Chapter Highlights

- All technologies depend on information resources.
- Information technology is any electronic means of gathering, storing, organizing, and moving information.
- The computer is the main tool used in information technology.
- Data and information can be collected, stored, and retrieved in many ways.
- A computer changes data into bursts of coded electrical energy.

Test Your Knowledge

1. How is data different from information?
2. What do we call a system used to process facts into information?
3. Define *information technology*.
4. What type of data might an engineer need to gather when developing a product?
5. Describe a computer network.
6. List three places in which computer networks might be used.
7. Why are bar code scanners used at supermarket checkout counters?
8. List three computer output devices.
9. What does a computer program do?
10. What four parts do all computers have in common?

Correlations

SCIENCE

1. Find out how a bar code scanner works.

MATH

1. The binary number system is based on powers of 2 and uses only 0's and 1's. See if you can count to ten in this system. The chart below will help.

Powers:	2^3	2^2	2^1	2^0
Values:	8	4	2	1
1=				1
2=			1	0
3=			1	1
4=		1	0	0

LANGUAGE ARTS

1. Many grocery stores are now using computerized cash registers. The bar code on packages is scanned for price. What do you think are the benefits to the store and to the consumer? Write your ideas in a brief essay.

SOCIAL STUDIES

1. When were computers first developed? What technology had to be developed before it was possible to build electronic computers?
2. If you have computers in your home or school, how are they used?

CHAPTER 7

Energy Resources

Introduction

When people create and use technology, they consume energy—lots of energy. Energy is the force that makes all things move and work. Our people-made world is an energy-hungry machine.

We consume energy to transport people and products from place to place. We rely on energy to fuel the engines in our cars, trucks, trains, planes, and ships.

We consume energy to make electricity. Electricity feeds our homes, businesses, schools, and hospitals with power. Machines, appliances, and electric lights gobble up electricity at an enormous rate.

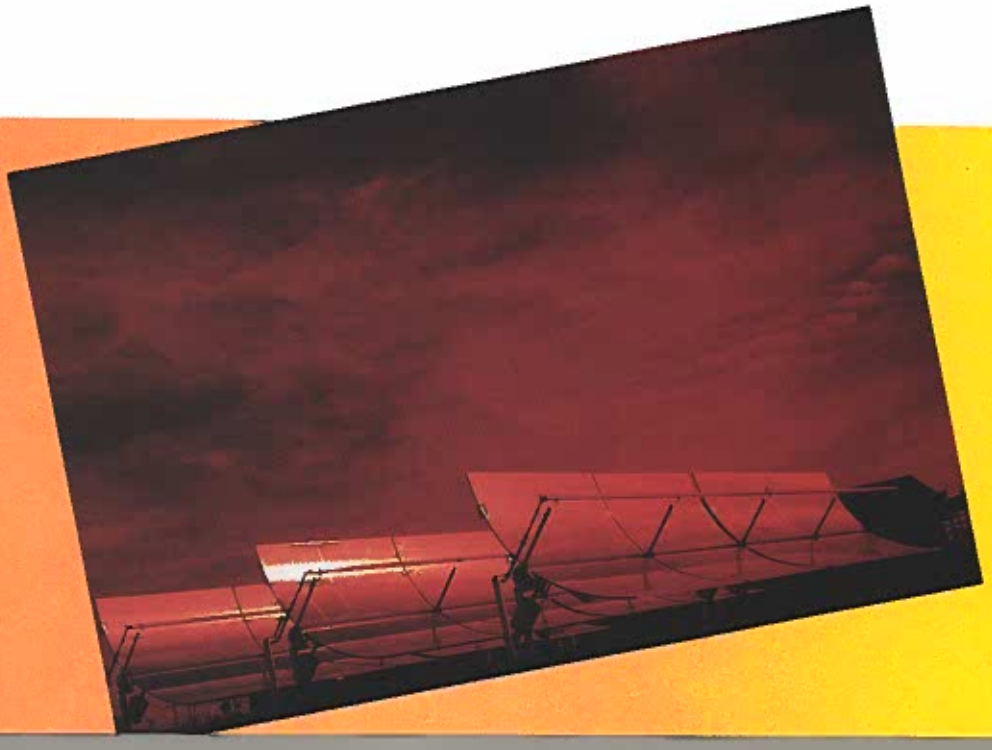
We consume energy when we change materials into products. Just think of the heat energy required to make steel, melt glass, and create food products. This chapter will help you become more familiar with our energy needs and how we fulfill them.

After reading this chapter, you should be able to

Define energy.
List the major forms of energy.
Discuss the major sources of energy.
Explain energy conversion.
Discuss energy-related problems.

Words you will need

energy
mechanical energy
chemical energy
atomic energy
kinetic energy
potential energy
law of conservation of energy
fossil fuels
photovoltaic cells
generator
hydroelectric plants
nuclear fission
nonrenewable resources



Work and Energy

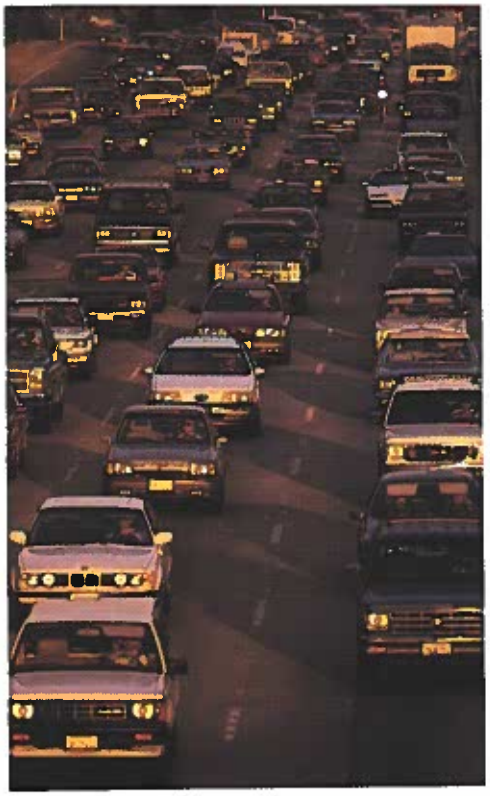
What is energy? **Energy** is the ability to do work and create movement. People are able to do work because of the energy they receive from food. When your body moves, it uses energy. When your body plays or works hard, it uses greater amounts of energy.

Technology uses energy for the same reasons. Fig. 7–1. Automobiles get energy by burning gasoline. Energy allows a car to move. To make the car move faster, the engine has to work harder. The harder the engine works, the more energy it consumes.

