

Introduction to electricity fundamentals



Welcome to Module 1: **Introduction to electricity fundamentals**

By the end of this module, you should be able to:

- Identify key electrical terms and their definitions
- Outline the history of electricity in Canada
- List the various sectors of electricity life cycle

This course uses images, audio, and text; content will appear on your screen as you scroll through the module. Keyboard navigation instructions will be provided for those who are not using a mouse or touchscreen. There is a short, graded assessment at the end.

This module should take approximately 30 minutes to complete.

Last updated August, 2025



Introduction



Electricity - Getting started



A brief history of electricity in Canada

 The basics – generation, transmission, distribution

 Module assessment

 Attestation

Introduction



It would be very difficult to find any place or any aspect of our lives that is not touched by electricity.

Electricity Canada would like to thank our sponsor for their support of Electricity Fundamentals in Canada. Please take a moment to get to know them!

Select the play button to view the video.



Domino Highvoltage Supply - dominohighvoltage.com



Electricity in Canada

Electricity is all around us. It's a part of our natural world. In modern society, electricity literally powers our lives. Yet, as important as this resource is, how electricity is made and how it ultimately gets to our homes, offices, and factories may not be well understood. Electricity Canada has therefore created an e-learning program to provide an overview of electricity fundamentals in Canada.



Reference Documents

To facilitate your understanding of terminology used in this course, please download the glossary of electrical terms.



EFiC_Glossary_EN.pdf
164.7 KB



If you are not using a mouse or touchscreen to navigate the course, please download the keyboard navigation instructions.



EFiC_Keyboard_Navigation_Instructions_EN.pdf

159.4 KB



CONTINUE

Activity: The value proposition

Before we get into how the electricity system in Canada works, it's important to take a moment to consider the value that electricity provides in our day-to-day lives. To help understand this "value proposition," let's do a short activity.

Select the check box as you complete each step of the activity.

Get a sheet of paper and take a few minutes to make a list of everything you use electricity for at home or at work/other.

Tally how many items you wrote down.

Get a copy of your electricity bill and locate the total amount owing on the bill for a one-month period. (A typical Canadian electricity bill is in the range of \$60–\$150 per month, depending on the size of your home and your region.)

Divide this amount by 30. This is how much you pay for electricity per day on average.



How does this number compare with everything else you pay for in your life and the value you get? (For example, your transit pass or parking costs, your cell phone bill or even your daily cup of coffee)



Ask yourself: When was the last time you thought about electricity like this – if ever?

So, after completing this exercise, does electricity deliver good value for what you pay, or not?



Read all the information and complete each activity to continue with your training.

Cost of electricity

Typically, the cost of electricity at a residential level compares roughly to the cost of a cup of coffee per day.

Between 2015 and 2023, the price of electricity in Canada increased about 9.45%. This compares favourably to other household expenditures such as property taxes, water and sewage, cell phone service, and Internet service – which increased in price by anywhere from about 15% to nearly 87% during the same timeframe.

Spending increases per household
comparing 2010-2023



Now let's look at how this valued resource is made and continues to make its way into our homes, offices, and industries.

Electricity – Getting started



No matter how little or how well one understands electricity, everyone will agree that it has transformed our lives and our world.

Neither finite nor unlimited

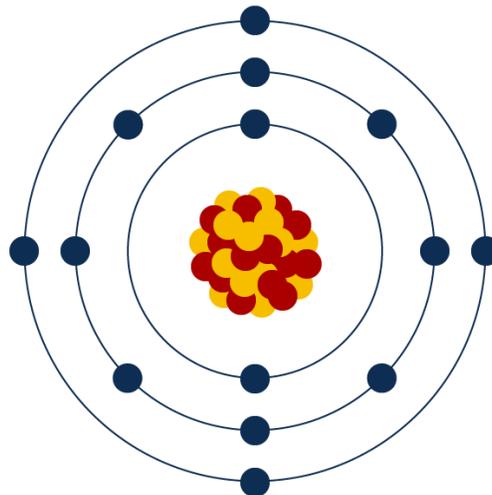
Where does electricity come from? How does it work? Many people never bother to ask, even though it provides much of our energy. There is an expectation that Canadians will flip a switch and lights will go on.

Electricity is not a finite natural resource, but it isn't unlimited either. As a manufactured energy form, electricity possesses unparalleled flexibility, but it can only be stored with difficulty. For the most part, it must be used up in the very moment it is produced, or the opportunity to use it is lost forever.

Our need for electrical power is so great, we have created huge power plants and altered the very face of the land on a scale that's visible from the moon. We have even bent the force of the atom to our will.

