CHAPTER 2

Power to You

Getting Ready...

- How far is your TV from its source of electricity?
- What does a nuclear power station have in common with a wind turbine?
- How can turning off your bedroom light help protect the environment?

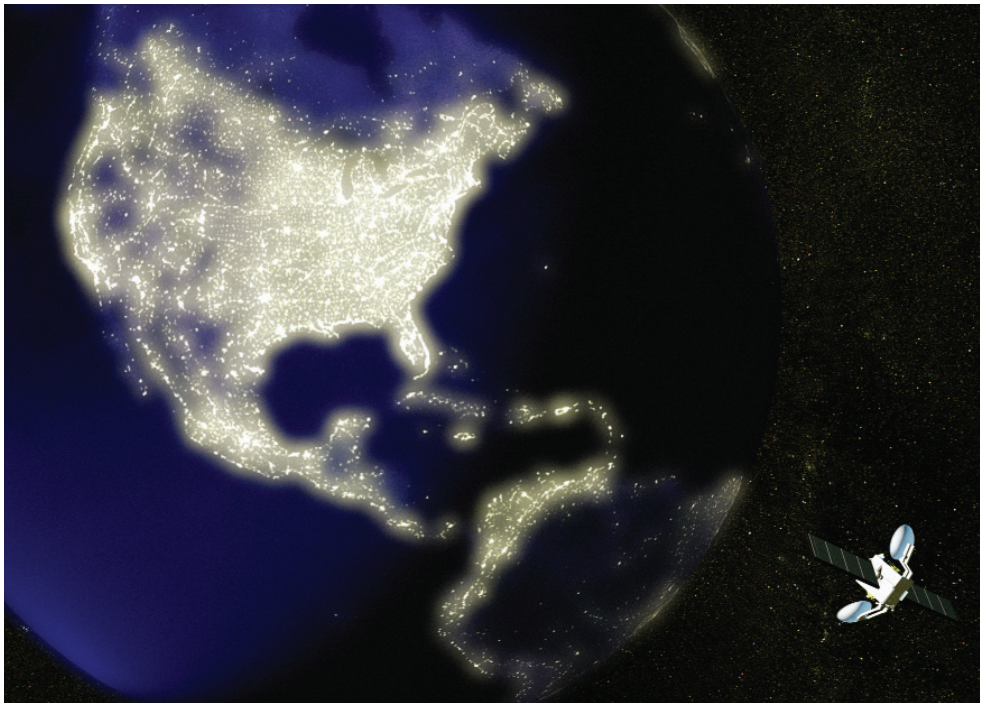


Figure 2.1 Bright spots on this satellite image show cities and towns that use large amounts of electricity.

Nighttime images make it easy to see which parts of a country use the most electricity. Did you know that many people in Canada live hundreds or even thousands of kilometres away from the power station that produces the electricity they use every day? This can make it easy to forget that producing electricity is more than just flicking a switch.

Electricity seems clean and easy to use. All electricity comes from the natural environment, however, and all methods of producing electricity affect communities and ecosystems locally and around the world. In this chapter, you will study how we generate electricity in Canada, and how new technologies are changing electricity production. You also will learn how you can use electricity more responsibly.

What You Will Learn

In this chapter, you will learn

- how electricity is converted into other kinds of useful energy
- how electricity is produced in Nova Scotia and in Canada
- how you can reduce the amount of electricity you use every day

Why It Is Important

- Some people think that the link between electricity and magnetism is one of the most useful scientific discoveries of all time.
- Wise energy use can help to protect the environment and can save money.

Skills You Will Use

In this chapter, you will

- observe the relationship between electricity and magnetism
- classify different sources of electricity
- communicate advantages and disadvantages of different methods of producing electricity
- develop strategies for household and community electricity conservation

Wind energy is used to produce electricity in some parts of Nova Scotia.

Starting Point ACTIVITY 2–A

Electric Lunch

What to Do

1. In your science journal, make a list of every item that you will have (or had) for lunch today. Include the food as well as any wrappers or packaging.
2. Share your list with a classmate. Together, brainstorm as many steps as you can think of that are involved in making each item, transporting it, and storing it. Be as specific as you can. Draw a flow chart to record the steps.
3. Try also to include steps that are not obvious uses of electricity. For example, the kitchen lights may be on while you cut bread for a sandwich, or you may use an electric can opener to open your can of tuna. You could say that these uses of electricity are *indirectly* involved in making your lunch.
4. Put a star beside any steps that might use electricity directly or indirectly.
5. Count the stars. The total is your "electric lunch score." Record your score in your science journal.

What Did You Find Out?

1. How could you make the same lunch but reduce your electric lunch score?
2. As a class, discuss some changes you would be willing to make in your lifestyle to reduce your use of electricity.

Section 2.1 Using Electricity

Key Terms

- light bulb
- incandescent bulb
- compact fluorescent bulb
- electromagnetism
- electromagnet

For an electric circuit to be useful, it must change electrical energy into another form of energy such as light, sound, or motion. You learned in Chapter 1 that electricity flows in a circuit and produces a response in loads connected to the circuit. As charges pass through a load, electrical energy is converted into other forms of energy. But why does the electric current produce a different response in different kinds of loads? In the next few pages, you will learn how some loads convert electrical energy.

Figure 2.2 Compact fluorescent bulbs such as these use only one quarter to one third of the energy used by similar incandescent bulbs to produce the same amount of light. They are made to fit in the same light sockets as incandescent bulbs.

Electricity to Light

A **light bulb** is a device that turns electrical energy into heat and light energy. Traditional light bulbs, or **incandescent bulbs**, produce light by passing charges through a very thin wire, called a filament, inside the bulb. As charges pass through the wire, their electrical energy is given off as heat. As the wire heats up, it glows and produces light. As much as 95 percent of the energy used by an incandescent bulb is lost as heat. **Compact fluorescent bulbs** are designed in a different way. Charges pass through a tube containing mercury gas. As the charges collide with the gas, the mercury gives off energy that causes the coating of the tube to give off visible light. Only about 30 percent of the energy used by a compact fluorescent bulb is lost as heat.