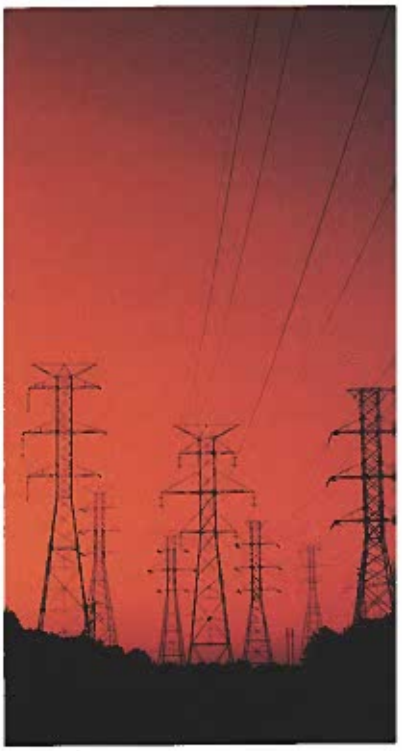
▶▶▶ FOR DISCUSSION ◀◀◀

1. Which of the four families of technology (communication, transportation, production, or biotechnology) do you think consumes the most energy? Explain your answer.
2. Make a list of all the devices you use each day that require some form of energy.

Products



Transportation



Energy

Fig. 7-1. Of all the energy we consume in this country: 37% is used to create products, 36% to transport people and goods, 16% to heat and power our homes, and 11% to run businesses.

Forms of Energy

Energy comes in a variety of forms. Work can be accomplished using any one or a combination of forms of energy. The most common forms of energy are:

- mechanical energy
- electrical energy
- light energy
- heat energy
- chemical energy
- sound energy
- atomic energy

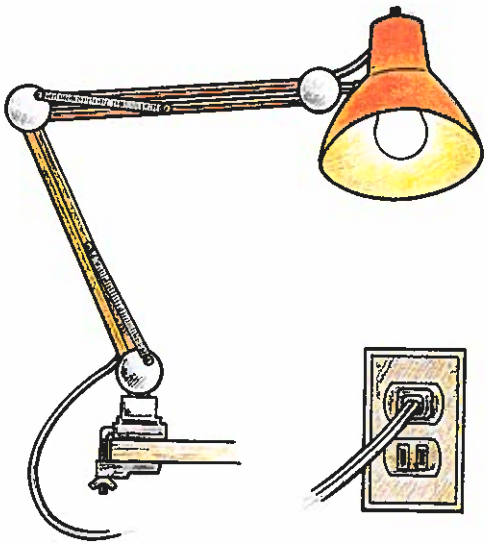


Fig. 7-3. Electrical energy is the flow of electrons through a wire.

Relationships Among Forms of Energy

Electric motors consume electrical energy for power. Fig. 7–2. These motors provide mechanical energy for many types of machines. **Mechanical energy** is the energy found in moving things. Electrical energy can also produce light energy, although the sun provides most of the light energy on earth. Fig. 7–3.

We have all experienced heat energy. Rub your hands together quickly and feel the heat build up from the friction.

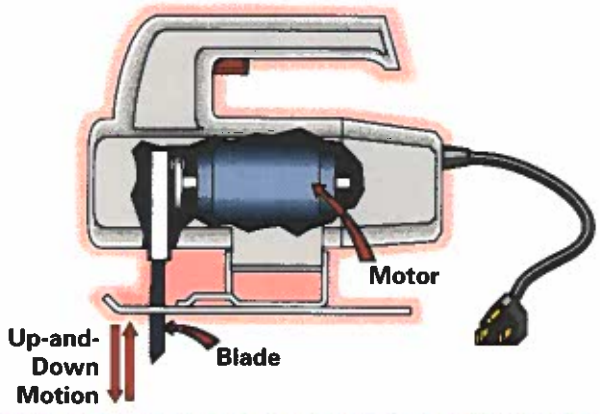


Fig. 7-2. Mechanical energy is the energy of motion. The motor in this saber saw uses electrical energy to create mechanical energy, which moves the blade up and down.

Heat from friction is also what causes a match to light. When the match head is rubbed against the striking surface, the heat releases the **chemical energy** stored in the match head. The match ignites, giving off heat and light. The sound made by striking the match is really sound energy vibrating the molecules of the surrounding air. Fig. 7–4.

Atomic energy is the energy stored in the nucleus of an atom. Nuclear reactors release a great deal of energy by splitting the nuclei of atoms. Fig. 7–5.

Energy Conversions

Changes in energy forms are called *energy conversions*. The most common energy conversion involves potential and kinetic energy. **Potential energy** is energy at rest, or stored energy. **Kinetic energy** is energy put into motion. Potential and kinetic energy changes take place all around us. Fig. 7–6.

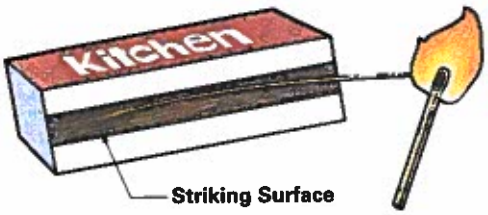


Fig. 7-4. Heat energy is often used to release the energy stored in chemicals. Sound energy vibrates the molecules in the air, creating the noise we hear.

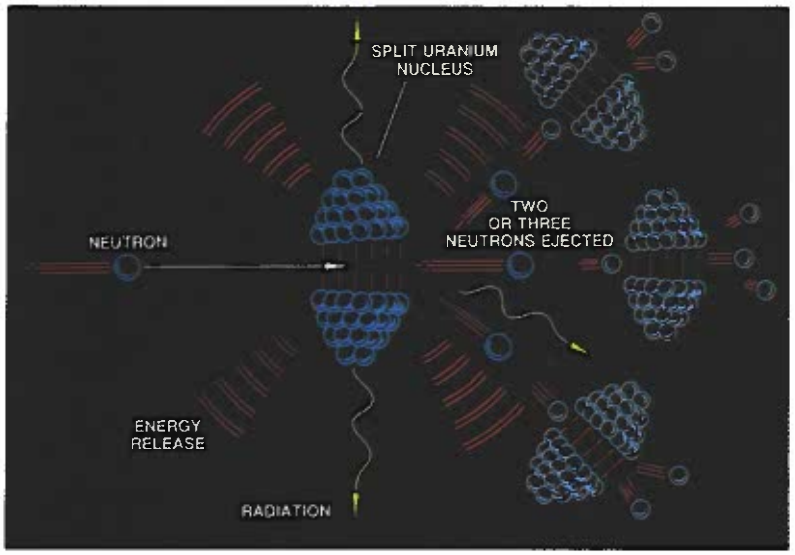


Fig. 7-5. A great deal of energy is released when an atom splits. Uranium-235 is often used in nuclear reactors.

