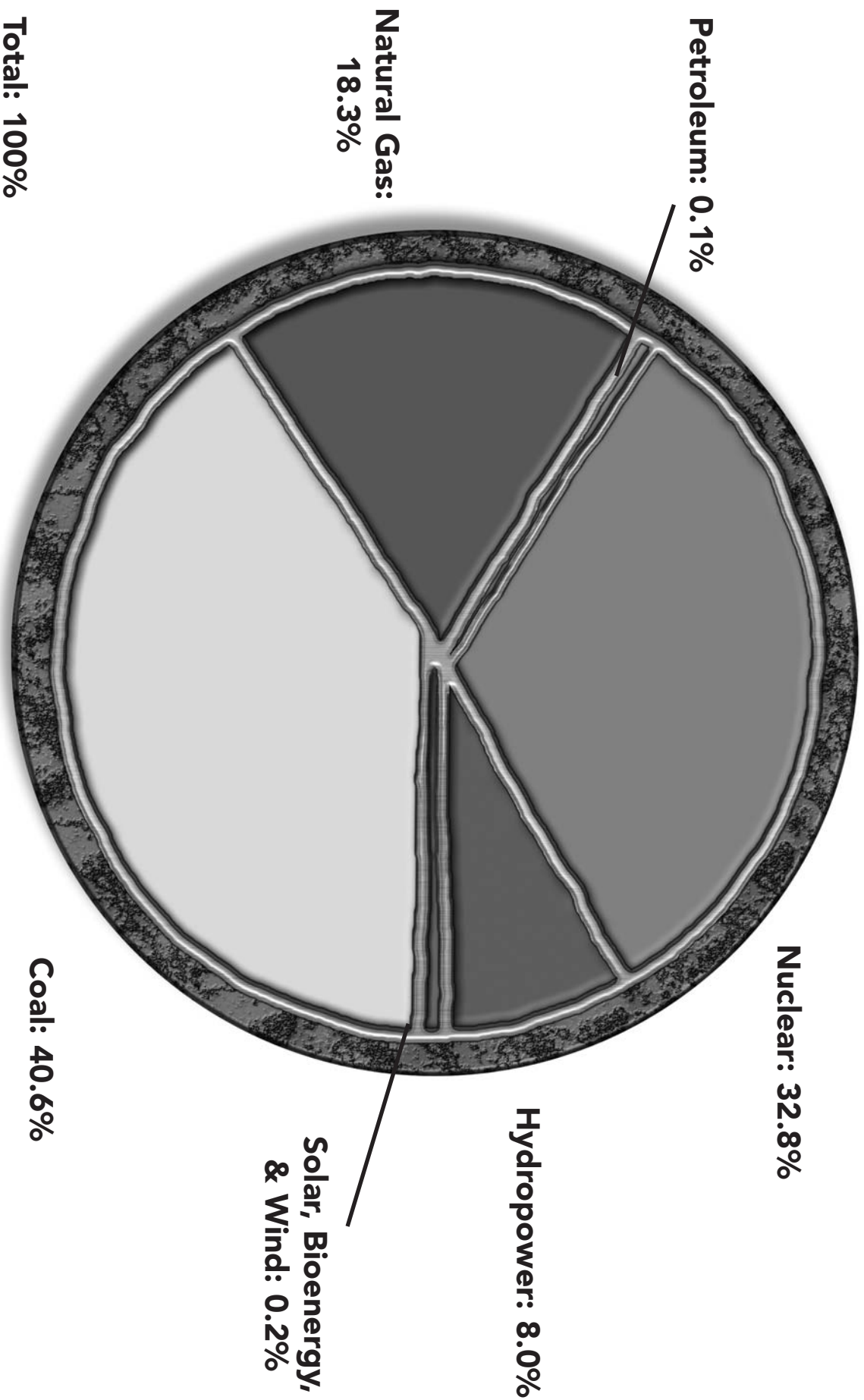
8 Ask students to repeat the names of the three fossil fuels and ask the student with the *Fossil Fuels* card to read their definition. Reiterate that fossil fuels are a nonrenewable energy resource.

9 Discuss the similarities and differences of how electricity is produced from the different energy sources. Ask the class what resources they think are used to produce electricity in Arizona: renewable or nonrenewable?