Electricity to Heat

Inside a traditional light bulb, electricity is converted into heat. When the filament gets very hot, it glows, producing light. Many appliances produce heat alone, or with only a little light (think of the glow of the wires in a toaster). These loads work like the light bulb but use different materials so that the right amount of heat or light is produced. The heating filament in a toaster or hair dryer is made of a metal that becomes hot when an electric current runs through it.

Figure 2.3 A traditional light bulb and a hair dryer work in a similar way. Electricity is converted to heat in both devices. However, in a light bulb we use the light produced by the glowing filament, and in a hair dryer we use the heat.

Electricity to Magnetic Effects

An electric current creates magnetic energy. The magnetic energy that surrounds a wire carrying a current is called a *magnetic field*. Magnets are objects that can attract some metals. You can use a small magnet to pick up paper clips or pins. You can create the same kind of magnetism in some metal objects by using electricity.

Electromagnetism is the name given to magnetism produced by electricity. An **electromagnet** is a temporary magnet created by an electric current (Figure 2.4). In your next activity you will build your own electromagnet.

Figure 2.4 Electromagnets are used at scrap yards and recycling centres to pick up metals and separate them from other materials.

CONDUCT AN

INVESTIGATION 2-B

SKILLCHECK

- Observing
- Measuring
- Predicting
- Interpreting Data

What's the Big Attraction?

What does a traditional telephone have in common with a doorbell? Each of these devices contains an electromagnet. You can use a simple electric circuit to create your own electromagnet.

Question

How can you create magnetic effects with electricity?

Safety Precautions

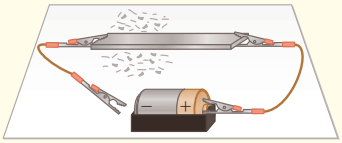
- Avoid breathing in the iron filings.
- Dispose of iron filings carefully.
- Wear rubber gloves when handling iron filings.

Materials

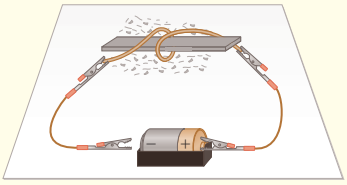
1 D-cell battery (1.5 V) in holder
2 copper wires with alligator clips
1 iron rod (5 cm long)
1 piece of copper wire (15–20 cm)
iron filings
white paper
rubber gloves

Procedure

1. Place a white piece of paper under the circuit for easier cleanup. Build an electric circuit by connecting the wires to each end of the iron rod. Scatter the iron filings around the iron rod. Connect one of the wires to the battery. Do not close the circuit yet. Your circuit should look like the illustration.



2. Close your circuit and record what happens.
3. Open your circuit and wrap the copper wire around the iron rod twice. Connect the circuit wires to either end of the copper wire. Place the iron rod back near the scattered iron filings. Your circuit should look like the illustration.



4. Close the circuit and record what happens.
5. Open the circuit and wrap the copper wire around the iron rod four more times. Place the iron rod back among the iron filings.
6. Close the circuit and record what happens.
7. Take apart your circuit, clean up your work area, and return all materials to your teacher.

Analyze

1. What happened to the iron filings
   (a) in step 2?
   (b) in step 4?
   (c) in step 6?
2. What happened as you wrapped the copper wire more times around the iron bar?

Conclude and Apply

3. What do you think caused the difference in your observations between steps 2, 4, and 6?
4. Based on these observations, how would you change your circuit to create a stronger electromagnet?

Section 2.1 Summary

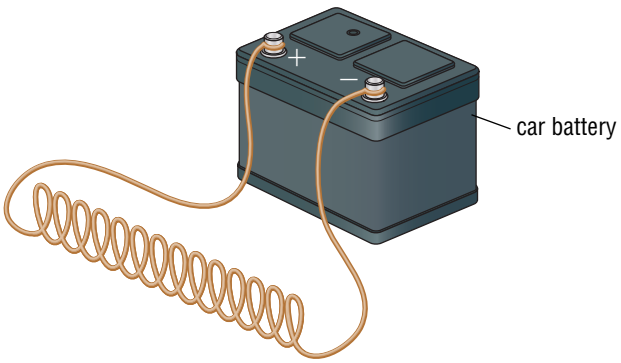
In this section, you learned that the passage of charges through a load in a circuit converts electrical energy into other forms of energy, such as light, heat, sound, or motion.

You also learned about electricity and magnetism:

- An electric current produces a magnetic field.
- Electromagnetism is the magnetism produced by electricity.
- An electric current will turn some metals into temporary magnets called electromagnets.
- We can use electromagnets to convert electrical energy into motion.

Check Your Understanding

1. Which part of an electric circuit converts electricity into other forms of energy?
2. How does a compact fluorescent bulb convert electricity into light?
3. What are the advantages of compact fluorescent bulbs when compared to traditional (incandescent) bulbs? Can you think of any disadvantages of using compact fluorescent bulbs?
4. What materials can be used to create an electromagnet?
5. What happens to the strength of an electromagnetic field when you increase the current flowing through a coil of wire around an iron bar?
6. The illustration shows a simple electromagnet. Which part is missing?



Key Terms

light bulb
incandescent bulb
compact fluorescent bulb
electromagnetism
electromagnet

Section 2.2

Using the Electromagnetic Connection to Generate Electricity

Key Terms

- electric generator
- turbine
- hydro-electric energy
- hydro
- fossil fuel energy
- nuclear energy

Figure 2.5 Gas-powered electric generators can be used to supply emergency power during blackouts.

To produce electricity, another form of energy is converted to electrical energy. Most electricity in Canada is produced by converting the energy of motion to electrical energy. In Section 2.1, you learned that an electromagnet can convert electrical energy into motion. An **electric generator** uses the energy of motion to produce electricity.

