Topic 4.1

# How do the sources used to generate electrical energy compare?

## Key Concepts

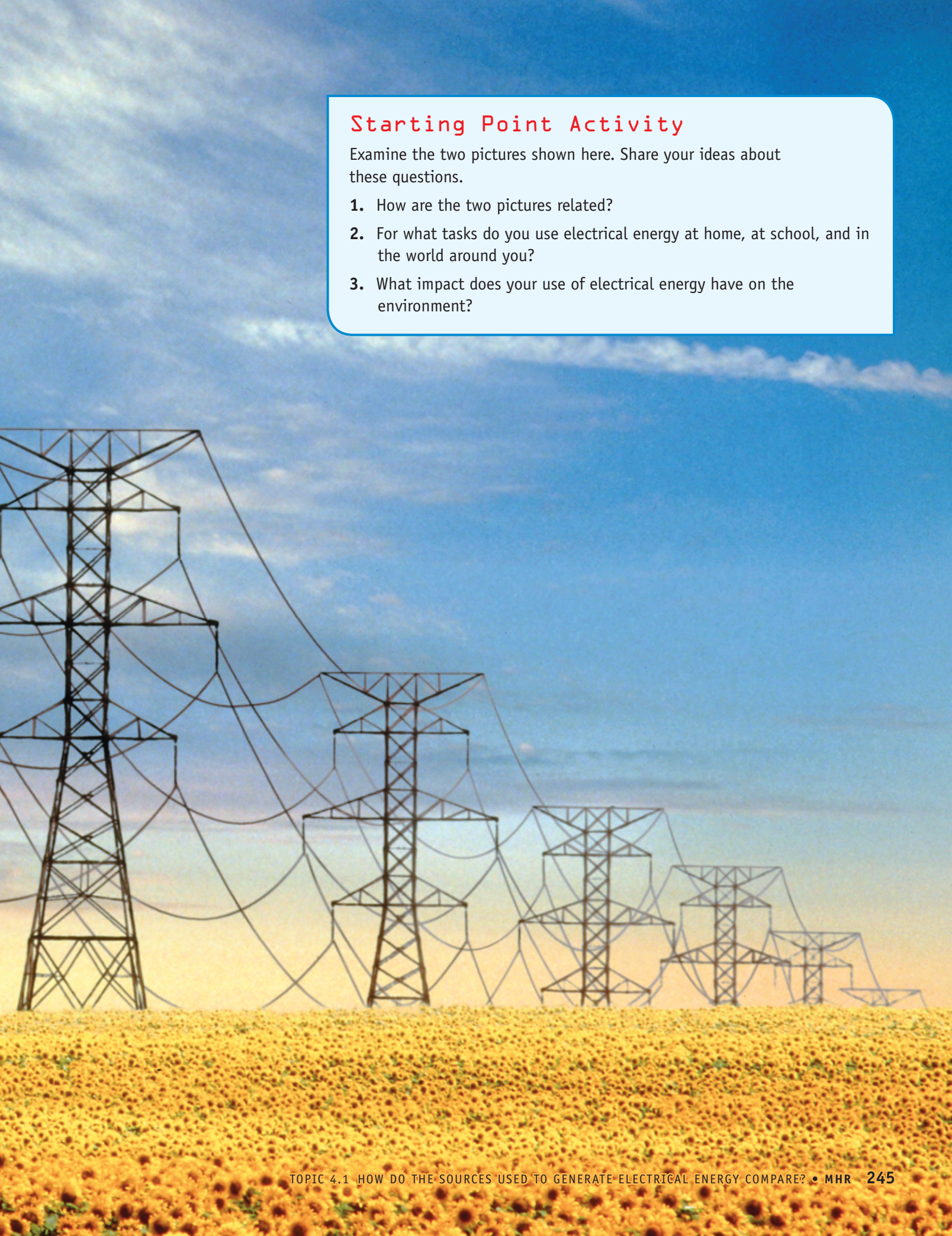
- Different sources of energy can be converted into electrical energy.
- Renewable and non-renewable energy sources have advantages and disadvantages.