10 Display the overhead transparency, *Natural Resources Used to Generate Electricity in Arizona*. This circle graph (or pie chart) depicts the natural resources that are used to produce electricity here in Arizona. Ask students to interpret the circle graph. Review the graph and be sure students understand that we get most of our electricity from fossil fuels — specifically, coal. While we do get most of our electricity from nonrenewable resources, our electric companies are more and more interested in developing ways to produce electricity from renewable resources. Why might that be?

11 Assign students to read the booklet, *Nonrenewable Energy Sources – Powering Our Past and Present, What About Our Future?* Explain that the booklet will provide more information about nonrenewable energy sources. Following the reading assignment and some additional preparation, the entire class will go on the *eJourney*, an on-line, interactive computer learning activity in which they will discover renewable energy. Explain that this whole renewable energy unit is called ***Powering Our Future*** and ask students to consider: *How will we power our future?*

Natural Resources Used to Generate Electricity in Arizona



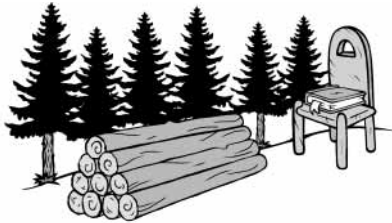
source: <http://www.eia.doe.gov>

Defining Energy Cards



natural resources

Materials and energy obtained from the natural environment for human use.



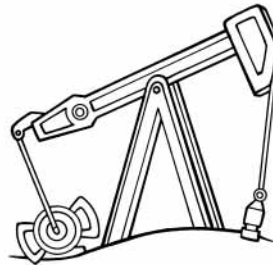
renewable natural resources

Resources that are replenished or made “new” through natural cycles. Trees and other plants, or energy from sun, wind, and water are all renewable natural resources.



nonrenewable natural resources

Resources that are not replenished through natural cycles or are replenished extremely slowly, on a geological time frame. Because they cannot be made “new” by nature, nonrenewable resources are limited in supply.



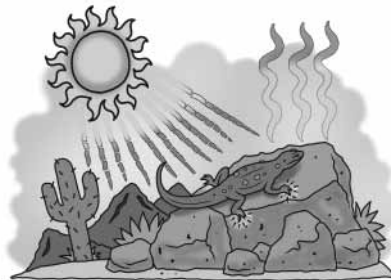
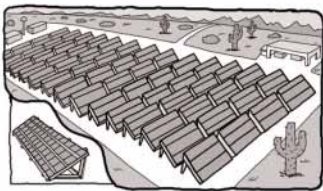
fossil fuels

Fossil fuels are the remains of plants and animals that lived long, long ago. Over time, they were buried under layers of earth. Decomposition, pressure and heat transformed them into coal, oil and natural gas. To produce electricity, fossil fuels are burned. The heat is used to produce steam. The steam powers a turbine generator which produces electricity. Fossil fuels are nonrenewable.



sun - solar power

Energy, radiated from the sun and used by humans in the forms of heat and light. Solar energy can be used to generate electricity in two ways: The heat from the sun can be concentrated to produce steam. The steam powers a turbine generator which produces electricity. Light energy from the sun can be transformed directly into electricity. This is called the photovoltaic effect.



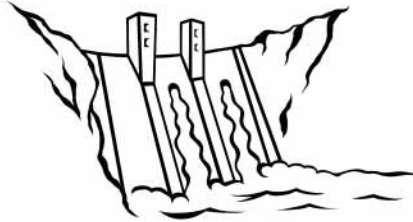
wind - wind power

The circulation of air caused by the uneven heating of the earth's surface. Blowing wind can make a turbine spin. A spinning turbine connected to a shaft can be used to spin magnets inside a coil of copper wires (this is called a generator). This creates electricity.



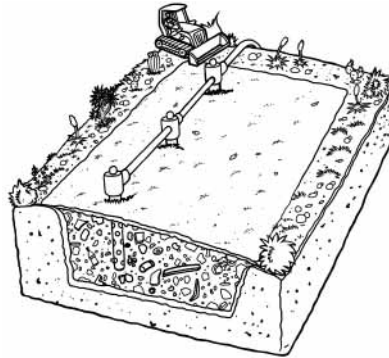
water - hydropower

The water cycle is a never-ending cycle on Earth. Hydropower is the force of moving water caused by gravity. Flowing water can make a turbine spin. A spinning turbine connected to a shaft can be used to spin magnets inside a coil of copper wires (this is called a generator). This creates electricity. Electricity made with flowing water is called hydroelectric power.