The atom

All matter is made up of particles called atoms. Each atom has a centre, called a nucleus, that contains positively charged particles called protons and uncharged particles called neutrons. The nucleus of an atom is surrounded by negatively charged particles called electrons. Electrons are the smallest unit of electric charge.



● 14 Protons ● 14 Neutrons ● 14 Electrons

Diagram of an atom with protons and neutrons in the nucleus and electrons orbiting around the nucleus

What exactly is electricity?

Together, all the electrons of an atom create a negative charge that balances the positive charge of the protons in the atomic nucleus. When the balancing force between protons and electrons is upset by an outside force, an atom may gain or lose an electron. When electrons are “lost” from an atom, the free movement of these electrons constitutes an electric current. Electricity is, therefore, a form of energy caused by the flow of electrons. Using electricity as a power source involves harnessing that flow.

Key terms

To control the flow of electrons, it is important to be able to measure or quantify aspects of an electrical charge. Let's review some key electrical terms used for measurement.

Select each flip card to learn more.

**Amperes
or amps**

The measure of the flow of an electric current, specifically how many electrons flow past a given point in one second.

Voltage or volts

The measure of the force or pressure applied to electrons. In our homes, standard plug-in wall outlets are typically rated at 120 volts. There are also specialized 240-volt outlets for larger electric appliances such as stoves, dryers, hot water tanks, central air conditioning, and electric vehicle charging stations.

Watts (Demand)

The measure of electrical power derived by multiplying amps x volts. Watts describes the rate at which electricity is used at a specific moment, and represents the demand placed on electricity supply. For example, a 15-watt LED light bulb draws 15 watts of electricity at any given moment it is turned on.

Watt-hours (Consumption)

The measure of electricity consumption over time. Watt-hours are a combination of how much demand for electricity there is (watts) and over what period of time (hours). For example, a 15-watt LED light bulb draws 15 watts of electricity at any given

Kilowatts and Kilowatt-hours

One kilowatt (kW) simply equals 1,000 watts, and one kilowatt-hour (kWh) equals 1,000 watt-hours. On your electricity bill, consumption is typically measured in kilowatt-hours because it aligns well with the amounts of electricity used by large appliances and

Megawatts

This measure is used in relation to the output of power plants, or the amount of electricity required by large customers or entire cities. One megawatt (MW) simply equals 1,000 kilowatts or 1,000,000 watts.

Gigawatts

This measure is used in relation to the output of very large power plants, or collections of such plants. One gigawatt (GW) simply equals 1,000 megawatts or one billion watts – in other words, very large amounts of electricity.



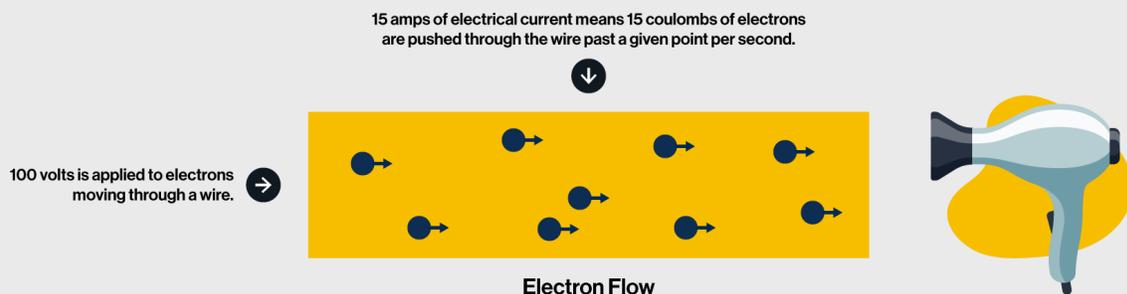
Read all the information and complete each activity to continue with your training.

Electricity – calculating power

This schematic diagram shows the relationship between voltage, amperage, and wattage using a standard hairdryer as an example.

Volts (force) multiplied by amps (flow) equals watts (power).

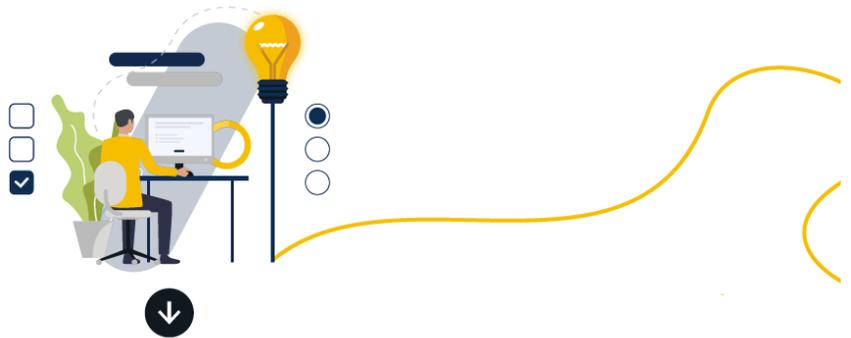
One ampere is equal to the flow of one coulomb of charge per second (one coulomb is equal to 6.28×10^{18} electrons).



