

Energy and Energy Resources

section 1 Sources of Energy

Before You Read

You must plug in most appliances before they will work. Where does the energy in an electrical outlet come from?

What You'll Learn

- what renewable, nonrenewable, and alternative resources are
- the advantages and disadvantages of using different energy sources.

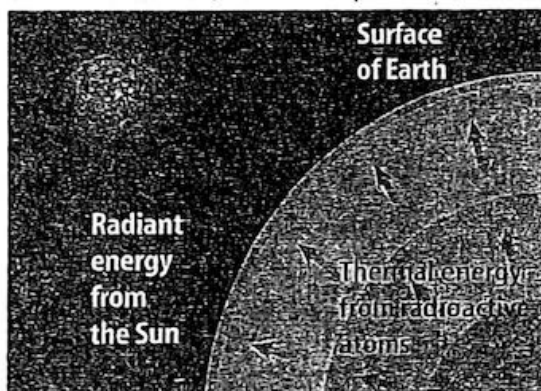
Read to Learn

Using Energy

Energy is used every day to provide light and heat to homes, schools, and workplaces. The law of conservation of energy states that energy cannot be created or destroyed. It can only change form. If a car or refrigerator cannot create energy, where does the energy come from?

Energy Resources

Energy must come from the natural world. The surface of Earth gets energy from two places. It comes from the Sun and radioactive atoms in Earth's interior. Earth gets far more energy from the Sun than is made in Earth's interior. Almost all the energy you use today can be traced to the Sun. Even the gasoline used to power a car can be traced to the Sun.



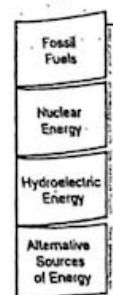
Mark the Text

Identify Details As you read this section, highlight the text each time that you read about an energy source.

FOLDABLES™

D Organize Information

Make the following Foldable to organize information about the fossil fuels, nuclear energy, hydroelectric energy, and alternative sources of energy.



Fossil Fuels

Fossil fuels are coal, oil, and natural gas. Oil and natural gas were made from the remains of microscopic organisms. These organisms lived in Earth's oceans millions of years ago. Heat and pressure slowly turned these organisms into oil and natural gas. Coal was formed in a similar way.

As shown in the figures below, coal was made from the remains of plants that once lived on land. Through photosynthesis (foh toh SIHN thuh sus), ancient plants transformed the radiant energy from sunlight into chemical energy. The chemical energy is stored in molecules. Over time, heat and pressure changed these molecules into fossil fuel. Chemical energy stored in fossil fuels is released when the fossil fuels are burned.

Picture This

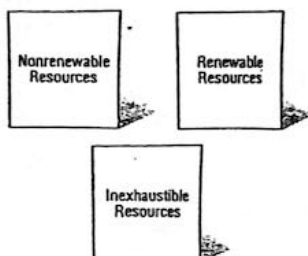
1. **Identify** What three things changed the plant molecules into coal molecules?



FOLDABLES

E Compare and Contrast

Use three quarter-sheets of notebook paper to help you compare and contrast nonrenewable resources, renewable resources, and inexhaustible energy sources.



Can fossil fuels be replaced?

Most of the energy you use comes from fossil fuels. It takes millions of years to replace each drop of gasoline and each lump of coal that is burned. This means that the amount of fossil fuels on Earth will keep decreasing as it is used. Fossil fuels are nonrenewable resources. A nonrenewable resource is an energy source that is used up much faster than it can be replaced.

Disadvantages of Fossil Fuels Burning fossil fuels also makes chemical compounds that cause pollution. Each year billions of kilograms of air pollutants are made by burning fossil fuels. These pollutants cause respiratory illnesses and acid rain. Carbon dioxide gas is made when fossil fuels are burned. This carbon dioxide gas might cause Earth's climate to warm.