In Activity 2-B, you created a magnet by passing an electric current through a wire conductor wrapped around an iron bar. It is also possible to create an electric current by moving a magnet across a wire conductor. This is the basic idea for an electric generator.

Figure 2.6 shows how an electric generator uses a spinning device called a **turbine** to create motion that produces electricity. But what makes the turbine spin? In the rest of this section, you will learn what form of energy causes the turbine to spin for each of the three main sources of energy used to generate electricity in Canada.

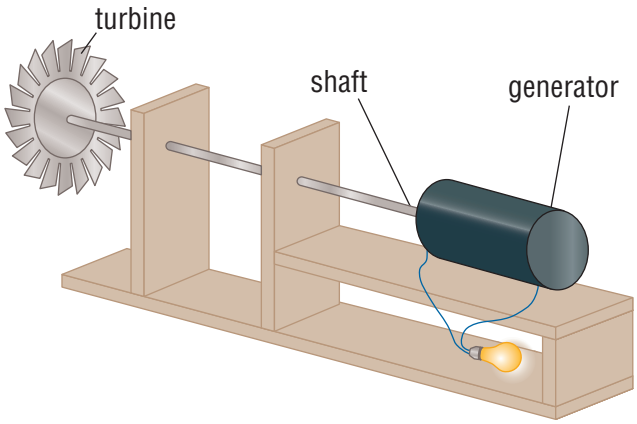


Figure 2.6 A simplified diagram showing a model of key parts of a generator. A bladed wheel, called a turbine, is made to spin. A shaft is connected to the turbine, so when the wheel is spinning the shaft is also spinning. The energy of motion of the spinning shaft is converted into electric current inside the generator.

Find Out ACTIVITY 2–C

What's Your Source?

The energy needed to power an electric generator can come from a variety of sources. Which sources are used most commonly across Canada?

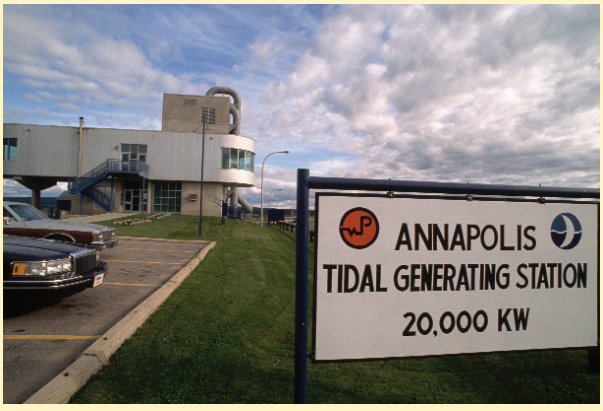
This station generates electricity by burning fossil fuels (coal, oil, or gas).

What to Do

1. Your teacher will assign your group one province or territory to research. Use library or Internet resources to find the sources of energy used for generation of electricity in that province. What are the top two sources in the province?
2. Share your findings with the other groups in the class.
3. Arrange the information you have collected for all of the provinces into a table. Give your table a descriptive title.
4. Use the Internet, your school library, or community resources to locate the electricity-generating station closest to your community. What source of energy does it use?

What Did You Find Out?

1. What are the top two sources for electricity generation in Nova Scotia? Does the electricity-generating station near your community use one of these sources?
2. What factors might explain why the electricity-generating station was built or placed in this particular location near your community?
3. What are the most common sources of electricity across Canada? Are the top sources of electricity the same for all of the provinces? How do they compare with the top sources in Nova Scotia? Explain any differences. (Hint: What factors could make a source suitable for a particular province?)



Energy from the ocean tides can be used to generate electricity. Which provinces have tidal generating stations?

Generating Electrical Energy

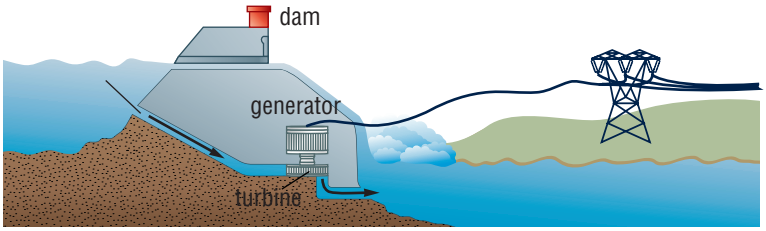
Figure 2.7 shows three ways that electricity is generated in Canada.

- **hydro-electric energy** (often called **hydro**): uses the energy of falling water to spin a turbine.
- **fossil fuel energy**: converts the energy of burning fossil fuels (mainly coal) into heat that boils water into steam to spin a turbine
- **nuclear energy**: converts the energy released from a nuclear reaction into heat that boils water into steam to spin a turbine

Figure 2.7 In these illustrations, what is similar about the way electricity is generated? What is different?

A

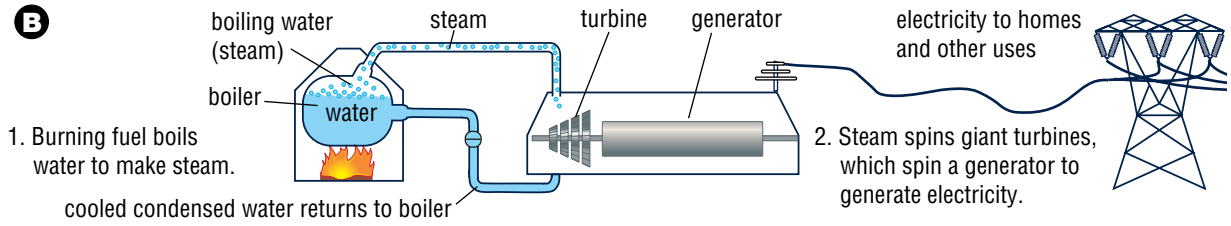
1. Water flowing through dam spins giant turbines, which spin a generator to produce electricity.