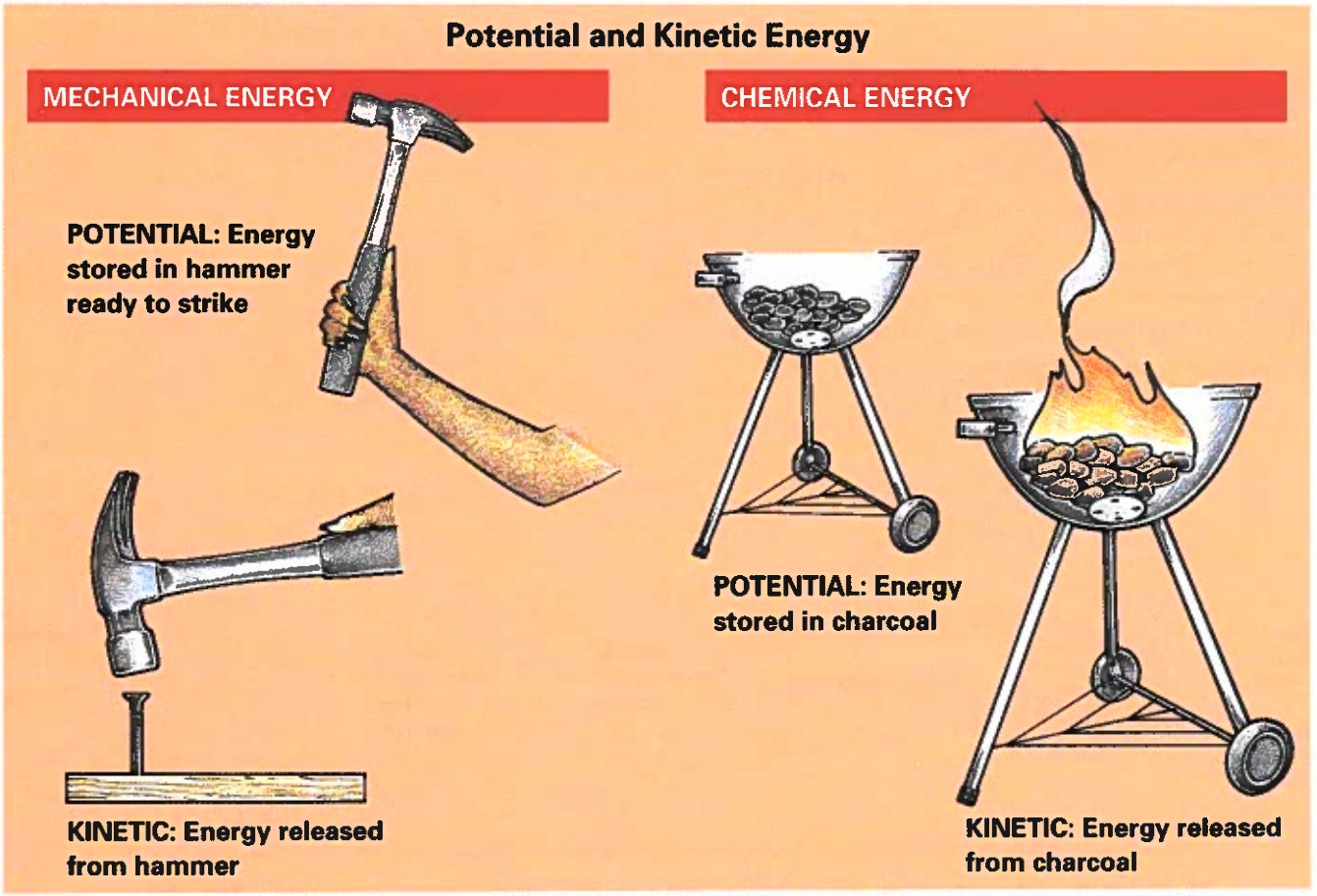


Fig. 7-6. All stored energy is potential energy, regardless of the form (mechanical, electrical, chemical, etc.). Kinetic energy is any form of energy in motion.

Other Energy Conversions

Energy changes other than potential and kinetic changes also take place. When a hammer hits a nail, for example, mechanical energy is changed into sound energy.

Have you ever felt a nail after it has been pulled from a board by a hammer? It's hot! Mechanical energy has been changed to heat energy.

In some cases, many energy changes occur to do what seems to be a simple task. For example, how many energy changes take place when you use a flashlight? Figure 7–7 shows these changes. Other examples of energy conversions are shown in Figure 7–8.

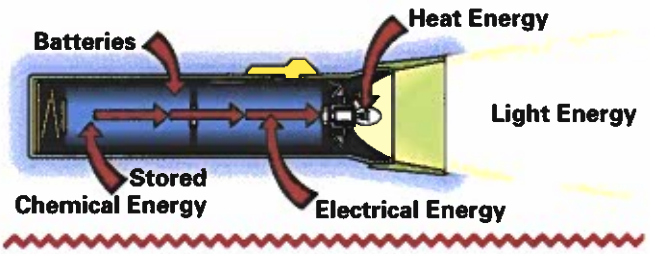


Fig. 7-7. Several energy conversions take place every time you switch on a flashlight.

Conservation of Energy

We often hear that the world may face an energy shortage in the near future. Why don't we create new energy?

We don't create new energy because it is not possible. Energy can be changed from one form to another, but it cannot be created or lost. This is called the **law of conservation of energy**.

▶▶▶ FOR DISCUSSION ◀◀◀

1. List the different forms of energy changes that take place during a bicycle ride. Start with the breakfast you eat before the ride.

2. If energy cannot be lost or destroyed, where does the heat absorbed by a concrete driveway go at night?

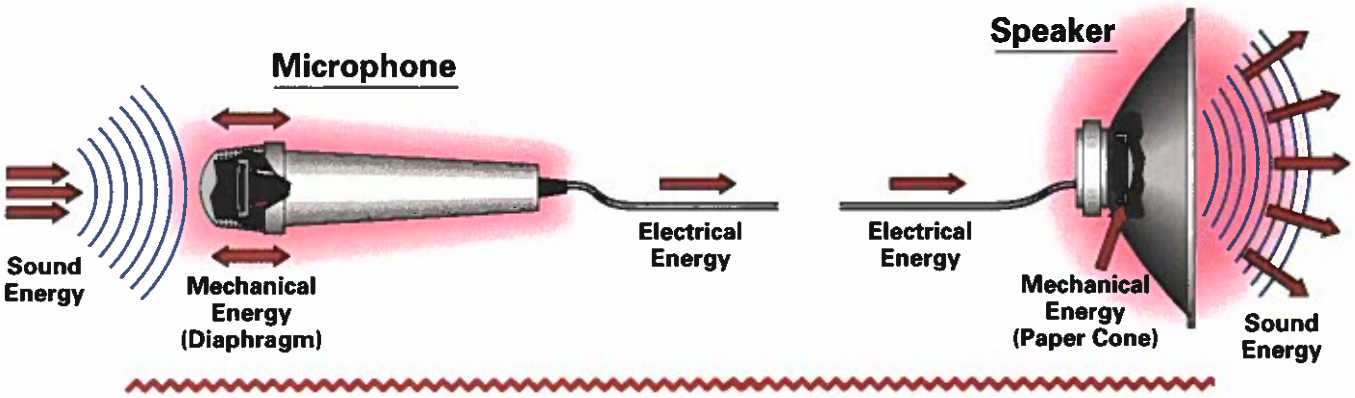


Fig. 7-8. A speaker and a microphone convert energy forms in opposite ways. The speaker converts electrical energy into sound energy; the microphone converts sound energy into electrical energy.