## Key Skills

Literacy
Research

## Key Terms

renewable energy source
non-renewable energy source



## Starting Point Activity

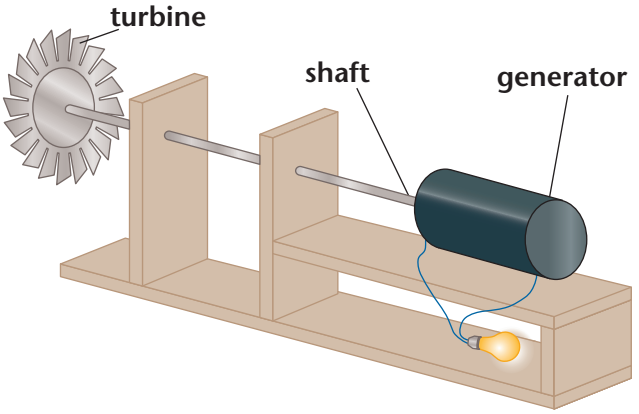
Examine the two pictures shown here. Share your ideas about these questions.

1. How are the two pictures related?
2. For what tasks do you use electrical energy at home, at school, and in the world around you?
3. What impact does your use of electrical energy have on the environment?

# Different sources of energy can be converted into electrical energy.

You use electrical energy many times every day. You probably have also seen power lines like the ones shown on the previous page. Power lines such as these carry electrical energy from great distances to your community. What is at the other end of those power lines? How is the electrical energy that travels along those power lines generated?

Most of the electrical energy in Canada is made by converting kinetic energy (the energy of motion) into electrical energy. This is done with a device called a generator. **Figure 4.1** shows a simple model of a generator used to make electrical energy.




▶ **Figure 4.1** The key parts of a system used to produce electrical energy are a turbine, a shaft, and a generator. The shaft connects the turbine to a rotor inside the generator. As the turbine spins, it makes the shaft and rotor spin. The kinetic energy of the rotor is converted into electrical energy inside the generator.

## Resources for Generating Electrical Energy

Any type of energy that can be used to turn a turbine can be used to generate electrical energy.

The vast majority of electrical energy used in Ontario (and Canada) is generated from three sources of energy: falling water, fossil fuels (coal, oil, natural gas), and uranium. **Figure 4.2** outlines the processes that convert these three sources to electrical energy.

Go to **scienceontario** to find out more

**Literacy Focus**

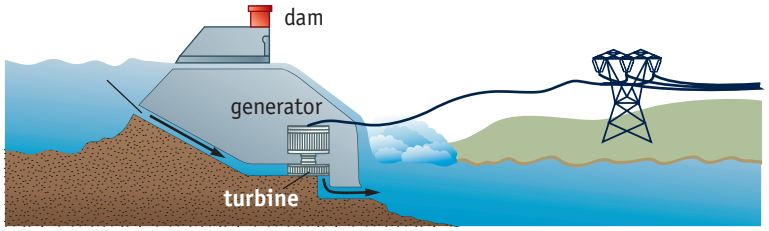
### Activity 4.1

**YOUR SOURCE OF ENERGY**

Is the source of electrical energy for your community one of the three sources described in **Figure 4.2**? If so, which one? If not, what is the source of your electrical energy? If you don't know or aren't sure of the source of electrical energy for your community, check with your classmates and friends. If you're still not sure, how else can you find out?

