

# 9.2

## Conventional Energy Sources

Thermal-electric power plants, hydro-electric power plants, and nuclear power plants supply most of the electrical energy used in Ontario. These three methods of producing electricity are often referred to as **conventional energy sources**. This means that they are the more traditional or more commonly used sources of electrical energy. Why are these conventional energy sources so widely used? What advantages and disadvantages do they have compared to other energy sources? Think about these questions in this section.

### conventional energy source:

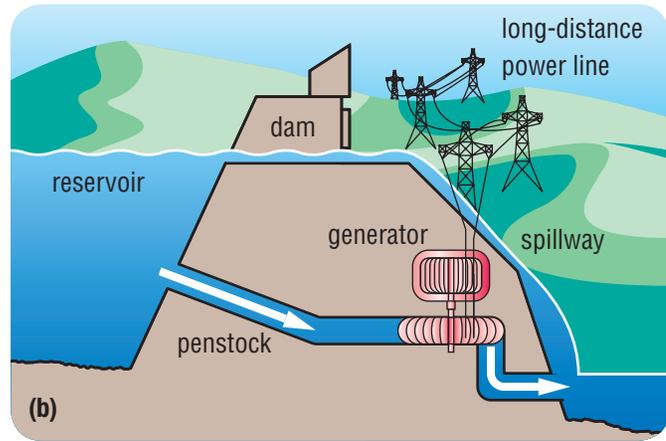
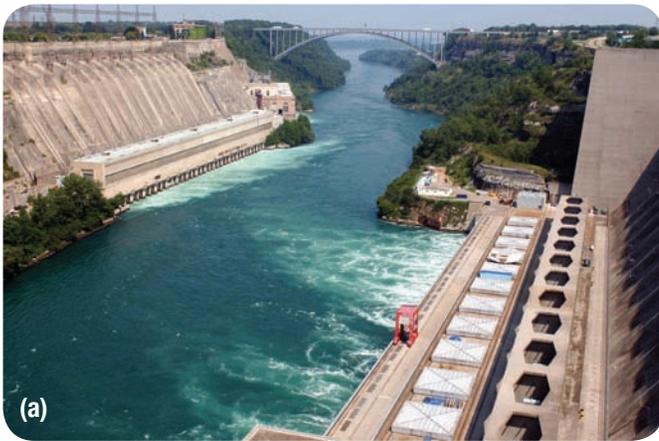
a source of energy that has been widely used for many years

### renewable energy resource:

a source of energy that can be used indefinitely, without running out

### Hydro-Electric Energy

Electrical energy is produced in hydro-electric power plants from the energy stored in water behind a dam (Figure 1). As this water falls through the penstock, the water's energy of motion spins the turbines. The spinning turbines turn the electrical generator that transforms the water's mechanical energy into electrical energy.



**Figure 1** (a) A hydro-electric power plant on the Niagara River (b) Cross-section of a hydro-electric power plant



**Figure 2** The top photo shows water flooding the land above the Three Gorges Dam (China).

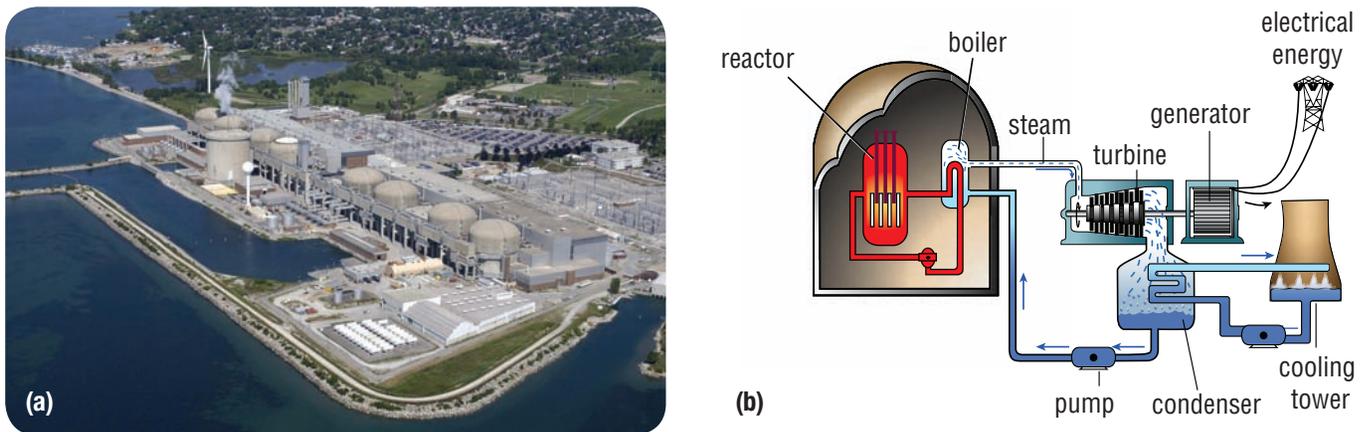
Hydro-electricity is a **renewable energy resource**. The water above the dam is replaced continually by natural processes (rain). We can obtain energy from a hydro-electric power plant almost indefinitely.