Where Does Energy Come From?

Where do we get the chemical energy we need to power an automobile? How do we change mechanical energy into the electrical energy we use at home? We are dependent on energy resources supplied by nature. Using technology, we have created methods for converting these resources into more useful energy forms.

Fossil Fuels

Most of the energy we use every day comes from fossil fuels. **Fossil fuels** are created when heat and pressure act on decaying plants and animals. It takes millions of years for decaying plants and animals to become fossil fuels. Fig. 7–9 A and B.

The three main fossil fuels are oil, coal, and natural gas. Fossil fuels provide us with gasoline, oil, and kerosene. When fossil fuels are combined with oxygen, they burn extremely well. This makes them very valuable as a source of energy. Figure 7–10 shows how fossil fuels are used to generate electrical energy.

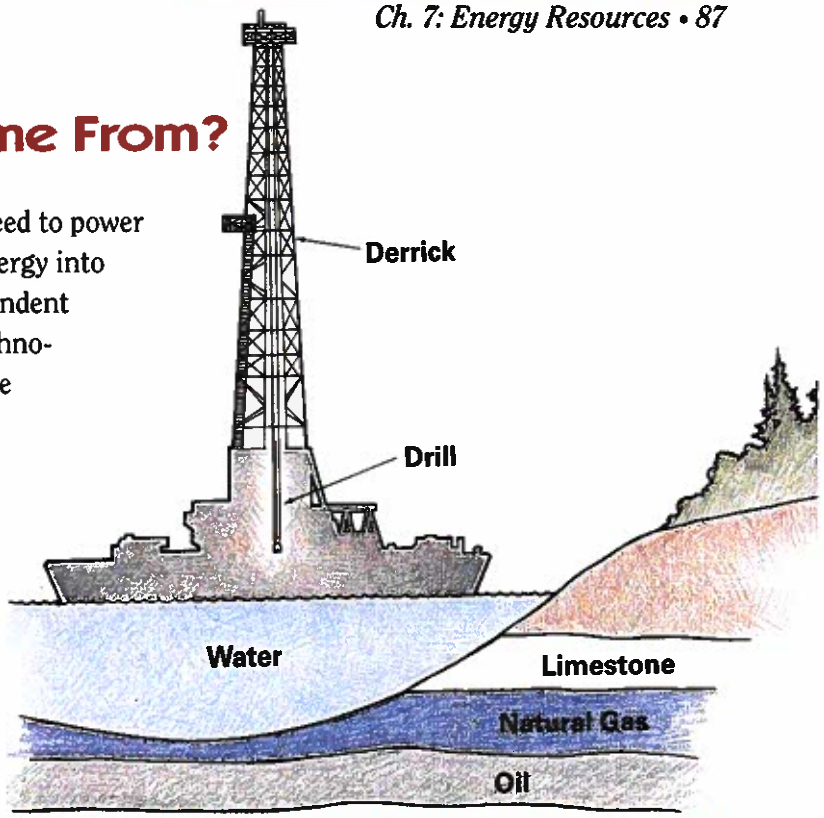


Fig. 7-9A. Oil and natural gas are created from decaying plants and animals. Millions of years of pressure and heat change the plant and animal remains into oil and natural gas.

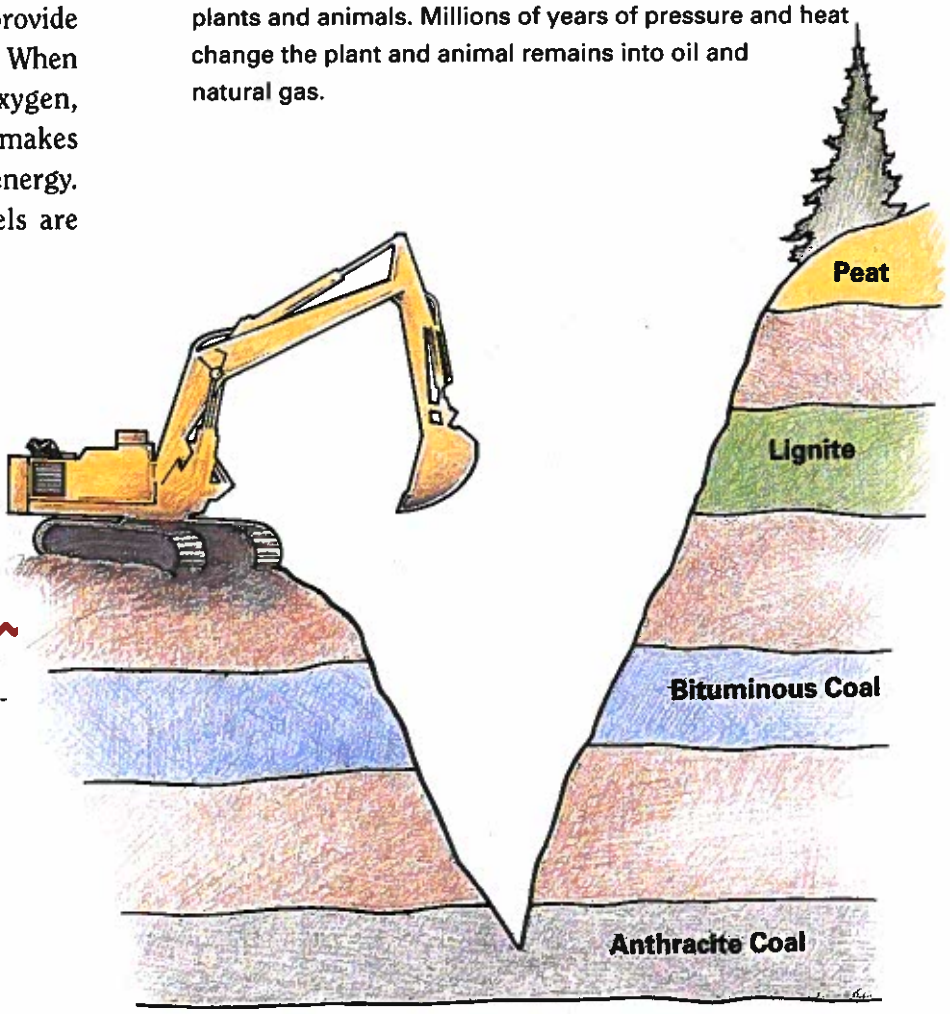


Fig. 7-9B. Coal is created when decaying plant and animal remains are compressed under sand, stone, or clay for millions of years. There are four types of coal: peat, lignite, bituminous, and anthracite.

