

Renewable Sources of Energy

You've just arrived at the campsite for your family vacation. The sun streaming through the trees warms your face. A breeze stirs, carrying with it the smell of a campfire. Maybe you'll start your day with a dip in the warm water of a nearby hot spring.

You might be surprised to learn that even in these woods, you are surrounded by energy resources. The sun warms the air, the wind blows, and heat from inside Earth warms the waters of the spring. These sources of energy are all renewable—they are constantly being supplied. Scientists are trying to find ways to put these renewable energy resources to work to meet people's energy needs.

Harnessing the Sun's Energy

The warmth you feel on a sunny day is solar energy, or energy from the sun. The sun constantly gives off energy in the forms of light and heat. Solar energy is the source, directly or indirectly, of most other renewable energy resources. In one day, Earth receives enough solar energy to meet the energy needs of the entire world for 40 years. Solar energy does not cause pollution, and it will not run out for billions of years.

So why hasn't solar energy replaced energy from fossil fuels? One reason is that solar energy is only available when the sun is shining. Another problem is that the energy Earth receives from the sun is very spread out. To obtain a useful amount of power, it is necessary to collect solar energy from a large area.

Solar Power Plants One way to capture the sun's energy involves using giant mirrors. In a solar power plant, rows of mirrors focus the sun's rays to heat a tank of water. The water boils, creating steam, which can then be used to generate electricity.

Solar Cells Solar energy can be converted directly into electricity in a solar cell. A solar cell has a negative and a positive terminal, like a battery. When light hits the cell, an electric current is produced. Solar cells power some calculators, lights, and other small devices. However, it would take more than 5,000 solar cells the size of your palm to produce enough electricity for a typical Spanish home.

Passive Solar Heating Solar energy can be used to heat buildings with passive solar systems. A passive solar system converts sunlight into thermal energy, which is then distributed without using pumps or fans. Passive solar heating is what occurs in a parked car on a sunny day. Solar energy passes through the car's windows and heats the seats and other car parts. These parts transfer heat to the air, and the inside of the car warms. The same principle can be used to heat a home.

Active Solar Heating An active solar system captures the sun's energy, and then uses pumps and fans to distribute the heat. First, light strikes the dark metal surface of a solar collector. There, it is converted to thermal energy. Water is pumped through pipes in the solar collector to absorb the thermal energy. The heated water then flows to a storage tank. Finally, pumps and fans distribute the heat throughout the building.

Hydroelectric Power

The sun is one source of renewable energy. Other renewable sources of energy include water, the wind, biomass fuels, geothermal energy, and hydrogen.

Solar energy is the indirect source of water power. Recall that in the water cycle, energy from the sun heats water on Earth's surface, forming water vapor. The water vapor condenses and falls back to Earth as rain and snow. As the water flows over the land, it provides another source of energy.

Hydroelectric power is electricity produced by flowing water. A dam across a river blocks the flow of water, creating a body of water called a reservoir. When a dam's floodgates are opened, water flows through tunnels at the bottom of the dam. As the water moves through the tunnels, it turns turbines, which are connected to a generator.

Today, hydroelectric power is the most widely used source of renewable energy. Unlike solar energy, flowing water provides a steady supply of energy. Once a dam and power plant are built, producing electricity is inexpensive and does not create air pollution. But hydroelectric power has limitations. In Spain, most suitable rivers have already been dammed. And dams can have negative effects on the environment.

Capturing the Wind

Like water power, wind energy is also an indirect form of solar energy. The sun heats Earth's surface unevenly. As a result of this uneven heating, different areas of the atmosphere have different temperatures and air pressures. The differences in pressure cause winds as air moves from one area to another.

Wind can be used to turn a turbine and generate electricity. Wind farms consist of many windmills. Together, the windmills generate large amounts of power.

Wind is the fastest-growing energy source in the world. Wind energy does not cause pollution. In places where fuels are difficult to transport, wind energy is the major source of power.