Hydro generating stations

- can capture the energy of motion from natural water falls
- can use a large wall, or dam, to block a river, creating an artificial fall of water
- use the movement of water to spin turbines

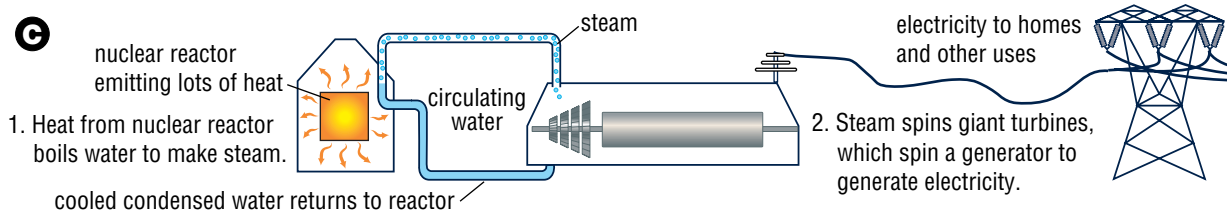
B



Fossil fuel-burning generating stations

- use the energy from burning coal (and sometimes diesel fuel, gasoline, or natural gas) to boil large amounts of water
- use steam from the boiling water to spin turbines

C



Nuclear generating stations

- use the energy from nuclear reactions to boil large amounts of water
- use steam from the boiling water to spin turbines

Section 2.2 Summary

In this section, you learned the following:

- An electric generator uses energy from motion to spin a turbine.
- The turbine spins a wire coil inside a magnet or a magnet inside a wire coil.
- The magnet produces an electric current in the coil.
- The sources of energy used for electricity production change from province to province.

Most of Canada's electricity comes from three energy sources:

- hydro-electric energy
- burning fossil fuels
- nuclear reactions

INTERNET CONNECT

www.mcgrawhill.ca/links/ns+science6

What are motors, and how do they use electromagnets? Go to the web site above and click on **Web Links** to find out about the role of motors in your life.

Check Your Understanding

1. What source of energy supplies most of Nova Scotia's electricity?
2. How does an electric generator produce electricity?
3. What are the three main ways that electricity is generated?
4. What do the energy sources listed in question 3 have in common, in terms of how they produce electricity?
5. In the next section, you will learn about some other ways that electricity can be generated. One of these ways involves the use of wind. Make a sketch with labels to show how you think the wind could be used at a power plant to generate electricity. (Hint: Think about what the three methods in Figure 2.7 have in common.)
6. The provinces of Newfoundland, British Columbia, and Ontario use a lot of hydro-electric energy to generate electricity. The province of Alberta and the territory of Nunavut do not. Explain why some places can use only certain kinds of energy to generate electricity.

Key Terms

electric generator
turbine
hydro-electric energy
hydro
fossil fuel energy
nuclear energy

Section 2.3

Renewable Sources of Electricity

Key Terms

- renewable
- non-renewable
- solar energy
- wind energy
- tidal energy
- geothermal energy
- biomass energy

In Section 2.2, you learned that hydro (moving water), fossil fuels, and nuclear energy can be used to generate electricity. In the next few pages, you will study some other technologies that generate electricity.

Renewable and Non-Renewable Energy Sources

Some sources of electricity are renewable. A **renewable** source of energy is one that can renew or replace itself. Hydro-electricity is an example of a renewable energy source because the water that flows through a hydro-electric generating station is not used up in the process.

Other sources of electricity are **non-renewable**. They cannot be replaced within a human lifetime. Fossil fuels and nuclear energy are examples of non-renewable energy sources because eventually the supply of these materials will be gone.

Figure 2.8 Hydro-electricity is a major renewable source of energy in parts of Canada.

Electricity from Renewable Sources

As demand for electricity in Canada continues to grow, using renewable energy resources to generate electricity will become more important. Examples of these resources include the Sun (solar), the wind, tides, geothermal energy, and biomass energy. Some of these already provide electricity in your province. As you read about these resources in the rest of this section, see if you can figure out which are used right now to generate electricity.

Solar energy

What is it?

- energy from the Sun

How does it work?

- light is captured and converted to electrical energy by a solar cell (also known as a photoelectric cell)
- solar cells can be connected to form large solar panels, which can be linked to form solar arrays, as shown in the photo

Where is it used?

- in areas that do not receive much precipitation, where there are not many clouds to block light
- rooftops, south-facing walls, wide-open areas

Examples:

- the desert of Nevada, in the southwestern United States, is home to the largest solar array in North America
- across all of Canada, solar cells provide over 14 MW of electricity

Wind energy

What is it?

- energy from moving air

How does it work?

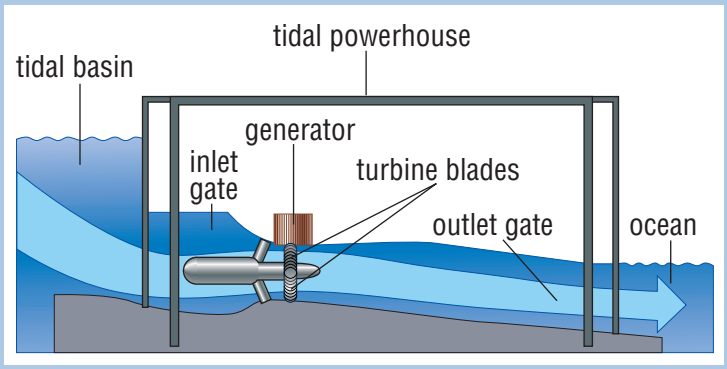
- moving air pushes on the blades of a wind turbine or windmill
- the turbine powers an electric generator

Where is it used?

- in areas with fairly constant winds of at least 15 km/h

Example:

- Pubnico Point Wind Farm, southeast of Yarmouth, Nova Scotia, is powered by 17 huge turbines



Tidal energy

What is it?

- energy from the moving water in tides

How does it work?

- water flows into bays and inlets when the tide rises and out again when the tide falls
- the movement of the water spins a turbine that powers an electric generator

Where is it used?