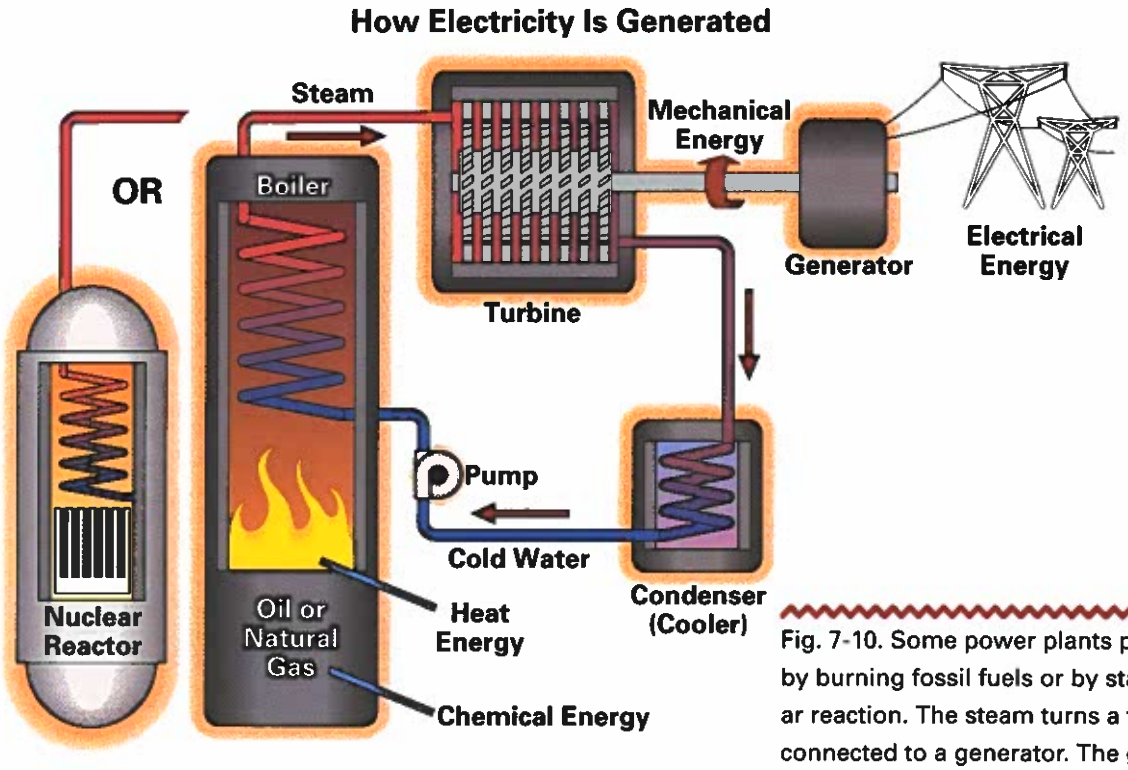


Fig. 7-10. Some power plants produce steam by burning fossil fuels or by starting a nuclear reaction. The steam turns a turbine that is connected to a generator. The generator changes mechanical energy into electrical energy.

Solar Energy

The light energy from the sun can be used to create heat energy and electrical energy. **Photovoltaic cells** (solar cells) change light energy directly into electrical energy. Fig. 7–11. Your calculator may use solar cells to provide electrical energy. The sun also provides a great deal of heat energy that can be used for heating air and water. Fig. 7–12.

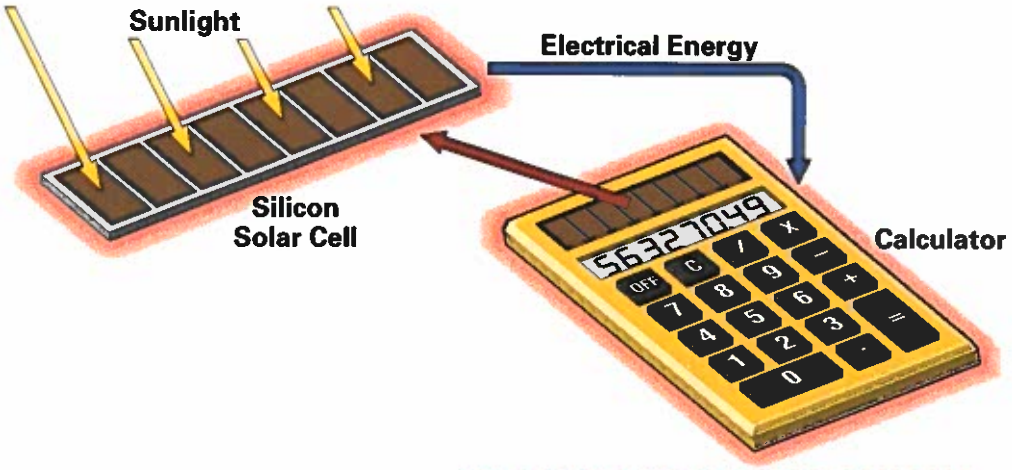


Fig. 7-11. A solar cell changes light energy directly into electrical energy.