One hundred volts of pressure is applied to electrons moving through a wire.
Fifteen coulombs of electrons are moving past a given point per second.

● $100 \text{ volts} \times 15 \text{ amps} = 1,500 \text{ watts}$

- 1,500 watts is the typical demand (or load) placed on the electricity supply by a hairdryer
- For every hour it's used, that hairdryer consumes 1,500 watt-hours of electricity



Knowledge check

Match each electrical term with its corresponding definition.

Click and drag each item on the left to its corresponding definition on the right, then select SUBMIT.

⋮ Atoms

Particles that make up all matter and contain protons, neutrons, and electrons

⋮ Watts

Positively charged particles in the nucleus of the atom

⋮ Protons

Negatively charged particles that are the smallest units of electrical charge

⋮ Electrons

The number of electrons that flow past a given point in one second

⋮ Amps

A measure of the force or pressure applied to electrons

⋮ Volts

A measure of electric power derived by multiplying force by flow

SUBMIT

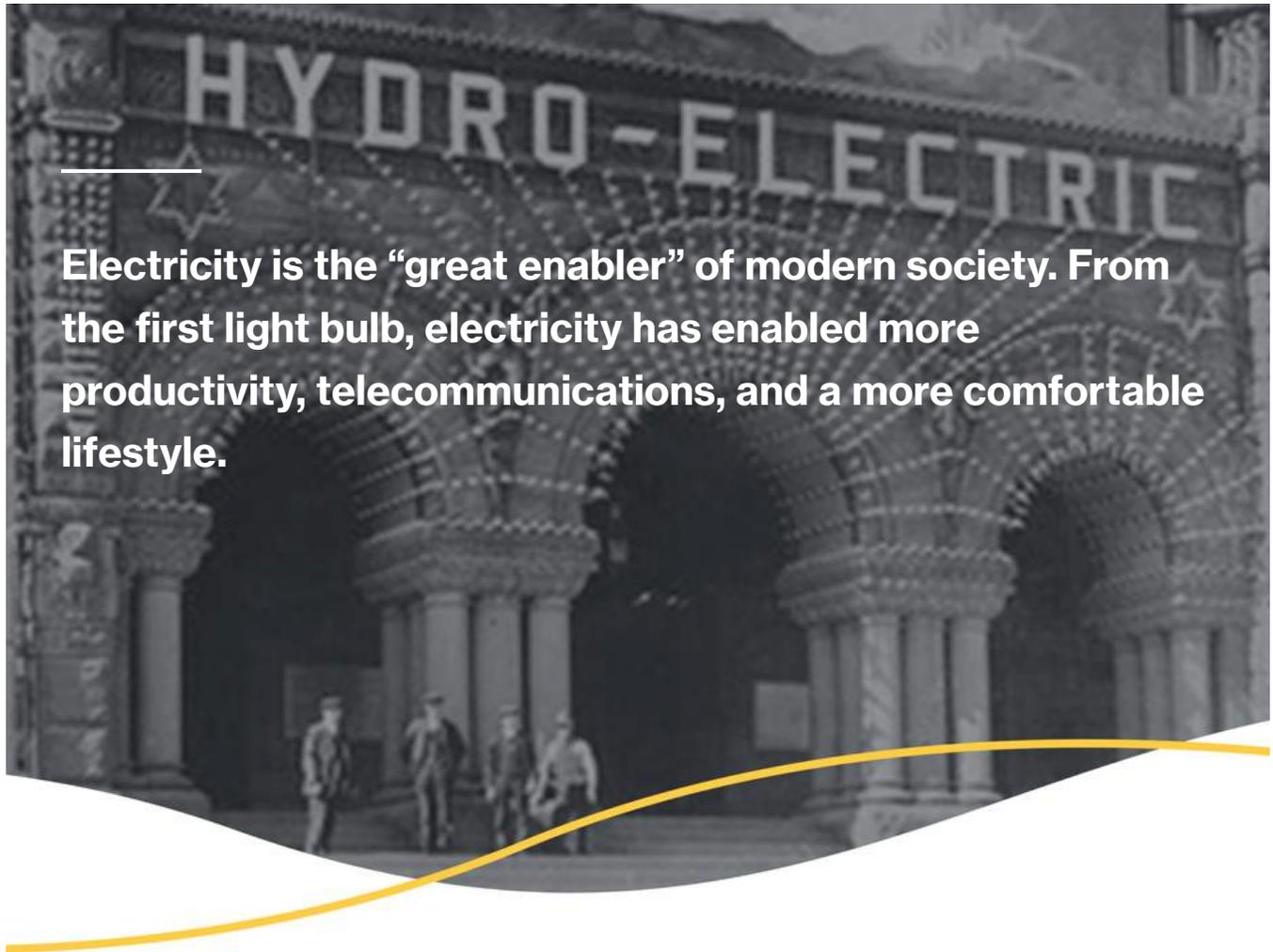


Now that you know what electricity is, let's look back at when electricity became integral to all Canadians.



Read all the information and complete each activity to continue with your training.

A brief history of electricity in Canada



Electricity is the “great enabler” of modern society. From the first light bulb, electricity has enabled more productivity, telecommunications, and a more comfortable lifestyle.

Introduction to electricity in Canada

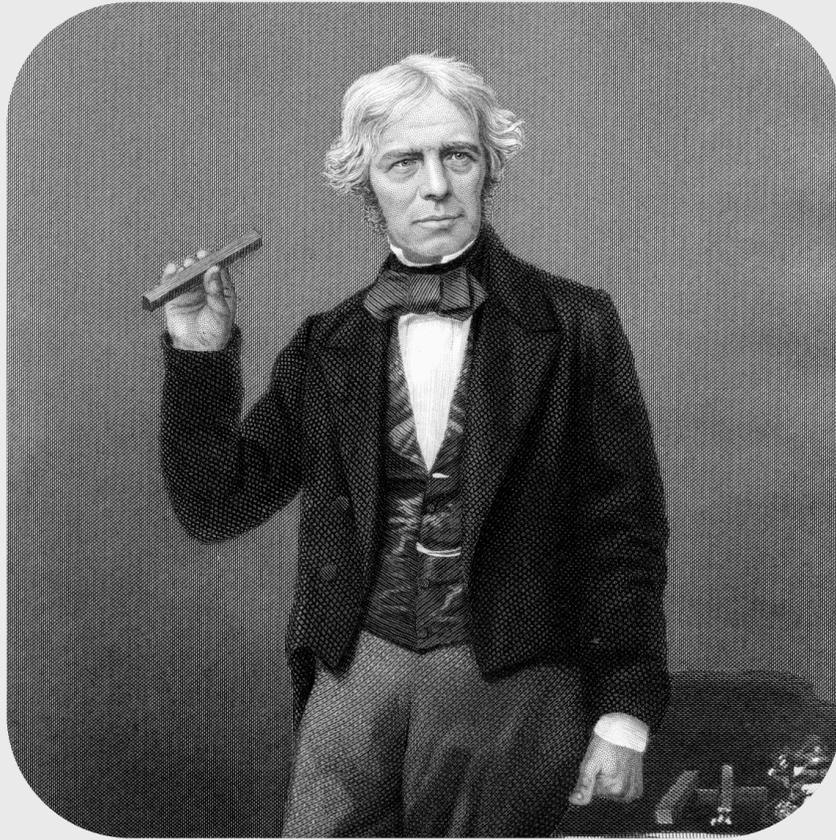
Electricity is deeply embedded in every facet of modern life in Canada and throughout most of the world. So much so that it is largely taken for granted and only vaguely understood. But

impressive feats of scientific inquiry and practical application have brought us to today's electric and digital age.

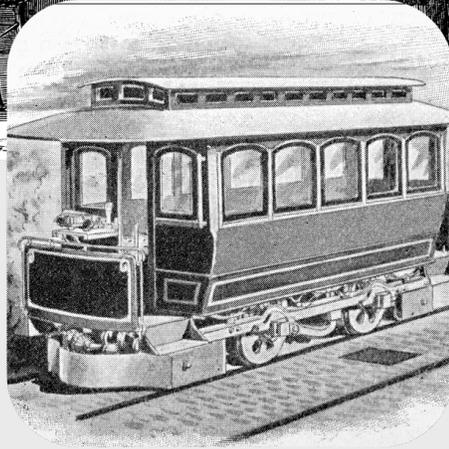
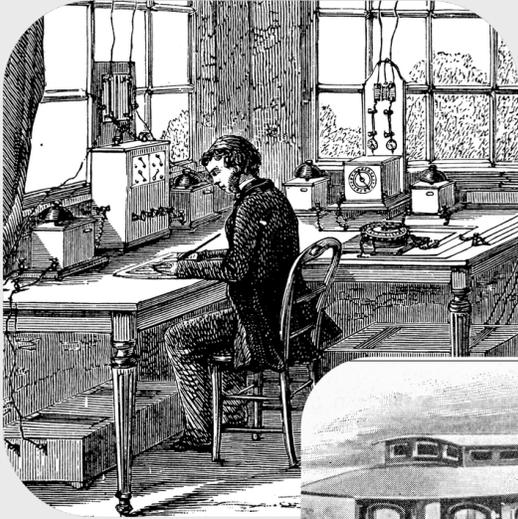
Advent of electricity