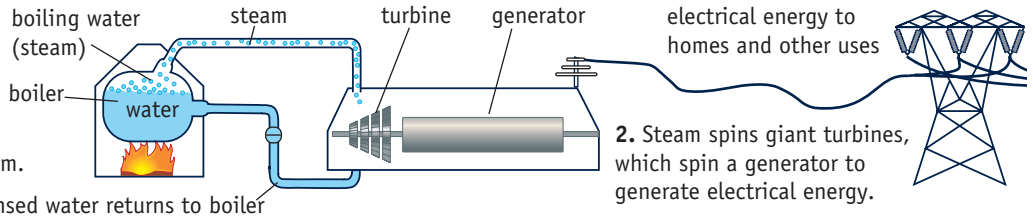
**A**

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



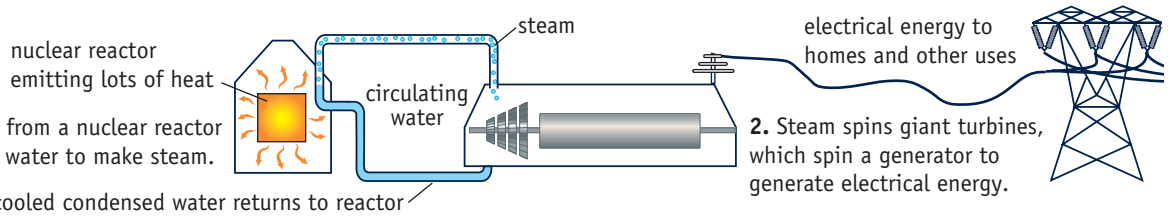

Hydroelectric sources of energy convert the kinetic energy of moving water to electrical energy.

**B**




Thermoelectric sources of energy convert the chemical energy of burning fossil fuels (mostly coal) into heat that boils water into steam. The kinetic energy of the hot steam spins a turbine to generate electrical energy.

**C**




Nuclear sources of energy convert the energy released from the splitting of uranium atoms into heat that boils water into steam. The kinetic energy of the hot steam spins a turbine to generate electrical energy.

▲ **Figure 4.2** Compare the ways in which moving water, fossil fuels, and uranium are used to generate electrical energy.

## LEARNING CHECK

1. Describe how most electrical energy is generated in Canada.
2. Refer to **Figure 4.1**. List the three key parts of a generator system, and briefly describe their functions.
3. Refer to **Figure 4.2**. Use a table to compare the similarities and differences among the use of moving water, the burning of fossil fuels, and nuclear reactions to generate electricity.
4. Describe how your life would be different if the electric generator had not been invented.

# Energy sources have advantages and disadvantages.

**renewable energy source:** an energy source, such as moving water, that can be replaced or restocked within a human lifetime, or less

**non-renewable energy source:** an energy source, such as fossil fuels and uranium, that cannot be replaced or restocked within a human lifetime, or longer

You probably recall that sources of energy can be classified as renewable and non-renewable. A **renewable energy source** can be replaced or restocked within a short period of time. The water that is used to generate hydroelectric energy is an example of a renewable energy source. Wind, solar, biomass, tides, and geothermal (heat from below Earth's surface) are other examples of renewable energy sources. **Figure 4.3** shows two of these energy sources being converted into electrical energy.

A **non-renewable energy source** is one that cannot be replaced or restocked within a human lifetime. Fossil fuels and uranium are examples of non-renewable energy sources. Fossil fuels took millions of years to form on Earth, and millions of years will be needed to create new stocks of them. Uranium was formed in the explosions of stars before Earth was formed. Some of the uranium condensed with the dust that formed Earth billions of years ago. It can never be replaced. So when all available supplies of fossil fuels and uranium on Earth are used up, they are gone forever.

Whether it is renewable or not, every energy source has pros and cons—advantages and disadvantages.


▶ **Figure 4.3** Two energy sources used to generate electrical energy

**A** A generator is located directly behind the blades of each wind turbine. As the blades turn the shaft, electrical energy is generated.