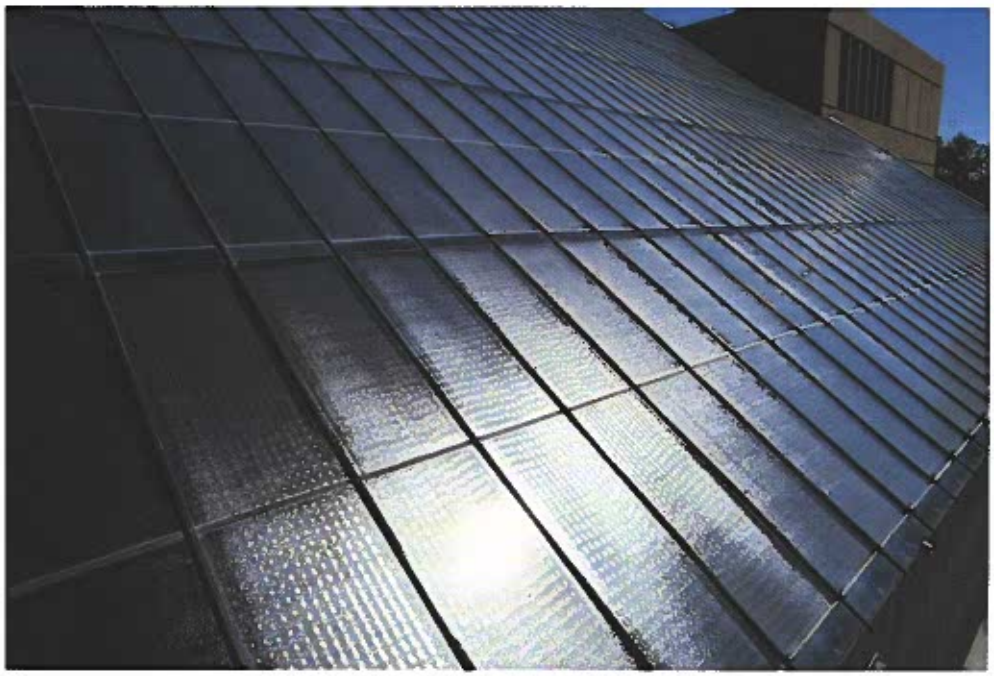


Fig. 7-12. Solar collectors on the roof of this building change light energy into heat energy, supplying most of the hot water needs of the owner.

Wind Power

Wind is created by the uneven heating of the earth by the sun. Wind has been used for centuries to create mechanical energy.

Today, wind power is used to turn generators. **Generators** change mechanical energy into electrical energy. Fig. 7–13.

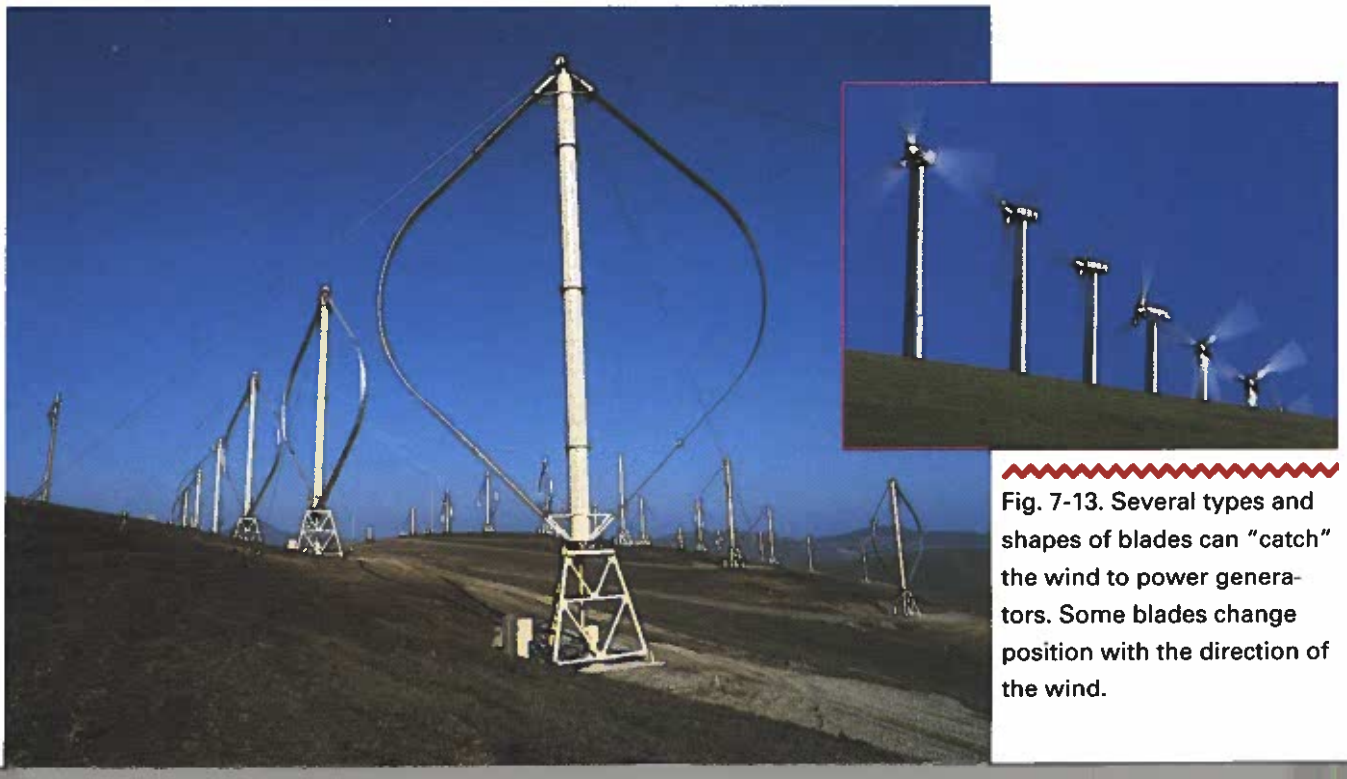


Fig. 7-13. Several types and shapes of blades can "catch" the wind to power generators. Some blades change position with the direction of the wind.

Water Power

The mechanical energy in falling or flowing water has also been used for centuries to do work. Today, **hydroelectric plants** provide much of our country with electricity. Tidal generators and wave generators also use moving water to create electricity. Fig. 7–14.

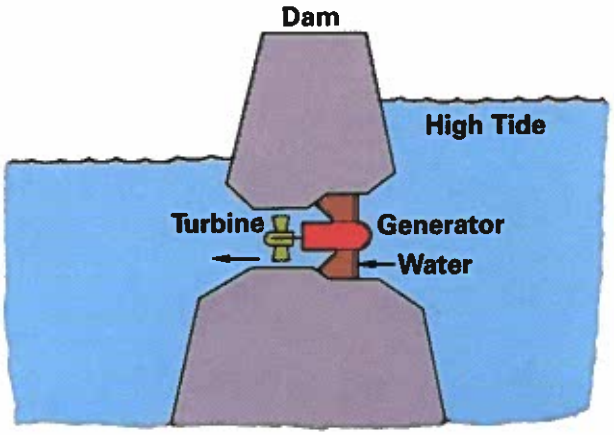
TECHNOLOGY TRIVIA

Most early factories were built near water. Waterwheels, pulleys, and belts transferred the energy of the moving water to the factory's machines. During the 1700s, steam engines began to replace waterwheels.

Nuclear Energy

Nuclear reactors produce electrical energy by harnessing the energy in an atom. **Nuclear fission** takes place in a nuclear reactor. Fission is the splitting of the nucleus of an atom into smaller nuclei. During fission, a tremendous amount of heat is released. This heat is used to create electricity. Fig. 7–10.