Hydro-electricity is often thought of as a “clean energy” source because hydro-electric power plants produce little to no pollution. This does not mean that they have no impact on the environment. The construction of a major hydro dam often results in the flooding of a large area of land (Figure 2). The dam also stops fish and other animals from moving up and down the river. Water in reservoirs above hydro-electric power plants may also get warmer and become lower in oxygen content than free-flowing river water. This also negatively affects the water's ecosystem.

Another disadvantage of hydro-electricity is that the dams can only be built on certain sites. For example, although Ontario has many rivers and streams, there are few suitable sites for more large hydro-electric power plants.

## Nuclear Energy

Nuclear energy is produced from the nucleus of the tiny particles that make up matter. The nucleus of a particle stores large quantities of nuclear energy. Canadian nuclear power plants use the nucleus of a substance called uranium as fuel. The nuclear energy in the uranium nucleus is transformed into thermal energy. This thermal energy is used to boil water to produce very hot, high-pressure steam. Then, the steam is used to turn the turbines of an electricity generator (Figure 3).



**Figure 3** Nuclear power accounts for approximately 52 % of Ontario's electrical energy supply. (a) A nuclear power plant in Pickering, Ontario (b) Cross-section of a nuclear power plant

Like other sources of energy, nuclear energy has significant advantages and disadvantages. Nuclear energy is the most highly concentrated form of energy. Just 1 kg of uranium has more energy than 2000 kg of coal!

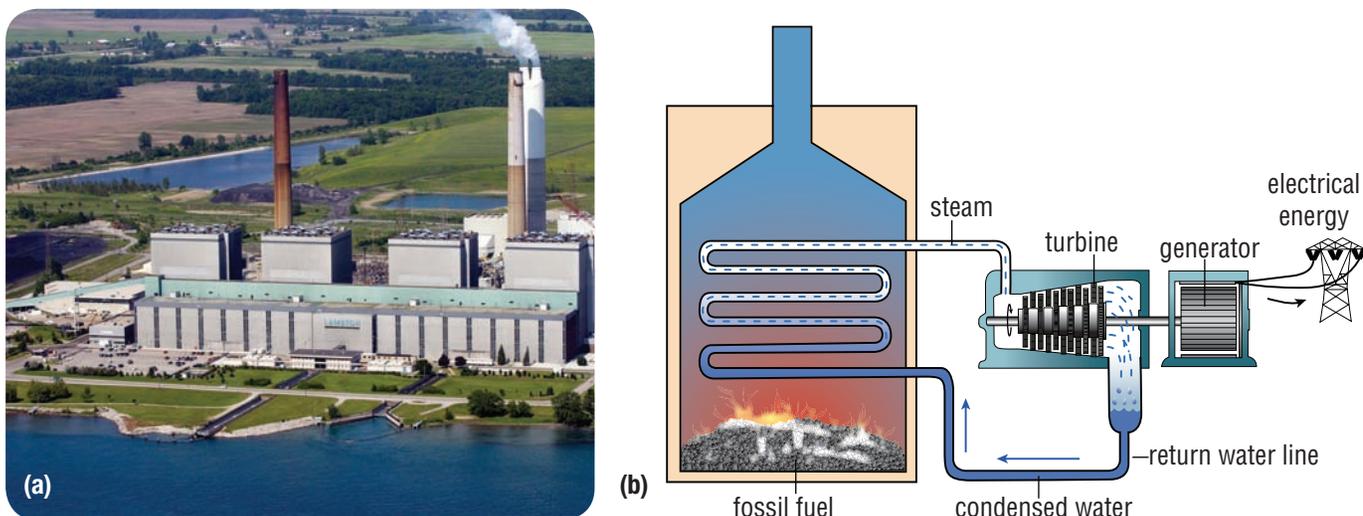
Nuclear power plants have some major disadvantages. They are complex and expensive to build and maintain. Nuclear fuel is highly radioactive. The radiation that it gives off can damage or kill living cells. Some forms of nuclear fuel are used in atomic weapons. This means that uranium mines and nuclear power plants must be designed and monitored to ensure safety. A number of serious accidents has occurred at nuclear power plants around the world. These accidents released large amounts of radioactive materials into the atmosphere and into nearby bodies of water. Unlike hydro-electricity, uranium is also a **non-renewable energy resource**. This means that it is a resource that is in limited supply and could eventually be completely used up.