**B** Solar cells convert solar energy directly into electrical energy.

## LEARNING CHECK

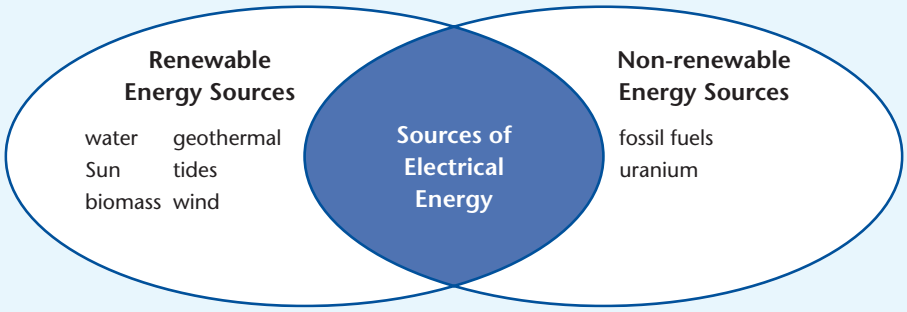
1. Define the terms "renewable energy source" and "non-renewable energy source."
2. Explain why uranium is a non-renewable energy source and why water is a renewable energy source.
3. In your opinion, why is it important to assess every energy source in terms of its advantages and disadvantages?

**INVESTIGATION LINK**
Investigation 4A, on page 250

Research Focus

# Activity 4.2

## ASSESS THE SOURCES




**Environment**

- What impact does the use of the energy source have on ecosystems?
- What impact does extracting or providing it have on ecosystems?

**Society**

- What impact does using this energy source have on the ability of people to live where and how they choose?
- How abundant are the supplies of this energy source?
- Is it possible or practical to use the energy everywhere or only in specific places?

**Technology**

- Is there technology to convert the energy source to electrical energy?
- Is the technology energy-efficient and cost-effective?
- Does the technology solve one problem by creating another?

What do you think is the best choice of energy source or combination of sources to generate electrical energy? To help you assess the sources and reach a decision, you will use a R.A.D.D. chart like the one below. The letters that make up R.A.D.D. stand for **R**esearch, **A**dvantages, **D**isadvantages, and **D**ecision.

Work in small groups. Your group will fill out a R.A.D.D. for one specific energy resource. Use the Venn diagram above and the questions that follow it to help make your decision. When you and the other groups are done, you will share your information with one another. Combine all of the information on one large chart, and use it to make a class decision. Decide which energy source or combination of sources will be best for Ontario. Give reasons to justify your decision.

| **Research** the Energy Source | **Advantages** of the Energy Source | **Disadvantages** of the Energy Source | **Decision** |
|---|---|---|---|
| (List key characteristics of using the energy source for electrical energy. Include effects on the environment, on society, and the economy.) | (Identify the characteristics that make this energy source an attractive choice.) | (Identify the characteristics that make this energy source an unattractive choice.) | (Weigh the advantages and disadvantages for this one energy source, and decide if it represents a good choice or a bad choice.) |

# Investigation 4A

**Skill Check**

- Initiating and Planning
- Performing and Recording
- ✓ **Analyzing and Interpreting**
- ✓ **Communicating**

**What You Need**

Internet access

## Leapin' 'Lectricity

### What To Do

Read the information below. Use the website of Bullfrog Power and information at a local library to answer the "What Did You Find Out" questions that follow.

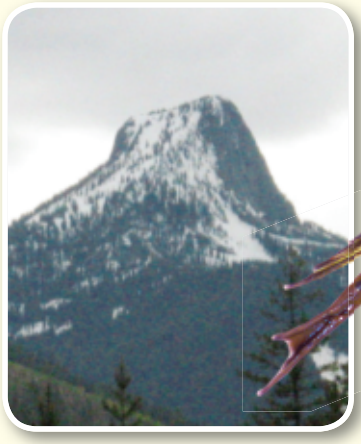
To some North American Aboriginal people, such as the Sinixt Nation of British Columbia and the Seminole of Florida, frog is a symbol of survival, offering hope in times of fear and concern. The green colour of the frog also makes it a natural symbol of hope for the "green movement" and its promise of products and energy that are more environmentally sensitive and responsible.