■ **Would wind, water, or solar energy be most appropriate for use in your community? Build a small model of a device for the energy source that you selected.**



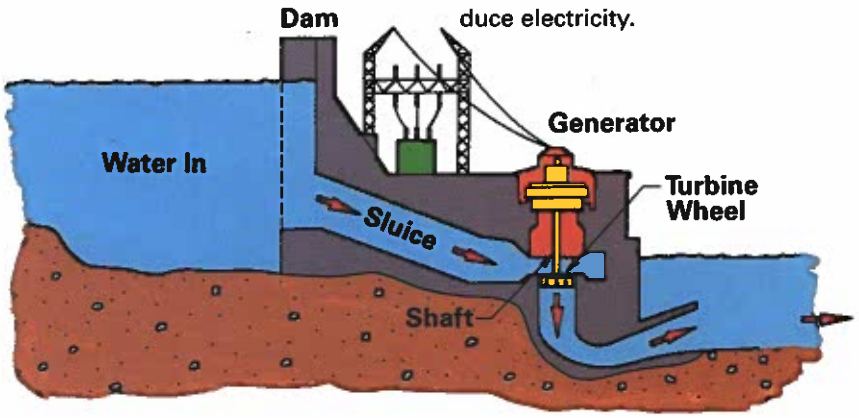


Fig. 7-14. The mechanical energy provided by moving water is used to turn a turbine. The spinning turbine is connected to a generator to produce electricity.

Alternative Energy Resources

The energy resources you just learned about seem to satisfy all our energy needs. Why should we look for alternative resources? There are two important reasons.

Many pollution problems are associated with burning fossil fuels and the use of nuclear fission. Automobiles, power plants, and manufacturers release smoke and chemicals into our air. Smog, acid rain, and polluted natural resources are the result.

IMPACT

The burning of fossil fuels releases carbon dioxide and other gases into the air. As these gases build up, they prevent heat from escaping into space. Temperatures increase. Eventually, this "greenhouse effect" could cause drastic changes in the earth's climate.

Nuclear energy produces dangerous nuclear waste. This radioactive waste will be with us for thousands of years. Finding a place to store it is a big problem. The possibility of a nuclear accident also exists.

The second reason for finding alternative energy resources is our shrinking supply of energy sources. Our supply of oil, coal, natural gas, and nuclear fuels is limited. These sources are known as **nonrenewable resources**.

Nonrenewable resources take millions of years to replace. We cannot continue to use these resources without thinking about future generations and their energy needs. Renewable resources such as wind, water, sunlight, plants, and animal waste must become alternatives to fossil fuels. Figures 7–15 and 7–16 show some alternative energy resources and how they might be used.

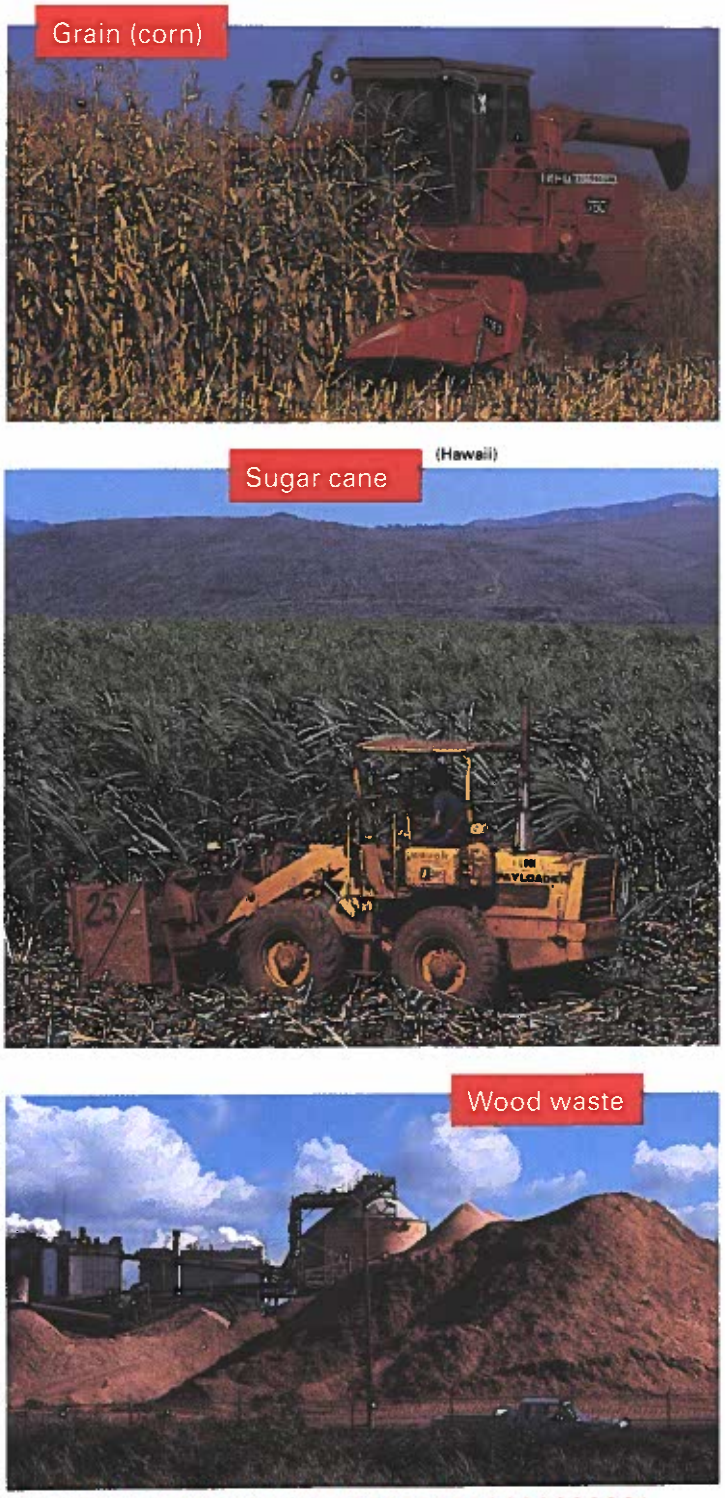


Fig. 7-15. Plants and animal waste make up the energy source known as *biomass*. After processing, these materials can be burned to provide energy.