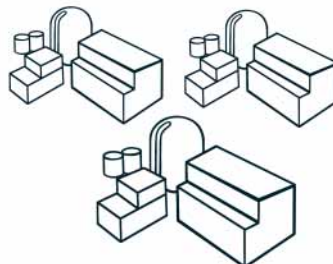
biomass - bioenergy

Any organic material that may be used for its energy content. Wood and other plant matter, garbage, yard waste, agricultural waste, animal waste and human waste are all forms of biomass. The energy that we get by burning biomass is called bioenergy. Biomass can also be burned to produce electricity. The heat is used to produce steam. The steam powers a turbine generator which produces electricity.



uranium

A radioactive, metallic substance that occurs in different kinds of rocks all over the world. Nuclear energy is released as heat energy when the nucleus of uranium atoms are split (a process called fission). To produce electricity, the heat that results from fission is used to produce steam. The steam powers a turbine generator which produces electricity.



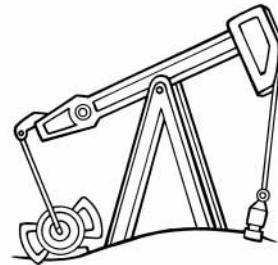
coal

A solid, black fossil fuel. Coal formed from the remains of plants that grew in swamps millions of years ago. Earth has more coal than any other fossil fuel.



oil

A liquid fossil fuel that formed from the remains of plants and animals that lived long ago.

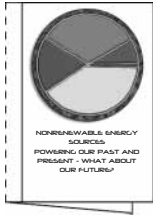


natural gas

A colorless, odorless, gaseous fossil fuel that formed from the remains of plants and animals that lived long ago. Natural gas is usually found with coal or oil.

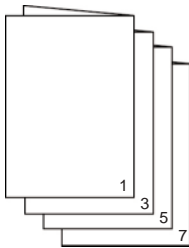


How to Construct the Nonrenewable Energy Sources Booklet



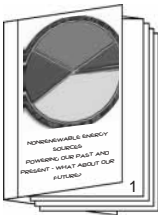
Step 1

1. Fold the cover page carefully in half. Line up the corners evenly. Be sure the illustration and cover text is on the outside.



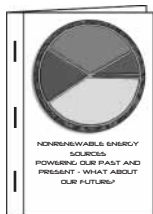
Step 2

2. Fold each of the interior pages in half with the text on the outside. Stack them in order with the open edges to the left and folded edges to the right.



Step 3

3. Place the stack of interior pages in order inside the front cover. The open edges of the interior pages should be tightly tucked into the fold of the cover page.



Step 4

4. With the cover tightly covering the open edges of the interior pages, evenly place three staples along the left edge of the booklet.

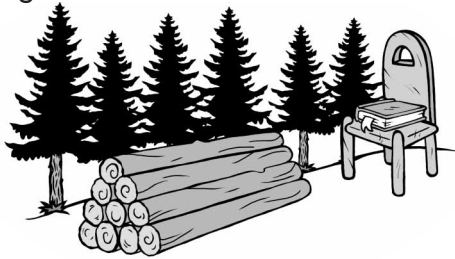
You now have your booklet!



**NONRENEWABLE
ENERGY SOURCES -
POWERING OUR PAST
AND PRESENT,
WHAT ABOUT OUR FUTURE?**

NATURAL RESOURCES

Look around you! Everything you see comes from our environment. Everything starts as part of nature. That includes things made by people or by machines. Originally, it all came from the environment!



Materials and energy that we take from nature are called **natural resources**. Everything you have is made of natural resources. That includes this booklet, your pencil, and your desk. It includes everything in the room. It even includes the walls around you!

Natural resources are also the source of the energy we use. They power our cars and buses, lights and televisions, heaters and coolers.

There are two main kinds of natural resources. **Renewable resources** can be made “new” by nature. The sun rises again and again with each new day. The water cycle continues on and on. More trees grow. More winds blow. Energy from sun, water, wood, and wind is **renewable energy**. Therefore the sun,



water, wind and wood are considered to be **renewable energy resources**.

Nonrenewable resources can not be made “new” by nature. Fossil fuels like coal, oil, and natural gas are forms of **nonrenewable energy resources**. They took millions of years to form. Minerals like iron and aluminum come from ores in the earth. These are also nonrenewable. Once we take them from the earth and use them, they are not replenished by natural cycles – at least not on a time scale useful to humans.