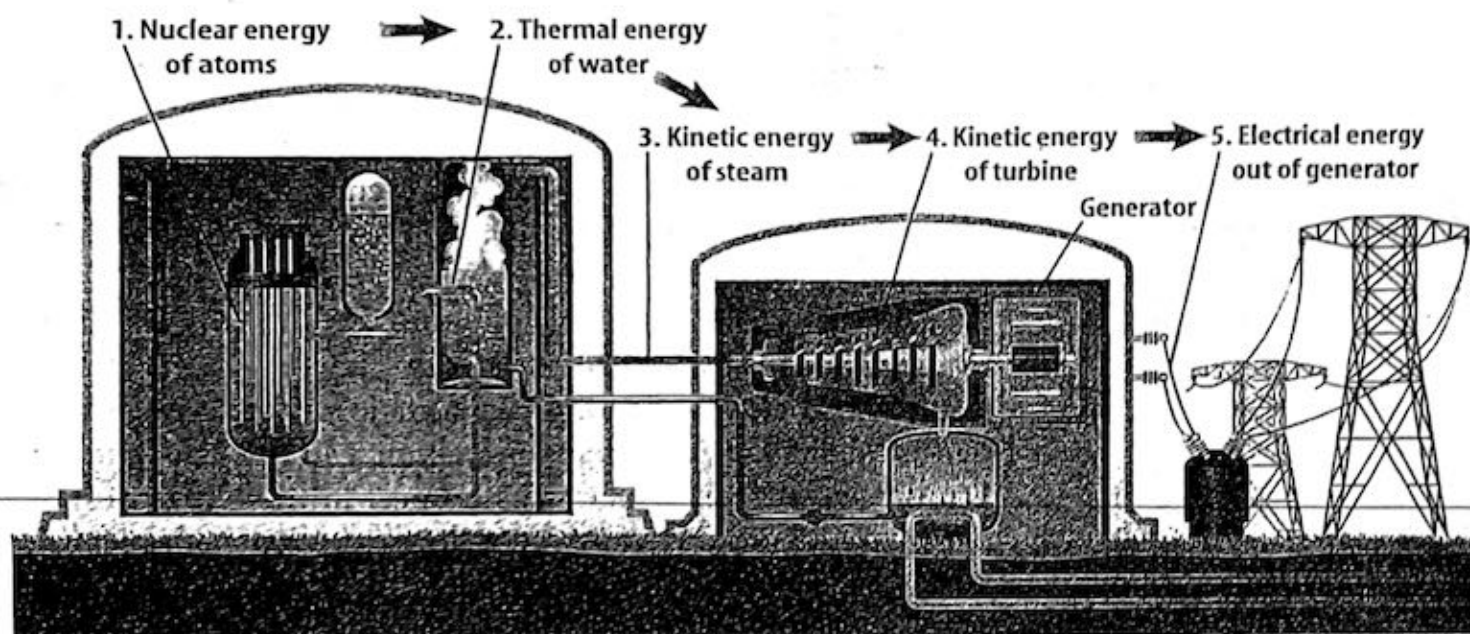
Nuclear Energy

Can you imagine 1 kg of fuel that has almost 3 million times more energy than 1 L of gas? What could have so much energy in so little mass? The answer is the nuclei of uranium atoms. When these nuclei break apart, they release huge amounts of energy. This energy is used to make electricity by heating water. The figure shows this process. The water makes steam that spins an electric generator. The generator makes electricity.

Picture This

2. **Identify** What type of energy does the steam and the turbine have in a nuclear power plant?
-

Electrical Energy from Nuclear Energy



What are the advantages of nuclear energy?

Making electricity by using nuclear energy helps make the supply of fossil fuels last longer. Nuclear power plants also produce almost no air pollution. In one year, a typical nuclear power plant makes enough energy to supply 600,000 homes with electricity. To do this, it produces only 1 m³ of waste.

What are the disadvantages of nuclear energy?

One disadvantage of nuclear energy is that uranium is a nonrenewable resource. It comes from Earth's crust. Another disadvantage is that nuclear waste is radioactive and can be dangerous to living things. Some of the materials in nuclear waste will remain radioactive for many thousands of years. This means nuclear waste must be carefully stored so no radioactivity will be released into the environment for a long time. ✓

✓ Reading Check

3. **Determine** What are two disadvantages of nuclear energy?
-
-

How can nuclear waste be stored?

One way to store nuclear waste is to seal it in a ceramic material that is put in protective containers. Then the containers are buried far underground. The place to bury them has to be chosen carefully. It cannot be near underground water supplies. It also has to be safe from earthquakes and other natural disasters. Earthquakes and other natural disasters could cause the radioactive material to leak.