But wind energy has drawbacks. Few places have winds that blow steadily enough to provide much energy. Wind energy generators are noisy and can be destroyed by very strong winds. Still, as fossil fuels become more scarce, wind energy will become more important.

Biomass Fuels

Wood was probably the first fuel ever used for heat and light. Wood belongs to a group of fuels called biomass fuels, which are made from living things. Other biomass fuels include leaves, food wastes, and even manure. As fossil fuel supplies shrink, people are taking a closer look at biomass fuels. For example, when oil prices rose in the early 1970s, Hawaiian sugar cane farmers began burning sugar cane wastes to generate electricity. At one point, these wastes provided almost one fourth of the electricity used on the island of Kauai.

Aside from being burned as fuel, biomass materials can also be converted into other fuels. For example, corn, sugar cane, and other crops can be used to make alcohol. Adding the alcohol to gasoline forms a mixture called gasohol. Gasohol can be used as fuel for cars. Bacteria can produce methane gas when they decompose biomass materials in landfills. That methane can be used to heat buildings. And some crops, such as soybeans, can produce oil that can be used as fuel, which is called biodiesel fuel.

Biomass fuels are renewable resources. But it takes time for new trees to replace those that have been cut down. And producing alcohol and methane in large quantities is expensive. As a result, biomass fuels are not widely used today in the United States. But as fossil fuels become scarcer, biomass fuels may play a larger role in meeting energy needs.

Tapping Earth's Energy

Below Earth's surface are pockets of very hot liquid rock called magma. In some places, magma is very close to the surface. The intense heat from Earth's interior that warms the magma is called geothermal energy.

In certain regions, such as Iceland and New Zealand, magma heats underground water to the boiling point. In these places, the hot water and steam can be valuable sources of energy. For example, in Reykjavík, Iceland, 90 percent of homes are heated by water warmed underground in this way.

Geothermal energy can also be used to generate electricity. A geothermal power plant uses heat from Earth's interior as an energy source. Cold water is piped deep into the ground, where it is

heated by magma. The resulting steam can be used for heat or to generate electricity. Geothermal energy is an unlimited source of cheap energy. But it does have disadvantages. There are only a few places where magma comes close to Earth's surface. Elsewhere, very deep wells would be needed to tap this energy. Drilling deep wells is very expensive. Even so, geothermal energy is likely to play a part in meeting energy needs in the future.

The Promise of Hydrogen Power

Now that you have read about so many energy sources, consider a fuel with this description: It burns cleanly. It creates no smog or acid rain. It exists on Earth in large supply.

This ideal-sounding fuel is real—it's hydrogen. Unfortunately, almost all the hydrogen on Earth is combined with oxygen in water. Pure hydrogen can be obtained by passing an electric current through water. But it takes more energy to obtain the hydrogen than is produced by burning it.

Still, scientists find hydrogen power promising. At present, hydroelectric plants decrease their activity when the demand for electricity is low. Instead, they could run at full capacity all the time, using the excess electricity to produce hydrogen. Similarly, solar power plants often generate more electricity than is needed during the day. This extra electricity could be used to produce hydrogen. Scientists are also searching for other ways to produce hydrogen cheaply from water.

Car manufacturers are now developing cars that run on hydrogen fuel cells. These would produce water as emissions. That water might then be used again as fuel. You can see that if scientists can find a way to produce hydrogen cheaply, it could someday be an important source of energy.

Read the text and answer the following questions:

1. List six renewable energy sources.
2. What two forms of energy does the sun supply?
3. What are two reasons that solar energy has not replaced energy from fossil fuels?
4. How do solar cells work?
5. What is hydroelectric power?
6. What is gasohol?
7. How can geothermal energy be used to generate electricity?
8. In what common substance is most hydrogen on Earth found?

Solar House

A solar house uses passive and active heating systems to convert solar energy into heat and electricity.