Both renewable and nonrenewable resources are limited. Only so much water will flow at a given time. Trees can only grow so fast. And so on. The only resource without limits is the energy of the sun.

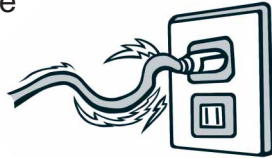
We need natural resources! They are the source of all we have. We need a healthy environment too! Our use of resources affects the environment. This makes it important to be careful about how we use resources.



To **conserve** resources means to use them wisely. We conserve resources when we save energy and when we reduce, reuse, and recycle. This is good for us, good for other people, and good for the environment.

FOCUS ON ELECTRICITY

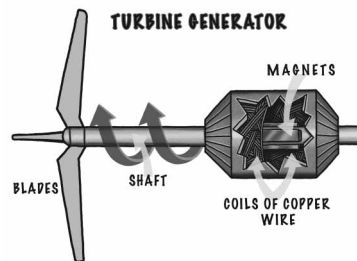
Electricity is a special kind of energy. You use electricity in many ways. It can be used to make light, heat, or sounds. We use it to run all kinds of motors. Just think! In only one day, you might use an electric lamp, clock, water heater, hair dryer, refrigerator, toaster, radio, TV and computer!



Where do we get electricity? The electricity we use is made from natural resources. Several kinds of renewable and nonrenewable natural resources can be used to make electricity. In many cases, the process is much the same.

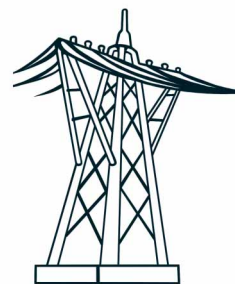
It all depends on a special relationship between magnets and electricity. Each affects the other. It's amazing! When electricity flows through a wire, any nearby magnets are affected. And magnets moving near wire cause electricity to flow in the wire.

Most power plants make electricity with **turbine generators**. These special machines depend on the relationship between magnets and electricity. Turbine generators have two main parts: The **turbine** has blades that spin. The **generator** has magnets and wires.



A shaft runs from the turbine to the generator. The end of the shaft in the generator has magnets on it. Around the magnets are coils of wire. When the turbine spins, the shaft and magnets spin too. The spinning magnets cause electricity to flow in the wires.

But what starts the turbine spinning? Energy from natural resources! It can be **renewable energy** sources like sun, wind, or flowing water. Or it can be nonrenewable energy sources. The two main types of nonrenewable energy sources we use are nuclear fuels and fossil fuels. The main kinds of fossil fuels are coal, oil, and natural gas. To make electricity, fossil and nuclear fuels are first used to make heat. The heat is used to make steam. The steam moving past the turbine blades makes them spin. As described above, the turbine spins the shaft and magnets of the generator to produce electricity.



Finally, this electricity flows to where you can use it! Electricity flows along metal transmission wires. Metal is a good conductor of electricity. A **conductor** is anything that lets electricity flow through it. Electric wires bring us electricity from hundreds of miles away. Perhaps it came from a coal-fired plant in Northern Arizona. Or maybe it was generated by a hydroelectric dam along the Colorado River. Regardless of where it came from, the electricity we use originated from a natural resource.

FOSSIL FUELS

Fossil fuels are important energy resources. We rely on them for most of our electricity as well as most of our transportation needs.

Fossil fuels are the remains of plants and animals that lived long ago. When the plants and animals died, they were buried under layers of earth. They did not decay fully. Over time, pressure and heat caused changes in them. They became fossil fuels.

Fossil fuels include coal, oil, and natural gas. Like other fossils, these are a record of past life forms. They are found in sedimentary rock. All fossil fuels are nonrenewable natural resources.

Coal



Coal is a fossil fuel. It formed from the remains of plants that grew in swamps millions of years ago. Earth has more coal than any other fossil fuel.

Coal looks like rocks. Some coal is hard, black, and shiny. Other coal is dull and brown. Coal can be burned. Coal is mined from the earth for our use.

The Chinese people used coal in 1000 BC. The ancient Romans used it too, from 50 to 450 AD. In Arizona, the Hopi Indians were using coal hundreds of years ago. Today, coal is used for making electricity.

Mining and burning coal have environmental costs. Coal mining can damage habitat and cause erosion. Sometimes it causes toxic runoff to rivers or ground water.