- in areas where the difference between high and low tides is very large, so that the water will move with a great deal of energy

Example:

- Annapolis generating station, on the shores of the Bay of Fundy, was the first of its kind in North America

Geothermal energy

What is it?

- energy from Earth's crust

How does it work?

- deep holes are drilled to release heat trapped in Earth's crust
- the heat is used to boil water, releasing steam
- the steam spins a turbine that powers an electric generator

Where is it used?

- in mountainous areas with large pockets of heat close to the surface of Earth's crust

Examples:

- The Geysers generating station, in California, is the largest in North America
- South Meager Geothermal Project, north of Vancouver, British Columbia, is the first site in Canada to do detailed drilling tests

Biomass energy

What is it?

- energy stored in plant and animal tissues

How does it work?

1. plant tissues, such as wood, wood pulp, or straw, are burned to release heat
   - the heat is used to boil water, producing steam
   - the steam spins a turbine that powers an electric generator
2. animal or plant tissues are fed to micro-organisms
   - the micro-organisms produce a form of natural gas called biogas
   - the biogas is burned to boil water, producing steam
   - the steam spins turbines that power an electric generator

Where is it used?

- in forested areas where waste wood chips or pulp from logging operations are available
- in areas where large crops such as wheat or corn are grown

Example:

- Brooklyn Energy Centre, in Brooklyn, Nova Scotia, produces 21 MW of power from wood energy

Find Out ACTIVITY 2–D

Comparing Energy Sources

How can we decide which sources or technologies to use?

What to Do

Part 1

1. Conduct research using Internet or library resources on two sources of electricity from the following list:
   - Hydro
   - Coal
   - Wind
   - Solar
   - Natural gas and diesel
   - Tidal
   - Nuclear
   - Biomass
   - Geothermal
2. Answer the following questions about these two sources:
   - Is it necessary to develop new technology to harvest this source of electricity?
   - How expensive is it to develop the technology?
   - How might the use of this source affect the environment?
   - How might the use of this source affect people and communities?

Part 2

3. Have a class debate to decide which source of electricity the class, as a whole, would choose to support based on the information everyone has collected.

What Did You Find Out?

1. Based on your classroom debate, decide which arguments were most convincing. In your science journal, explain which energy source would be best for a generating station in your community. Justify your answer.

Section 2.3 Summary

In this section, you studied a number of ways that different energy sources can be used to generate electricity. These technologies involve capturing the energy in sunlight, wind, water, Earth, and plant and animal tissues. These sources could play a larger role in providing electricity for Nova Scotia and Canada in the future.

- Sources of energy can be renewable, meaning they can be renewed or replaced, or non-renewable, meaning they cannot be renewed or replaced within a human lifetime.
- Many renewable energy sources will work only in certain regions or under certain conditions.
- Some renewable energy sources cause pollution.
- There is no single "best" way to produce electricity. Future energy plans are likely to combine different sources to provide a steady electricity supply.

Key Terms

renewable
non-renewable
solar energy
wind energy
tidal energy
geothermal energy
biomass energy

Check Your Understanding

1. Explain how an electric generator works.
2. Identify three sources of renewable energy. For each source, identify one or more factors that could limit the use of this source for electricity production in Canada.
3. Mary McDonald is the mayor of a small town. She and the other members of the town council have received a proposal from an energy company to build a geothermal power station on the outskirts of town. What are some of the things that the mayor and the councillors should consider as they decide whether or not to approve the proposal?
4. Many sources of electrical energy are less harmful to the environment than the burning of fossil fuels. However, these sources of energy are not in common use. Give two reasons why.

Section 2.4 Consuming and Conserving Electrical Energy

Figure 2.9 Refrigerators and dishwashers are among the top household appliances in terms of consuming electricity. How can you conserve electricity within your home?

Key Terms

- electric meter
- power
- energy consumption
- energy efficiency
- energy conservation

Do you know how much electricity you use every day? Your home's **electric meter** monitors the amount of electricity used by you and the other members of your family at home. The electric company uses information from a building's meter to calculate the cost of electricity. You can also get an idea of how much electricity your home uses by calculating the electricity consumed by the appliances you use regularly. Every appliance bears a label indicating how much **power** that appliance uses. Power is the rate at which electrical energy is transformed into a useable form such as heat, light, or motion. You will discover how to find this information in the next activity.

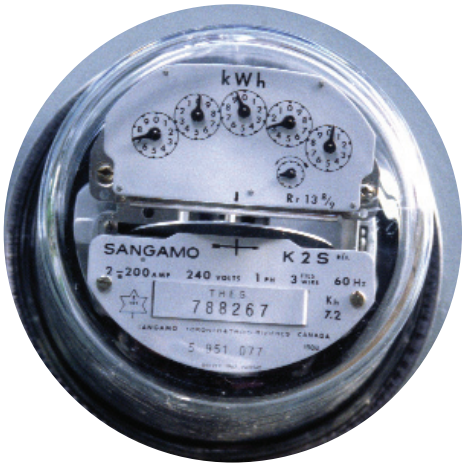


Figure 2.10 This is an electric meter. A technician can read the dials to find out how much electricity has been used since the last reading. Do you know where to find your home or building's electric meter?

At Home **ACTIVITY 2–E**

Watts Up?

A watt (W) is a unit of *power*. The rate at which a light bulb turns electrical energy into heat and light is the power of the light bulb. Appliances have labels, called *energy ratings*, that give you information about the power of the appliance. You will use the energy rating on appliance labels to estimate your home's electricity consumption.

What to Do

1. Copy the table below into your science journal. Give your table a descriptive title.

Column 1	Column 2	Column 3	Column 4
Device	Watts (W) (From label)	Number of hours device is used each day	Energy used by device each day in watt-hours (Column 2 × Column 3)

2. Choose at least three electric devices that often are used in your home. Look for the label on each device. If you cannot find a label on a certain device, you may substitute another device.
3. Use the table to calculate how much electricity those devices use.