Think it Over

4. **Infer** Which of the following is a renewable resource? Circle your answer.
- a. water
 - b. coal
 - c. oil
 - d. natural gas

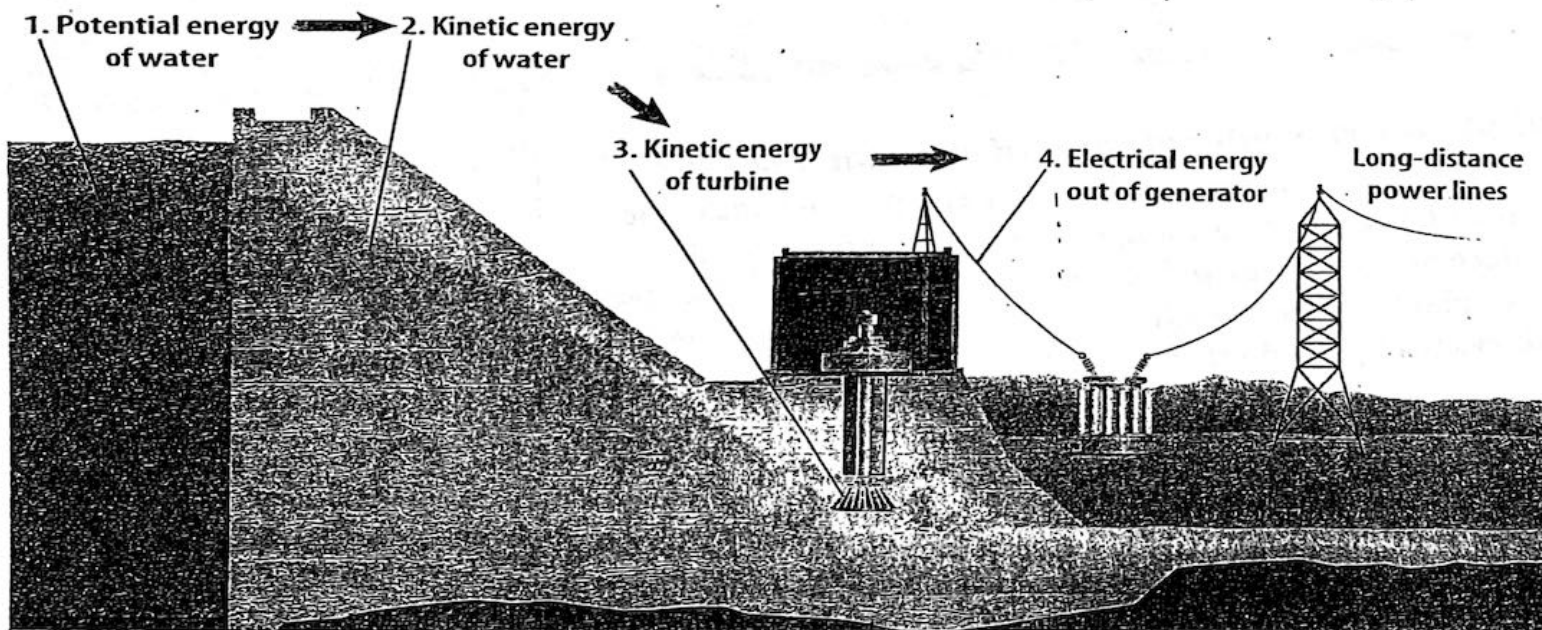
Picture This

5. **Identify** What type of energy does the water have when it flows through the dam?
- _____

Hydroelectricity

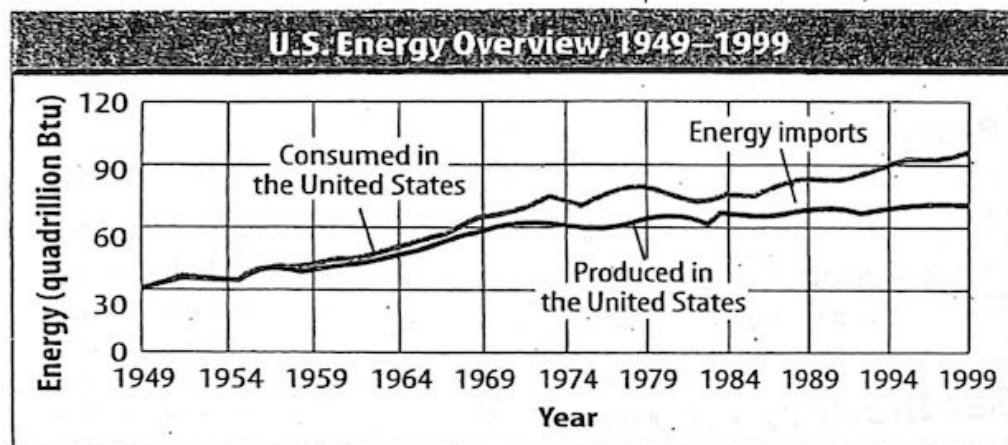
The potential energy of water trapped behind a dam can be transformed into electrical energy. Energy made this way is called hydroelectricity. This is shown in the figure below. About 20 percent of the world's electrical energy comes from water. Hydroelectricity is the largest renewable source of energy. A renewable resource is an energy source that is replaced continually. As long as rivers flow, hydroelectric power plants can make electricity.