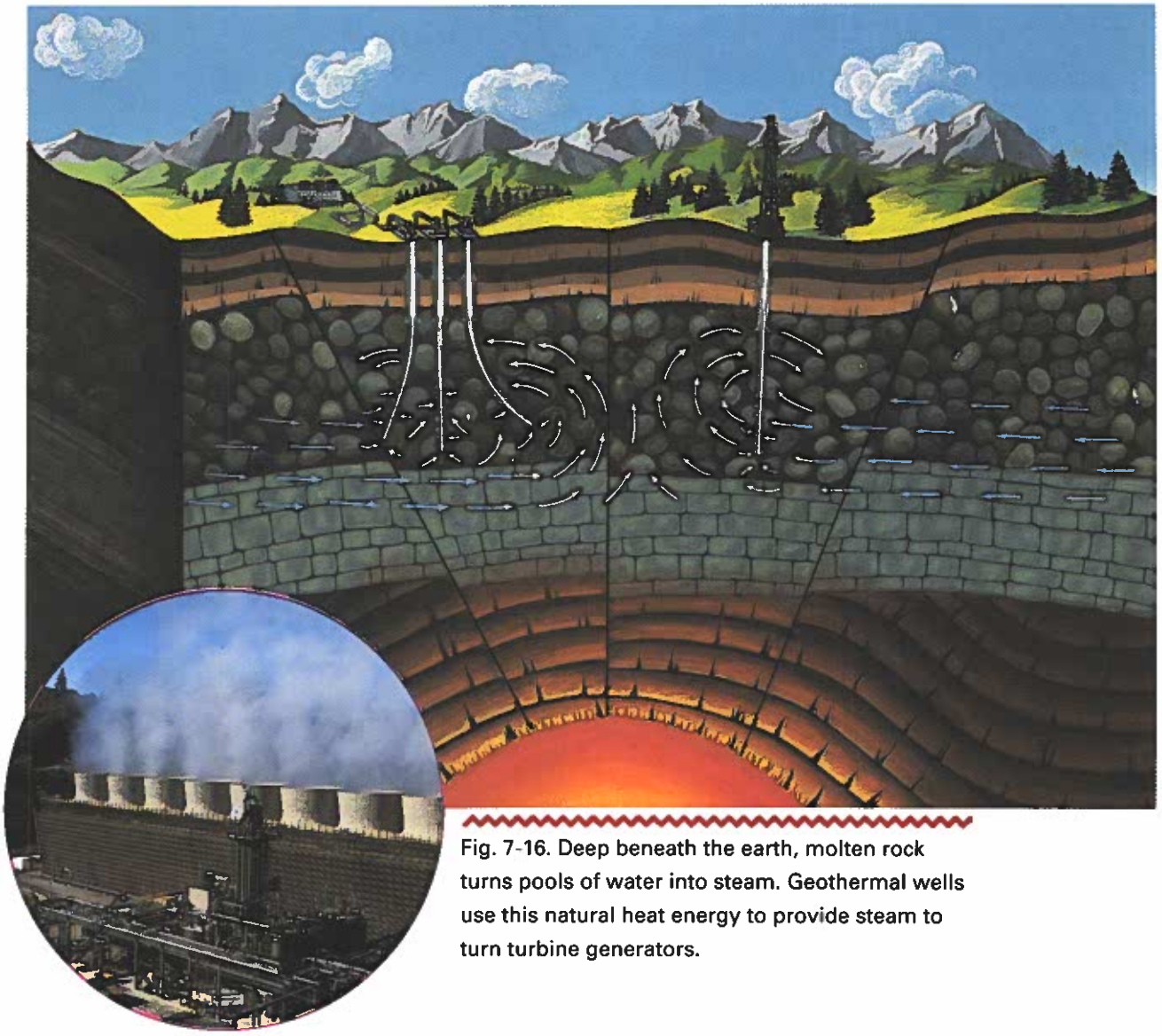


Fig. 7-16. Deep beneath the earth, molten rock turns pools of water into steam. Geothermal wells use this natural heat energy to provide steam to turn turbine generators.

▶▶▶ FOR DISCUSSION ◀◀◀

1. Solar energy seems like a great source of free heat and electricity. Can you think of any problems that might occur?
2. What would be your reaction if you found out a nuclear power plant was going to be constructed in your community?

■ **Collect newspaper and magazine articles about alternative energy resources. With other members of your class, organize these into categories and post them on a bulletin board.**

Chapter Highlights

- Technology requires large quantities of energy to make electricity, transport people and products, and process materials.
- Energy is the ability to do work and cause movement.
- Energy can be changed from one form to another, but it cannot be created or destroyed.
- Energy sources include fossil fuels, solar power, water power, wind power, and nuclear power.
- Alternative energy sources are needed to replace sources that are becoming scarce or that pollute our environment.

Test Your Knowledge

1. Why is energy such an important resource of technology?
2. Define *energy*.
3. Give two examples of potential energy.
4. Explain how the examples of potential energy you listed for question 3 could become kinetic energy.
5. List and describe four common forms of energy.
6. List and describe the energy conversions that take place when you turn on your Walkman.
7. Why do we consider fossil fuels to be nonrenewable?
8. Describe how hydroelectric plants generate electricity.
9. What are some of the negative environmental impacts resulting from energy production?
10. Describe two alternative energy sources.

Correlations

SCIENCE

1. In many chemical reactions, heat is given off. Is this always true? Put a thermometer into a 16-oz. glass with a quarter cup of vinegar. Record the vinegar's temperature. Now add a teaspoon of baking soda. What happens to the temperature?

MATH

1. Matt's car averages 23 miles per gallon of gas. He fills the 18-gallon tank and starts a 453-mile trip to his grandmother's house. Will he get there without stopping to refuel?

LANGUAGE ARTS

1. Imagine a nuclear power plant is to be built in an area near your home. What would be the concerns raised in your community? Hold a class discussion about the advantages and disadvantages.

SOCIAL STUDIES

1. Find out the various forms of energy used to heat American homes around 1900–1940. What kinds of problems were encountered with these? Which ones turned out to be most efficient?
2. Do you think any of those early methods of heating homes were better than today's? Why or why not?

CHAPTER 8

Capital and Time

Introduction

Capital and time are the hidden resources of technology. Their role in technology may not be as visible as people, materials, energy, machines, and information, but they are just as important.

When we say the word *technology*, what comes to mind? Most people think of fancy machines and robots. Some people see products made of new synthetic materials. Other people think about satellites and instant communication. Your parents may think about the rising costs of energy needed to run your home.

The purpose of this chapter is to help you understand the importance of capital and the role of time in technology. Have you ever considered the amount of money transferred from place to place in the production of a product? Have you ever heard the phrase "time is money"? Is there a connection between time and money in technology?

After reading this chapter, you should be able to

Define capital.
Discuss how money is spent in technology.
List some sources of capital.
Discuss the role of time in technology.

Words You Will Need

finance
capital
interest
stock
dividend
cash flow
profit