**non-renewable energy resource:**  
a source of energy that could eventually be used up

Another important disadvantage of nuclear power is that uranium remains dangerous for a very long time. Used nuclear fuel (called spent or depleted fuel) must be safely stored, and not allowed to escape into the environment. Radioactive substances break down into less harmful materials, but this process can take hundreds or thousands of years. We have to be willing to safely store nuclear waste. This is a very long and expensive commitment. The advantages and disadvantages of nuclear power are quite dramatic. Nuclear energy is one of the most controversial of all energy sources.

## Thermal-Electric Energy and Fossil Fuels

In thermal-electric power plants, electrical energy is produced by burning coal, oil, or natural gas. In this process, the thermal energy released when these fuels are burned is used to boil water. This produces steam. The steam is used to spin the turbines of generators that produce the electricity (Figure 4).



**Figure 4** (a) The Lambton coal-fired thermal-electric generating station near Sarnia, Ontario  
(b) Cross-section of a coal-fired thermal-electric generating station

**fossil fuels:** concentrated sources of chemical energy such as coal, oil (petroleum), and natural gas that were formed deep in Earth's structure over millions of years from decayed and compressed plant material

To learn more about fossil fuels,

[Go to Nelson Science](#) 

Coal, oil, and natural gas are concentrated sources of chemical energy called **fossil fuels**. Fossil fuels are formed from decayed and compressed plant and animal material from millions of years ago. Fossil fuels are extremely valuable in modern society. They are easy to transport and can be obtained at a relatively low cost. However, although fossil fuels are used around the world, they are only mined in certain areas, including parts of Canada. Because fossil fuels are so valuable and they are not found everywhere, international politics is very much involved in producing and distributing fossil fuels. 

Fossil fuels are used to generate electricity. They are also used for heating. Natural gas and oil are burned in furnaces to heat many homes, schools, and commercial buildings. Fossil fuels also provide the energy for virtually all of our transportation needs. Without gasoline, diesel, and jet fuels, our economy would come to a grinding halt (Figure 5).

In Ontario, fossil fuels provide almost all of the energy used for transportation. Fossil fuels also provide one-quarter of the energy used to produce electricity, and about two-thirds of the energy used to heat residential and commercial buildings.



**Figure 5** Oil refineries use crude oil as a raw material to produce gasoline, motor oil, diesel fuel, and jet fuel.

### The Fossil Fuel Dilemma

At present, fossil fuels account for more than 80 % of global energy production. Fossil fuels are extremely valuable, but they have two major disadvantages.

First, fossil fuels are non-renewable. We are consuming them far faster than they can be replaced. This poses a big problem for society and the economy. Some scientists think that we will run out oil and natural gas within the next few decades. We will need to find other sources of energy to take their place as our fossil fuel supplies run out. Alternative forms of energy are available, but not without problems.

Second, burning fossil fuels produces air pollution. This pollution contributes to acid rain and smog. Burning fossil fuels also causes an increase in the concentration of carbon dioxide. This results in climate change and global warming.



#### CHECK YOUR LEARNING

1. Describe an idea in this section that is new to you. How does this idea add to your understanding of heat in the environment?
2. List three conventional sources of energy.
3. Briefly describe the difference between renewable and non-renewable energy sources, with examples.
4. Construct a chart to compare the advantages and disadvantages of fossil fuels, hydro-electricity, and nuclear power.
5. How might concern for the environment affect your choice of the best energy source to use?
6. Some conventional energy sources are non-renewable. Why is this important?