The first known stirrings of humanity's understanding of the natural forces on which electricity depends go back more than 750 years – to Roger Bacon's 13th-century theories on the magnetism he observed in an iron oxide mineral we know now as magnetite.

Select the arrows to learn more.



The electric motor: In 1821, Michael Faraday invented a rudimentary electric motor. He then went on to discover a means of converting mechanical energy into electricity on a large scale in the early 1830s, creating the world's first electricity generator in 1831.



Milestones: Within a few short years, we had the telegraph in 1846, the telephone in 1876, incandescent lights in 1879, streetcars in 1883, the electric oven in 1892, electric cars in 1893, movies in 1896, radio in 1900 and a myriad of other inventions.



Advancements: We've gone from those first remarkable steps to a world of computers, smart phones, routers, instant replay, laser surgery, and satellites, all in the blink of an eye!

Until the mid-1800s, most of our power came from water, wood, wind, or brute force. Today, 99% of our work is powered by machines.



Read all the information and complete each activity to continue with your training.

The emergence and evolution of grids

The earliest electricity grids emerged in the late 1800s and were designed to transport electricity over short distances from small-scale generation sources to larger urban centres, where it was put to a limited range of uses.

Thomas Edison installed the world's first central, steam-generation electricity plant in New York City's financial district in 1882, and he developed a local grid to deliver direct current (DC) to the light bulbs he had invented just a few years earlier.

Let's look at the evolution of grids in Canada.

Select a topic to learn more.

EARLY GRIDS

MODELS

MODERN GRIDS

Early grids

Here in Canada, the Niagara Falls Hydraulic Power and Manufacturing Company established a small hydro generation facility in 1881. In 1895, the Adams No. 1 station, also at Niagara Falls, became the world's first large-scale alternating current (AC) generation plant. This is widely considered to be the advent of modern grid operations, as AC power could be transmitted further and more efficiently.

Around the turn of the century, many more electric engines and appliances were developed, and electricity began regularly meeting needs that extended well beyond lighting.

In the early 1900s, hydropower stations proliferated, including larger projects at more remote sites that offered excellent generating potential, with AC transmission and distribution systems used to deliver the electricity across long distances. This period of extensive development extended into the early decades of the 20th century, with fast-growing Western Canada becoming a focal point for grid development.

EARLY GRIDS

MODELS

MODERN GRIDS

Public and private models

Many of Canada's early power companies were small, privately held, and often did not stay in business long. In the early 1900s, a trend emerged of transferring private power companies to public ownership. In particular, the distribution grids that supply electricity to end users often became municipally owned.

Provincial legislation in 1906 established the Hydro-Electric Power Commission of Ontario (HEPCO), later known as Ontario Hydro. Investment in generation was left to private parties at this time, with Ontario Hydro having control over transmission in the province, and municipalities owning distribution systems.

Later developments would demonstrate the viability of alternative investment and ownership models. In 1948, Alberta voted to reject public ownership of electric utilities by an extremely narrow margin – although the province still faced the challenge of fewer than 4% of its farms having access to electricity at around this time.

Albertan farmers formed local co-ops, known as Rural Electrification Associations (REAs), to pool funding and access provincial loans. This model was extremely successful, with 87% of rural Alberta

having access to electricity by 1961. In contrast with other Canadian jurisdictions, the Government of Alberta has never owned or operated an electricity utility.

EARLY GRIDS

MODELS

MODERN GRIDS

Emergence of a modern grid

By the post-war period, the essential outlines of the modern electricity grid, which are still largely recognizable today, had emerged. This entails large, centralized generation plants, from which electricity is transmitted across often long distances for connection to local distribution grids.

This model predominated for at least the next half-century, as it proved to be a cost-effective and reliable means of ensuring universal access to electricity. While different ownership structures are in place across the country, there is close oversight of all these vital systems by provincial agencies.