What Did You Find Out?

1. Which device uses the most electricity each day?
2. Compare the energy ratings of similar devices with other members of your class. How different are they?
3. Suggest a reason why similar devices (for example, a microwave oven) can have different energy ratings.
4. Based on the results of this activity, what are some ways to reduce the amount of electricity your family uses in your home each day?

INTERNET CONNECT

www.mcgrawhill.ca/links/ns+science6

Energy meters are available to measure electricity being used by your home or school devices. Go to the above web site and click on **Web Links** to find out about this program.

Conserving Electricity

Earlier in this chapter, you saw that building electricity-generating stations can affect the environment and surrounding communities. Making responsible choices of energy sources by considering as many factors as possible can help reduce these effects.

Another strategy is to consume less electricity. **Energy consumption** is the amount of energy we use. How can you reduce energy consumption?

Energy efficiency describes using less energy or electricity to accomplish the same task. **Energy conservation** describes doing without certain things to save electricity. In the next Investigation, you will design your own plan to conserve energy or to use energy more efficiently.

PROBLEM-SOLVING

INVESTIGATION 2-F

SKILLCHECK
- Identify the Problem
- Decide on Design Criteria
- Plan and Construct
- Evaluate and Communicate

From Consuming to Conserving

You may already conserve energy at home. Now, you will create a plan to help reduce the electricity used in your school.

Challenge

Group Work

Working in a group, prepare a presentation on the topic "An Action Plan for Energy Conservation in Our School"

Materials

textbook, library books, and the Internet

pens and pencils, paper, other props

Design Criteria

A. Your presentation should explain why energy conservation is important.

B. Your presentation should include information about the use of electricity in your school now (before your plan is put into action).

C. Your presentation should include data on where and when electricity is used in the school, how much electricity is used in the school, and what source(s) of energy supplies the school's electricity. You will need to monitor electricity use in the school for one week to collect this data.

D. Your presentation should answer the question "Can improvements in energy efficiency be made in our school?" If your answer is "no", you must provide evidence and explain your reasoning. If you believe that improvements can be made, include them as a step-by-step plan, focusing on actions that people in the school can take to conserve energy. Be realistic. Include a time-line for these changes to be put into action.

E. Your presentation should include the data you have collected about your school's electricity use, in the form of a chart. This may be part of a written report, a poster, or an electronic slide show. Your conservation plan can be presented as an oral report, an electronic slide show, a musical performance (song/rap), or a drama.

Plan and Construct

1. With your group, brainstorm how you will gather information. Assign tasks to group members.
2. After you have collected your information, work together to organize it.
3. Design and create any images, models, or props that you will use.
4. Rehearse your presentation in front of another group. After your rehearsal, discuss your presentation with your audience. Decide whether you want to make any changes to your presentation.
5. Prepare your final presentation. Make your presentation to your class or to a school assembly.

Evaluate

1. Did you present enough data to convince your audience that your action plan was realistic? Explain.
2. What adjustments would you make to your plan for a new school being built in your community? Explain.

Section 2.4 Summary

In this section, you learned the following:

- Electricity usage is monitored by an electric meter.
- You can estimate electricity consumption by looking at the wattage labels on your appliances.
- You can make choices to reduce the amount of electricity you use.

Key Terms

electric meter
power
energy consumption
energy efficiency
energy conservation

INTERNET CONNECT

www.mcgrawhill.ca/links/ns+science6

Do you use electricity safely? Make a list of things you can do to stay safe around power lines, appliances, plugs, and outlets. Use the Internet to check your list. Go to the web site above and click on **Web Links** to find out where to go next.

Check Your Understanding

1. How could you calculate the energy used by an electric device in the home?
2. What is the difference between energy efficiency and energy conservation?
3. How much energy (in watt-hours) is used by a clothes dryer in one month if it is used 2 hours per week and its wattage label reads 5000 W?
4. List three ways that you could reduce your consumption of electricity.
5. List the following device usages in order of highest consumption of energy to lowest consumption of energy.

Energy Consumption of Household Devices

Device	Power Rating	Time Used
Hair dryer	600 W	15 min
Light bulb	60 W	4 h
Microwave oven	700 W	5 min

Prepare Your Own Chapter Summary

Summarize this chapter by doing one of the following:

- Create a graphic organizer such as a concept map.
- Produce a poster.
- Write a summary to include the key chapter ideas.

Here are a few ideas to use as a guide:

- Describe how electrical energy is transformed into other energy forms.
- Provide examples to show the importance of electromagnetism.
- Use diagrams to explain how turbines are used to generate electricity from three different sources. Point out similarities and differences.
- Make a chart listing the different ways that electricity is produced in Nova Scotia. In columns, try to identify possible advantages and disadvantages of each method.
- Explain the difference between renewable and non-renewable sources of electricity and identify how electricity should be generated in the future.
- Prepare step-by-step instructions on how to determine the energy usage of a home, school, or business. Include sample calculations.
- Draw a concept map to describe ways you can conserve electricity at home and at school.

UNIT 1

Conversation with an Elder

Dr. Elsie Charles Basque

Dr. Elsie Charles Basque was the first Mi'kmaq to earn a Nova Scotia Teacher's Certificate and the first Mi'kmaq to teach in a non-native school. She has lived in many different villages and towns in Nova Scotia, including Hectanooga and Meteghan near Yarmouth, Truro in the central part of the province, and Mabou Ridge in Cape Breton. As well, she lived many years near Boston, in the United States. Now she is back in the Yarmouth area, in Saulnierville.

The Nova Scotia Teachers' College awarded Elsie Charles Basque an honorary doctorate to recognize her work for Mi'kmaq people.

Q. What was your first experience of anything electrical?

A. When I was eight years old, a friend of my family bought a battery-operated radio and brought it to the store in Hectanooga. It was a large piece of furniture that stood on the floor. Several people could listen to it at once through several sets of earphones. When a large group wanted to listen, the twist of a button made the sound come through the speaker on the wall. It was magical!