Hydroelectricity makes little pollution. This is an advantage over some other sources of electricity. However, the production of hydroelectricity does have a major disadvantage. It upsets the life cycle of some animals that live in the water. Dams have caused problems for salmon in the Northwest. Salmon return to the spot where they were hatched to lay their eggs. Many salmon cannot reach these places because of dams. There are plans to remove some dams and build fish ladders to help fish go around other dams.



Are energy consumption and production equal?

More energy is being consumed, or used, in the United States than is being produced, or made. You use energy every day—to get to school, to watch TV, and to heat or cool your home. The amount of energy used by an average person has increased. Therefore, more energy must be made. The graph shows energy consumption and production by the United States from 1949 to 1999.



Applying Math

6. Reading Graphs

About what year did the United States start consuming more energy than it produced?

Alternative Sources of Energy

There are many ways to make electrical energy. Each has disadvantages that can affect the environment and humans. Alternative resources are being researched: **Alternative resources** are new sources of energy that are safer and less harmful to the environment. Alternative resources include solar energy, wind energy, and geothermal energy.

Solar Energy

The Sun is an inexhaustible resource. An **inexhaustible resource** is an energy source that cannot be used up by humans. The amount of solar energy that hits the United States in one day is more than the total amount of energy used by the country in one year. But less than 0.1 percent of the energy used in the United States comes directly from solar energy. One reason is that solar energy is more expensive to use than fossil fuels. However, as the supply of fossil fuels decreases, it might become more expensive to find and mine fossil fuels. It might also become more expensive to mine them from Earth. Then, it might be cheaper to use solar energy or other energy sources to make electricity. ✓

✓ Reading Check

7. **Identify** What type of resource is the Sun?

How is the Sun's energy collected?

Two types of collectors take in the Sun's rays. Have you ever seen large rectangular panels on the roofs of houses or buildings? These are collectors for solar energy.

Thermal Collector If the panels had pipes coming out of them, they were thermal collectors. A thermal collector uses a black surface to absorb the Sun's radiant energy. Black absorbs more radiant energy than any other color. The thermal collector uses the Sun's radiant energy to heat water. The water can be heated to about 70°C. The hot water can be pumped through a house to provide heat. It can also be used for washing and bathing. ☒

Photovoltaic If the panel has no pipes, it is a photovoltaic (foh toh vohl TAY ihk) collector. A **photovoltaic** is a device that transforms radiant energy directly into electrical energy. Photovoltaics are used in calculators and satellites. They also are used on the *International Space Station*.

Geothermal Energy

Imagine you could go to the center of Earth, about 6,400 km below the surface. As you went deeper and deeper, the temperature would increase. After going only about 3 km, the temperature would be warm enough to boil water. At a depth of 100 km, the temperature could be over 900°C.

The heat made inside Earth is called geothermal energy. Some geothermal energy is made when unstable radioactive atoms inside Earth decay. This transforms nuclear energy into thermal energy. At some places deep within Earth, the temperature is hot enough to melt rock. Melted, or molten, rock is called magma. Magma rises up close to the surface through cracks in Earth's crust. Magma reaches the surface when a volcano erupts. In other places, magma gets close to the surface and heats the rock around it.

What are geothermal reservoirs?

In some places, magma is very close to Earth's surface. Rainwater and water from melted snow can seep down to the magma through the cracks and openings in Earth's surface. The magma heats the water and it can become steam. The hot water and steam can be trapped under high pressure in cracks and pockets. These are called geothermal reservoirs. Geothermal reservoirs are sometimes close enough to the surface to make hot springs and geysers. ☒

☒ Reading Check

8. **Apply** Why are thermal collectors black?