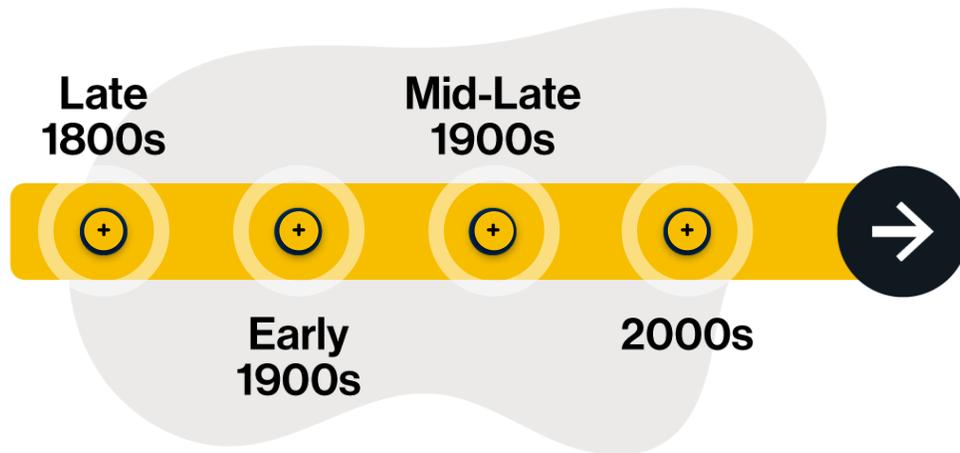


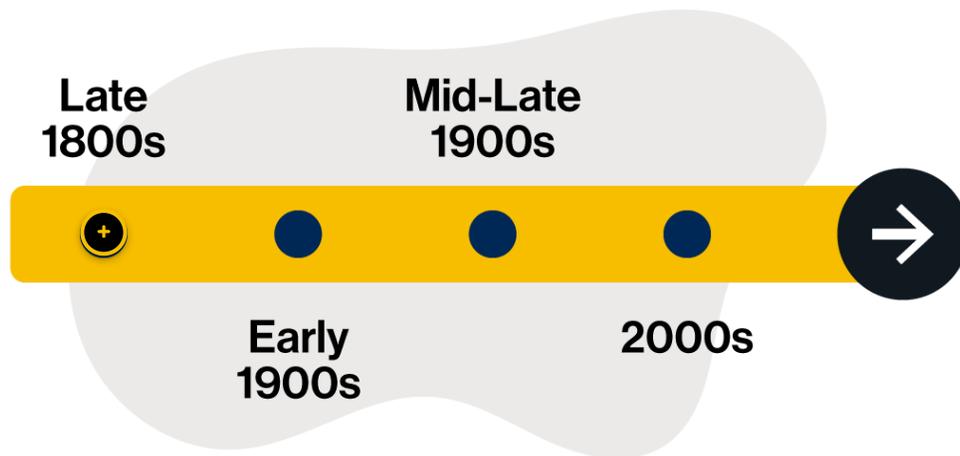
Read all the information and complete each activity to continue with your training.

Key dates for the electricity industry in Canada

We discussed how Michael Faraday invented the first electric motor (1821) and electric generator (1831). In 1873, the first arc lamp was switched on outside the Davis hotel in Winnipeg. Let's now look at some other key dates in the history of Canada's electricity industry.

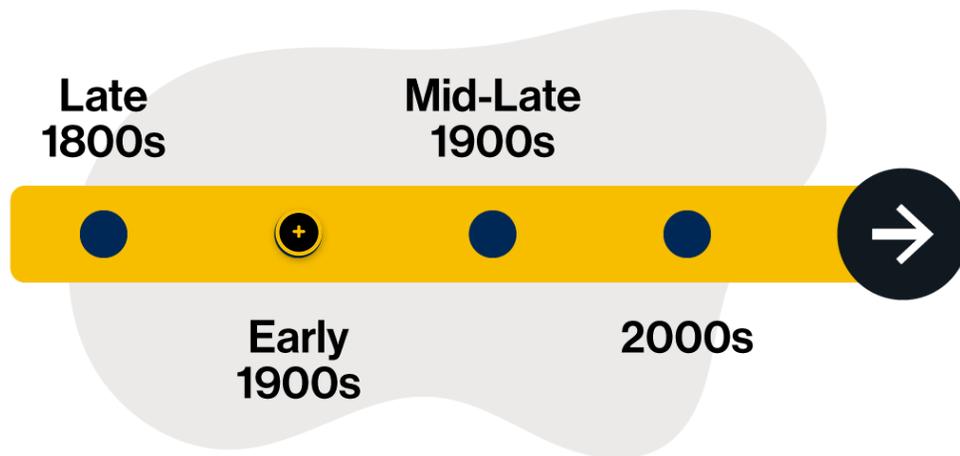
Select a marker to learn more.