The first broadcast I ever listened to was at Christmastime. I heard Santa Claus reading letters he had received from children all over the world. I was so excited! I remember hearing sleigh bells during that show. They sounded far away at first and then came closer.

Q. What else did you hear?

A. Other times when my family visited the store, we listened to the World Boxing Championship fights between Jack Dempsey and Max Schmeling. And of course we heard the serials of the time, such as "The Green Hornet" and "The Lone Ranger." Gathering around the radio was our family entertainment.

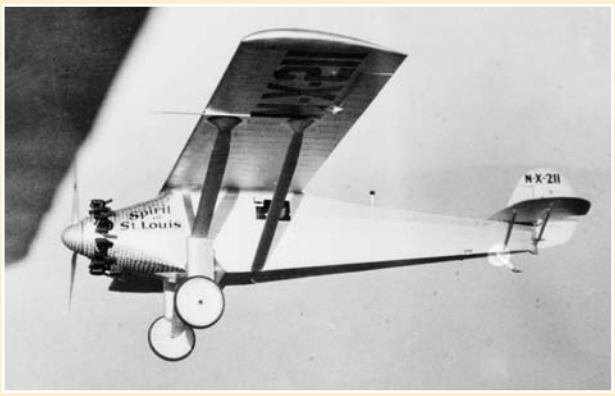
Q. You must have used a lot of batteries! When did Hectanooga get electricity from the Nova Scotia power grid?

A. Not until the 1950s. By that time I was in my 30s or 40s and had moved away.

Q. When did you first see TV?

A. My family bought our first TV set while we were living near Boston. I remember we had "rabbit ears" sitting on the TV to get better reception. My husband got the TV so he could watch the boxing championships. Nova Scotia had TV then, too. The first broadcast was in 1954.

What other early memories do you have of new technology?



In May 1927, when I was 11 years old, I remember my father telling me that I was going to hear a motor in the sky that night. I was quite frightened at that, but I went outside with Papa to listen for the roar. I held his hand tightly. Later on that night I did hear a motor in the sky. The noise turned out to be the engine of *The Spirit of St. Louis*, Charles Lindbergh's plane that was flying from New York to Paris. That was the first time anyone had tried a solo flight across the Atlantic Ocean. I also remember Papa saying that sometime in the future planes would carry lots of people at once, unlike the small, single-seat plane that I had heard flying overhead. Papa also predicted that in the future man would fly to the Moon.

EXPLORING Further

We all count on using electrical appliances to do many things, such as keep our food fresh, light our homes, cook our food, dry our hair, keep buildings cool in summer, or provide entertainment. We also have many battery-powered electrical devices for work and for fun, such as watches, MP3 players, cell phones, Blackberries, and video games. Can you imagine what life was like before all these inventions?

Interview an older person in your family about their experiences with electrical devices. A person who is over 70 or 80 years old may even remember what life was like before electricity. Someone over 40 will remember the days before CDs. Even someone over 30 will be able to tell you about life before a few devices that you are familiar with.

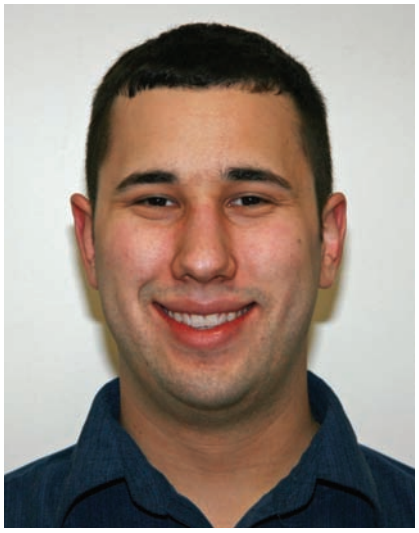
Select one or two items to discuss in the interview. Ask questions like these, and more that you write out:

- Tell me about the first time you saw (or heard or owned) a _____.
- What did you think of it?
- Before you had the _____, what did you do (use) instead?
- Did the _____ make your life better? Why or why not?

Make notes during the interview. Then, write up the interview and present it as a news item for a local paper, or do an "on the spot" oral news report for your class.

UNIT 1

Ask an Electrical Engineer



Andrew Gergely

When Andrew Gergely was very young, his grandfather gave him clocks to take apart. Life got even more interesting when his grandfather asked him to put one back together. Next his mother gave him some batteries, wire, a light bulb, and a bell and told him he could use the battery to make the light bulb come on and the bell ring. Andrew built his first electrical circuit and began his quest to find out not only how things come apart and how they go back together, but how they work. When he got older, Andrew attended Dalhousie University in Halifax and earned a degree in Electrical Engineering. He now works as an electrical engineer.

Q: Tell us what you do.

A: Right now I work as a project and field electrical engineer. This means that I work both in an office and on job sites (in the field). Some days, I spend the entire time doing paper work; other days I am outside taking readings and measurements and performing tests.

My office work can be anything from designing to managing projects—making sure the work gets done properly, on time, and at the expected cost. Right now, I am supervising 25 electricians. I am making sure that the engineering portions of many projects are being completed on schedule. I am also ensuring that the construction portion of other jobs is progressing as planned.

Q: What skills and knowledge do you need for your job?

A: I talk a lot with clients, so it is important that I am able to communicate well. I also have to be able to manage my schedule while working on more than one job at the same time. I have to be a leader, which means working as part of a team, so getting along with others is important. Being a quick learner helps a lot because I often work on my own, as well. Of course, I have to understand how electricity works, and I use a lot of what I studied in math and physics.

Q: After you finished university, did you continue learning?

A: Yes, I learned a lot on the job. Each employer provides specific training so staff can perform the job to their standards and learn new skills and technology. Part of being a good leader and working as a team is being willing to learn from anyone and any situation. Over time, I have learned from electricians and other engineers, as well as from co-workers such as accountants and administrative assistants.