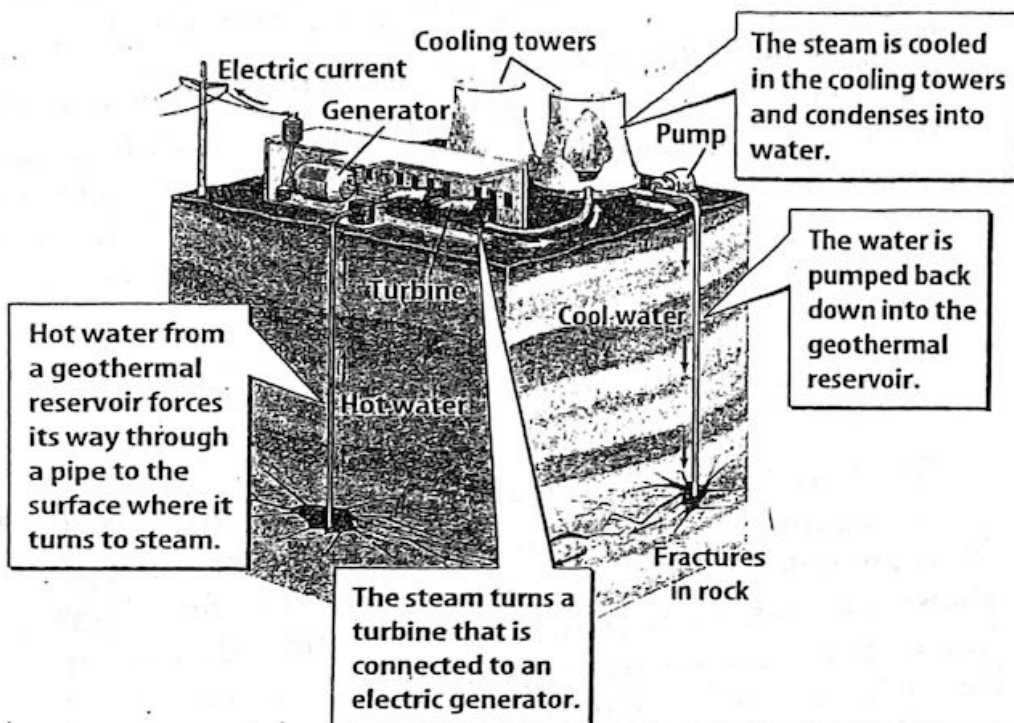
☒ Reading Check

9. **Determine** What does the magma in geothermal reservoirs turn water into?

How is geothermal power made?

Wells can be drilled to reach geothermal reservoirs in places where the reservoirs are less than several kilometers deep. Hot water and steam from geothermal energy is used by geothermal power plants to make electricity.

Geothermal Power Plant



The figure shows how geothermal reservoirs make electricity. Geothermal power is an inexhaustible resource. But geothermal power plants can be built only where geothermal reservoirs are close to Earth's surface, like in the Western United States.

How are heat pumps used?

Geothermal heat usually keeps the temperature of the ground that is several meters deep at 10° to 20°C . This constant temperature can be used to heat or cool buildings by using a heat pump.

During the summer, the air is warmer than the ground below. A heat pump sends warm water from the building through the cooler ground. The water cools and then is pumped back to the building to absorb heat. In the winter, the air is cooler than the ground below. Then, the cool water absorbs heat from the ground and releases it from the heat pump into the building.

Picture This

10. **Interpret an Illustration** Which is pumped back down into a geothermal reservoir from a geothermal power plant: steam, hot water, or cool water?
-


Think it Over

11. **Explain** Why does the cool water in the building absorb heat in the summer?
-
-

Reading Check

12. **Explain** What kind of resource is the movement of the ocean?
-

Energy from the Oceans

The ocean is constantly moving. If you have been to the seashore, you have seen the waves roll in. If you spent the day at the beach, you may have also seen the level of the ocean rise and fall. The rise and fall in the ocean level is called a tide. The movement of the ocean is an inexhaustible source of mechanical energy. Mechanical energy can be transformed into electric energy. Several electric power plants that use the motion in ocean waves, or tidal energy, have been built. 

How much change in water level is needed?