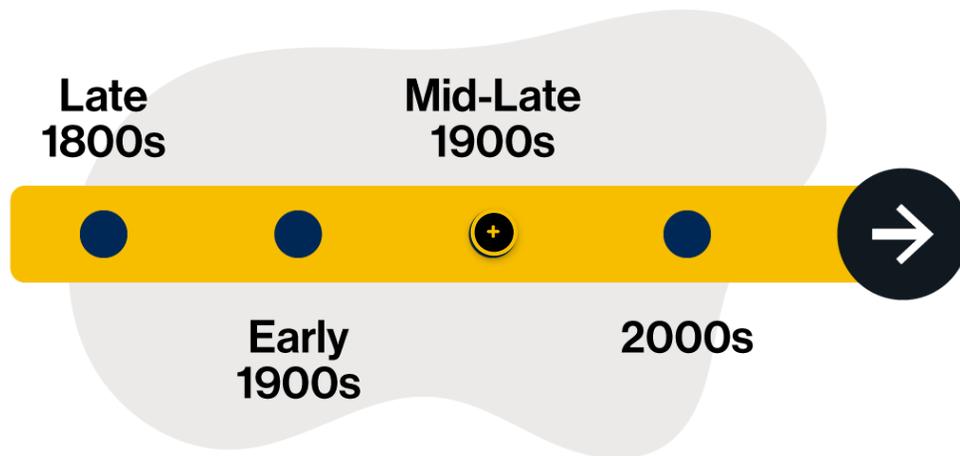
Late 1800s:

- 1881 – Hydroelectric power becomes the first form of commercial electricity in Canada.
- 1882 – The Parliament Buildings in Ottawa are lit with electricity, a full year before the U.S. Capitol Buildings in Washington, D.C.
- 1883 – Hamilton becomes Canada’s first city with an incandescent street light system.
- 1885 - A hydropower generating station near Montmorency Falls provides lighting to the City of Québec.
- 1891 – The Canadian Electrical Association is formed, one of the forerunners to Electricity Canada.
- 1891 – Electric streetcars are introduced to Ottawa. Two years later, they are the first in the world to be electrically heated.



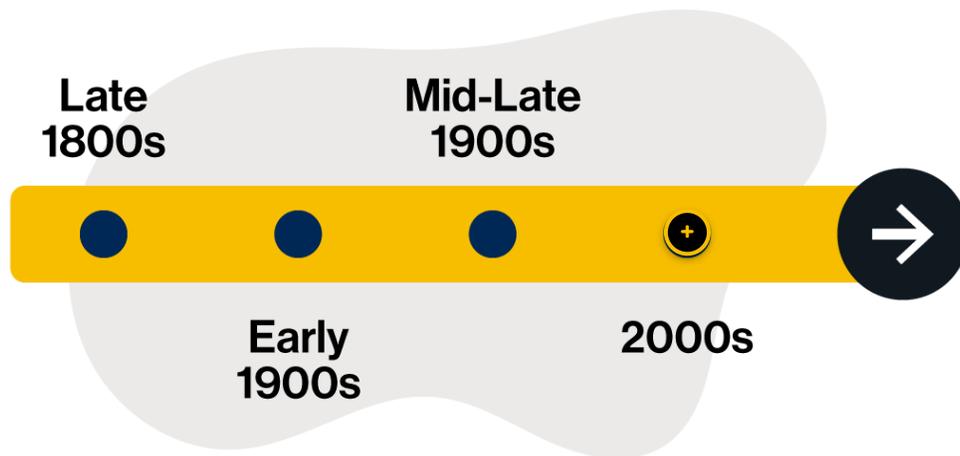
Early 1900s:

- 1900 – The Petty Harbour Hydroelectric Plant is completed by the St. John's Street Railway Company, providing electricity for St. John's streetcars and business and residential customers.
- 1902 – The Shawinigan Electric Company builds the largest generators and longest transmission line in the world.
- 1909 – The first international transmission line between Canada and the United States opens.
- 1912 – The Steel Company of Canada opens the world's first all-electric steel mill, revolutionizing the industry.
- 1918 – Canada launches the world's first electrically welded ship.
- 1921 – Ontario Hydro becomes the largest utility in the world.
- 1932 – The trans-Canada phone system is inaugurated, connecting the country.