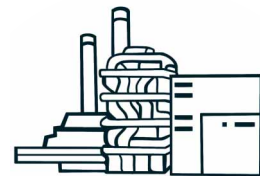


Burning coal creates air pollution. This pollution can include soot, smog, and acid rain. These can harm the air, water, and soil. Crops, forests, and other plants can be hurt. Animals and even buildings may be harmed as well. Burning coal also adds to the problem of global warming.

Coal is a nonrenewable natural resource. The United States has a great deal of coal. In fact, 1/4 of all the coal on Earth is found in the U.S.! In Arizona, almost half of our electricity is made with coal.

Natural Gas

Natural gas is a fossil fuel. It is usually found with coal or oil. Like these other fossil fuels, natural gas formed from the remains of plants and animals that lived long ago.



Special wells are used to take natural gas from deep in the Earth. Sometimes it can escape by itself through a crack in the ground. Natural

gas burns easily. Lightning can start a fire where it escapes the ground.

In about 1 AD, the Chinese became the first people to burn natural gas as a fuel. Now people in many parts of the world use it for heating and cooking. We also use it to make electricity.

Natural gas burns fairly cleanly. It creates less air pollution than coal or oil. It also creates less greenhouse gases that cause global warming. Wells for collecting natural gas sometimes harm the environment. The soil and water nearby can be polluted. Some of the pollutants are poisonous. They can harm plants, livestock, and wildlife.

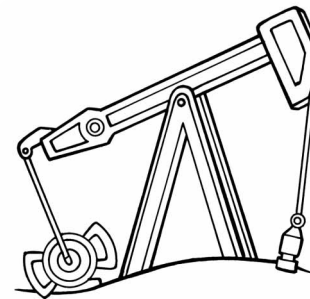
Arizona has very few natural gas deposits. The natural gas used here comes from other states. Our use of natural gas to make electricity is increasing.

Oil

Oil (also called petroleum) is a fossil fuel. It is a liquid that may be black, dark green, or golden brown. Like coal and natural gas, oil formed from plants and animals that lived long ago. In some ways, the chemicals in all these fossil fuels are much alike.



Crude oil is sometimes found on the surface of the ground. In ancient Mesopotamia, it was used to seal boats and as medicine. The ancient Egyptians used oil to preserve mummies. Around 50 to 450 AD, the Romans became first to burn oil as a fuel.



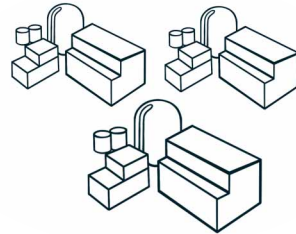
Wells must be used to take oil from underground. The first oil well was drilled in Pennsylvania in 1859. Crude oil can be made into several different kinds of products.

Oil is important in our overall energy use. Gasoline and diesel fuel are made from oil.

Most cars, trucks, boats, and planes are fueled in this way. Oil can also be burned to make electricity. This is common in some areas but not in Arizona.

NUCLEAR ENERGY

Nuclear energy is energy stored in the center (or nucleus) of atoms. Under special conditions, the center of an atom can be split apart. This splitting of the center of an atom is called fission. Fission releases stored nuclear energy as heat.



Electricity can be made from nuclear energy. A special kind of material called **uranium** is used. Uranium is radioactive. It is the heaviest metal that occurs naturally in Earth's crust. When uranium atoms are split, they produce heat. The heat is used to run a turbine generator to produce electricity.

The first nuclear power plants were built in the 1950s. Today in Arizona, over 1/3 of our electricity is made from nuclear energy.

Making electricity from nuclear energy does not release any pollution or greenhouse gases. However, as with all kinds of mines, uranium mines affect the land, plants, and wildlife. In very rare cases, there have been radioactive leaks from nuclear power plants. These can cause health and safety problems. Also, the nuclear waste from used uranium fuel is radioactive. It must be stored safely for thousands of years.

POWERING OUR PAST, WHAT ABOUT OUR FUTURE?

As you can see, nonrenewable energy sources benefit us in many ways. There are many benefits but there are costs, too. These costs are usually environmental, resulting from the mining and burning of these fuel sources.

We continue to rely on nonrenewable energy resources. Remember however, that these resources are nonrenewable. There is only so much oil, gas and coal in the ground. There is also a limited supply of nuclear fuels.

You have discovered many things about nonrenewable energy sources. It's now time for you to discover renewable energy sources. Like fossil fuels, the renewable energies of wind, water, the sun were important energy sources in the past. It's time for you to take a journey to see how renewable energy powered the past and will also power our future!