One company that has adopted the frog as a symbol is Bullfrog Power. Since 2005, residents and businesses in parts of Ontario, Alberta, and British Columbia can sign up with Bullfrog Power as their supplier of electrical energy. In return, the company promises energy that is generated from renewable energy sources such as wind and water.

### What Did You Find Out?

1. Bullfrog Power refers to itself as a "100% green electricity provider."
   a) What do you think this means?
   b) Check the Bullfrog Power website to check your answer.
2. The company has the endorsement of Canada's EcoLogo program.
   a) What is the EcoLogo program?
   b) What types of power generation qualify for the EcoLogo?
3. Name three wind-farm sites that are providers for Bullfrog Power. Compare these sites in terms of the amount of electrical energy they can, or are predicted to, provide.

Frog Mountain, B.C.



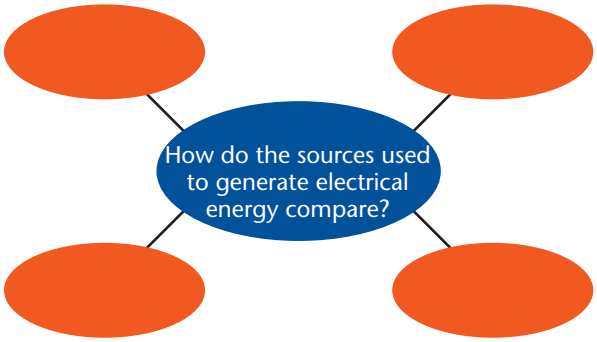
# Topic 4.1 Review

## Key Concept Summary

- Different sources of energy can be converted into electrical energy.
- Renewable and non-renewable energy sources have advantages and disadvantages.

## Review the Key Concepts

**1.** K/U Answer the question that is the title of this topic. Copy and complete the graphic organizer below in your notebook. Fill in four examples from the topic using key terms as well as your own words.




**2.** C In your notebook, draw and label the parts of a simple generator used to generate electrical energy. Include a brief explanation of how a generator works.

**3.** K/U **a)** Explain what a non-renewable energy source is.

**b)** Explain what a renewable energy source is.

**4.** K/U Use a double bubble graphic organizer or a table to compare the similarities and differences between renewable energy sources and non-renewable energy sources.

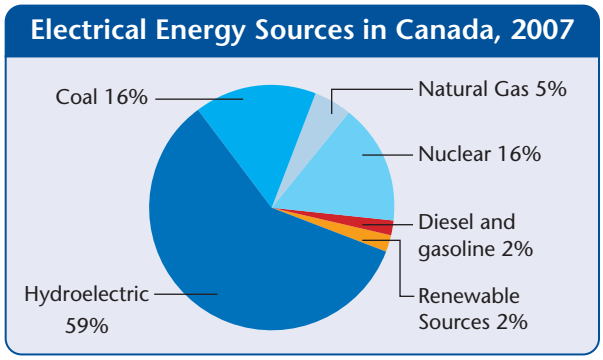
**5.** C Use words, pictures, or a graphic organizer such as a flowchart to explain how falling water can be used to generate electrical energy.

**6.** T/I Refer to the pie graph.

**a)** In your notebook, list the sources of electrical energy production in Canada from largest to smallest.

**b)** Predict what you think the percentage of each source of electrical energy will be in 2015. Re-draw the pie graph to reflect these changes.

**c)** Explain the reasons for your predictions.




**7.** A When producers of "green power", such as Bullfrog Power, sell their electricity to electrical utility companies, the amount they are paid often does not cover all their costs to produce the electricity. Consumers who buy "green power" are paying a premium (extra fee) that is the difference between the standard price the producer gets for the sale of electricity and the cost to generate it.

**a)** In your own words define the term "green power."

**b)** Refer to **Figure 4.2**. Identify the different methods used to generate electrical energy that you think would qualify as "green power." Justify your answer.

**c)** Would you be willing to pay a premium to buy electrical energy produced by green power? Write a blog explaining why you would or would not pay this premium.