A high tide and a low tide each happen about twice a day. In most places, the level of the ocean changes by only a few meters. In some places, it changes by much more. In the Bay of Fundy in Eastern Canada, the ocean level changes by 16 m between high tide and low tide. Almost 14 trillion kg of water move into or out of the bay between high tide and low tide. This tidal energy makes enough electricity to power about 12,000 homes.

How is tidal energy used to make electricity?

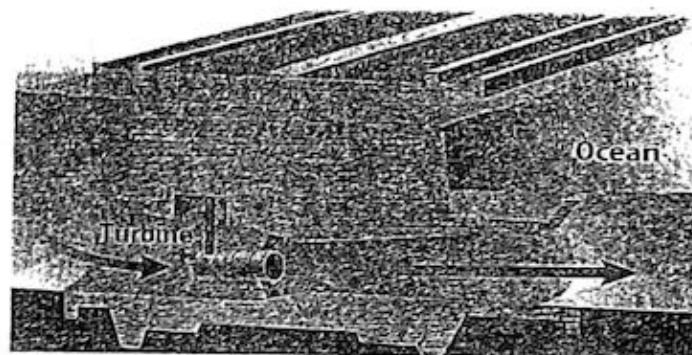
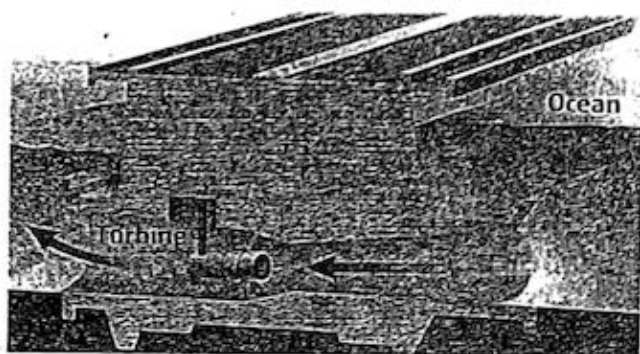
The figures below show how the power plant that has been built along the Bay of Fundy works. The first figure shows that as the tide rises, water flows through a turbine. The turbine causes a generator to spin, which makes electricity. The water is then trapped behind a dam. The second figure shows that when the tide goes out, the trapped water is released. It flows through the turbine making the generator spin. This makes more electricity. Electric power is made each day for about 10 hours.

Tidal energy is a clean, inexhaustible resource. But, only a few places have a large enough difference between high and low tide to build an electric power plant.

Picture This

13. **Highlight** Use a highlighter to trace the flow of water into and out of the tidal power plant.

Tidal Power Plant



Wind

Wind is another inexhaustible supply of energy. Modern windmills, like the ones in the figure, transform the kinetic energy of the wind into electrical energy. Electrical energy is made when wind spins the propeller. The propeller is connected to a generator, which makes electricity. These windmills produce almost no pollution. But windmills do make a lot of noise. You also need a large area of land to place a lot of windmills. Also, studies have shown that birds sometimes are killed by windmills.



Conserving Energy

Fossil fuels are a valuable resource. They are burned to provide energy. Oil and coal can be used to make plastics and other materials. To make the supply of fossil fuels last longer, people need to use less energy. Using less energy is called conserving energy.

You can save money by conserving energy. You should turn off appliances like televisions when you are not using them to conserve energy. Keep doors and windows closed tightly when it is hot or cold outside. This will keep heat from leaking out of or into your house. If cars were used less or were made more efficient, they would use less gas and oil, and therefore less energy. You also help conserve energy when you recycle aluminum cans and glass.

Picture This

14. **Infer** Why do you think the windmills shown in the figure are placed on top of mountains instead of between hills or mountains?



Think it Over

15. **Describe** What is another way you can conserve energy?

● After You Read

Mini Glossary

alternative resources: new renewable or inexhaustible energy sources

inexhaustible resource: an energy source that cannot be used up by humans

nonrenewable resource: an energy source that is used up much faster than it can be replaced

photovoltaic: a device that transforms radiant energy directly into electrical energy

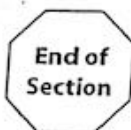
renewable resource: an energy source that is replaced continually

1. Review the terms and their definitions in the Mini Glossary. What is the difference between a renewable resource and a nonrenewable resource?

2. Write as many examples of renewable, nonrenewable, and inexhaustible resources in the chart as you can.

Renewable Resources	Nonrenewable Resources	Inexhaustible Resources

3. You were asked to highlight the text each time you read about an energy source. How did this help you learn about energy sources?



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