When a part of a project is unfamiliar to me, I usually ask for help from someone who has experience. Co-workers are always a great source of information. Usually, one of them will have done a similar project and can answer some of my questions if I get stuck. Now I also learn by applying my own experience. By taking on new projects, I am forced to find new solutions.

Q: So learning doesn't end when you finish school?

A: No, this is a job that is always changing. I learn something new every day. I am a member of the IEEE (Institute of Electrical and Electronics Engineers). This organization provides workshops and conferences to help members keep up with new technologies and ideas. It is a great opportunity to meet and talk with other engineers.

Q: Do you enjoy working as part of a team?

A: Working in a team has many benefits. Each person is different and thinks differently. This is really good for bringing new ideas to the table.

Q: Is safety a big issue in your work?

A: Safety is the number one concern. Most of the work I do is on industrial sites, so I have to be aware of any possible dangers. Every day, I assess potential hazards and find ways to either eliminate them or control them. We often deal with live electrical circuits. There is always a risk involved. My company has a procedure that we all follow to prevent any shocks.

EXPLORING Further

Within the Electrical Engineering discipline, there are specialties in Power Systems, Communications, and Control Systems. Within each one of those specialties, you can choose a narrower focus. For example, in Power Systems, specialties include Electricity Generation, Electricity Distribution, and Electrical Transmission.

Find out and describe the Electrical Engineering sub-specialties in Communications and Control Systems. Prepare a brief report. Then choose one of the sub-specialties in any of the fields related to Electrical Engineering and find out where these graduates might work and what work they might do. If possible, include a brief interview in your report.

Project

SKILLCHECK
- Interpreting Data
- Predicting
- Modelling
- Communicating

Building Communities

When a town is being built, a town council is formed to make decisions. One decision the council must make is how to provide the town with the most effective source of electricity. Experts survey the options available to determine which source of energy would give them the most electricity for the least cost. Models are built before the final decision is made so that the town council can make the best choice for the community.

Challenge

In a group, design a town and decide on a source of energy for this town.

Design Criteria

A. Imagine you are on the council for a new town.

B. Assume that three energy sources are available to your town: solar power, wind power, and hydro-electric power (hydro power).

C. Use information in your textbook as well as other sources (Internet, library books) to produce a list of advantages and disadvantages of each energy source.

D. Design your town with a population between 1500 and 5000 people.

E. Decide how many houses will be built in your town.Assume that four people live in each house.

F. Assume that you cannot store energy (that is, if you have extra energy in February, you cannot use it in May).

G. Assume that the energy usage by buildings (Table 1) does not change each month.

Materials
- drawing paper
- pens and pencils
- Bristol board

Apparatus
- 1 1.5 V D-cell batteries
- 3 10 watt light bulbs
- 10 copper wires with alligator clips

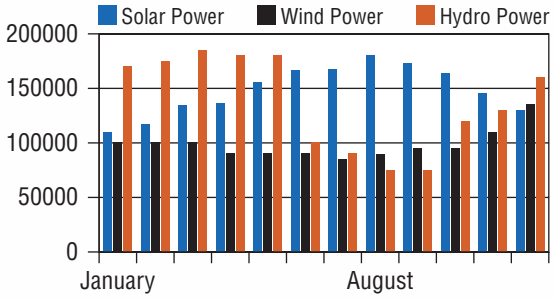


Figure 1 Energy sources available (measured in kilowatt-hours/month; a kilowatt is equal to 1000 watts).

Table 1 Energy Usage for Buildings

Building	Energy Usage
House	360 kWh/month
School, Store or Office Building	800 kWh/month
Hospital or Airport	850 kWh/month
Recreational Facility	875 kWh/month
Factory or Industry	975 kWh/month

Plan and Construct

1. In your group, create a table to show the advantages and disadvantages of the three energy sources available to your town. Your table should also identify which of the sources is most reliable throughout the year (based on Figure 1).

2. Use the information in step 1 to decide as a group which power source you would prefer to use. Explain why.

3. **(a)** Decide on the population of your town.
   (b) Estimate the number of buildings (houses, stores, hospitals, facilities) that will be constructed in your town. Select the buildings you will need from those listed in Table 1.

4. Create a map of your town plan. Use pencil in case you have to make changes to your plan. (Don't try to include every house on your map. You can draw squares to representing groups of houses. Indicate the number of houses each square represents.) Include a power station.

5. Calculate the total amount of electricity required by your town in one month. Do this by adding together the energy usage of all the buildings in your town. Show your work. Table 1 provides the energy usage for different types of buildings in kilowatt-hours/month.

6. Predict whether your chosen energy source will be able to supply electricity for your town throughout the year. Which months, if any, do you think could be a problem?

7. Determine whether your chosen energy source will be able to supply electricity for your town throughout the entire year.
   (a) From Figure 1, use the bars of the graph to estimate how much of your chosen energy source (in kilowatt-hours/month) is available each month of the year.
   (b) Compare these numbers to the total amount of electricity required by your town in one month (step 5).
   (c) Are there any months in which the energy source will not provide enough electricity for your town?

8. If the energy source will not provide enough electricity, you will have to either:
   (a) choose another energy source (repeat step 7 to ensure that enough electricity is available), or
   (b) remove some of the buildings from your town plan until enough electricity is available.

9. Draw a final map of your town on Bristol board. Show each building wired into the power plant. Each building should be labeled with its name and amount of energy usage.

10. Present your model.

Evaluate

1. How would you change the design of your town if you repeated this project?
2. What was the most important information your group used for choosing the source of energy?
3. Were you able to use the source of energy you chose, or did the amount of electricity needed by your town change the decision?
4. Compare your results to those of other groups. How did the size of the towns affect the choices of energy source?

Extend Your Skills

5. Which energy source would you choose if you needed a second one?
6. Imagine you are on the council for a city with 10 000 homes:
   (a) What other ways could you provide electricity to your city?
   (b) Which of these choices is least harmful to the environment?