Mid – late 1900s:

- 1954 – The first practical solar panel is invented.
- 1962 - Canada's first nuclear power plant, the Nuclear Power Demonstration Plant, is opened in Rolphton, Ontario.
- 1968 – The North American Electric Reliability Council (NERC) is formed.
- 1984 - The Annapolis Royal Generating Station, a tidal power generating station, is built in the Bay of Fundy in Nova Scotia.
- 1993 – The first commercial wind farm in Canada is completed in Alberta.



2000s:

- 2009 – Canada's first solar farm, the Arnprior Solar Project, is built.
- 2010 – Canada's largest photovoltaic plant, Sarnia Photovoltaic Power Plant, is built.
- 2013 – 80% of Canadian electricity is produced greenhouse gas free.
- 2014 – SaskPower's Boundary Dam facility becomes the first power plant in the world to integrate carbon capture and storage technology.
- 2016 – North America's first tidal turbine is installed by Cape Sharp Tidal.
- 2021 – Electricity Canada celebrates 130 years.
- 2023 – Electric vehicle (EV) registrations made up 10.8% of total vehicle registrations.
- 2025 – Ontario Power Generation is set to construct North America's first commercial, grid-scale Small Modular Reactor (SMR).

To learn more

2014 SaskPower's Boundary Dam & Carbon Capture

Source: saskpower.ca

Minutes: 0:41

GO TO VIDEO



Read all the information and complete each activity to continue with your training.

Electricity generation in Canada

Today Canada is the fourth-largest generator of hydroelectricity in the world.

Select a topic to learn more.

Utilities —

Our electricity utility industry employs more than 111,000 Canadians and contributes \$36B towards Canada's GDP. Several of our electricity utilities rank among the largest corporations in the country with

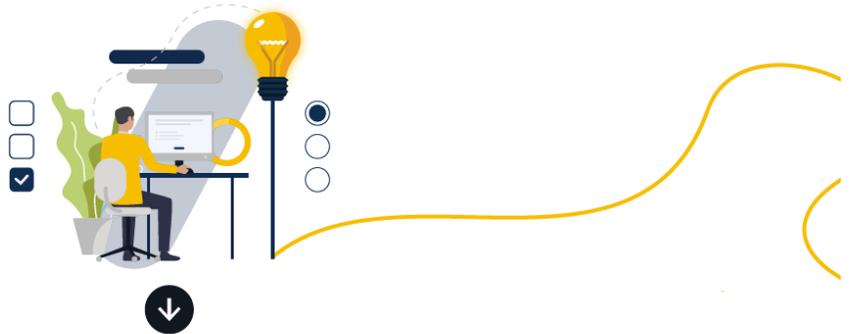
service territories larger than many of the countries in Western Europe put together.

Resources

Canada has tremendous natural resources in rivers, coal, oil, natural gas, uranium, wind, sunshine, tides, and biomass from which to make power. As pioneers in electricity generation, transmission, and distribution, we now possess a technological base pool of knowledge, and operate efficient and world class utilities.



Read all the information and complete each activity to continue with your training.



Knowledge check

Match each key event to its corresponding year.

Click and drag each item on the left to its corresponding year on the right, then select SUBMIT.

⋮ 80% of Canadian electricity is produced greenhouse gas free.	1821
⋮ Hydroelectric power becomes the first form of commercial electricity in Canada.	1873
⋮ Ontario Hydro becomes the largest utility in the world.	1881
⋮ The first arc lamp is switched on outside the Davis hotel in Winnipeg.	1909
⋮ Michael Faraday invents the first electric motor.	1921
⋮ The trans-Canada phone system connects the country.	1932
⋮ The first practical solar panel is invented.	1954
⋮ The first international transmission line between Canada and the United States opens.	2013

SUBMIT

Trying to describe our electricity history is more than just a simple matter of numbers or a recitation of how we got things done: it's a complex tapestry with many skeins. Now let's look at the main sectors of electricity's lifecycle.



Read all the information and complete each activity to continue with your training.

The basics – generation, transmission, distribution



The elements of generation, transmission, and distribution have been networked together over the past 100-plus years to form what has been called the world's largest machine.

The electrical grid

The electricity grid is the network through which power is generated, transmitted across long distances, and distributed to our homes, businesses, and institutions. The electricity grid

enables how we live, work, and play. It provides the ultimate in “just-in-time delivery,” as its product is largely consumed in real time as it is produced.

Transportation of electricity

The three main sectors of electricity's life cycle are generation, transmission, and distribution. Electricity travels through the grid at over 150,000 kilometres per second. The graphic below shows how the three sectors of the electricity grid are interconnected.

Select a marker to learn more.

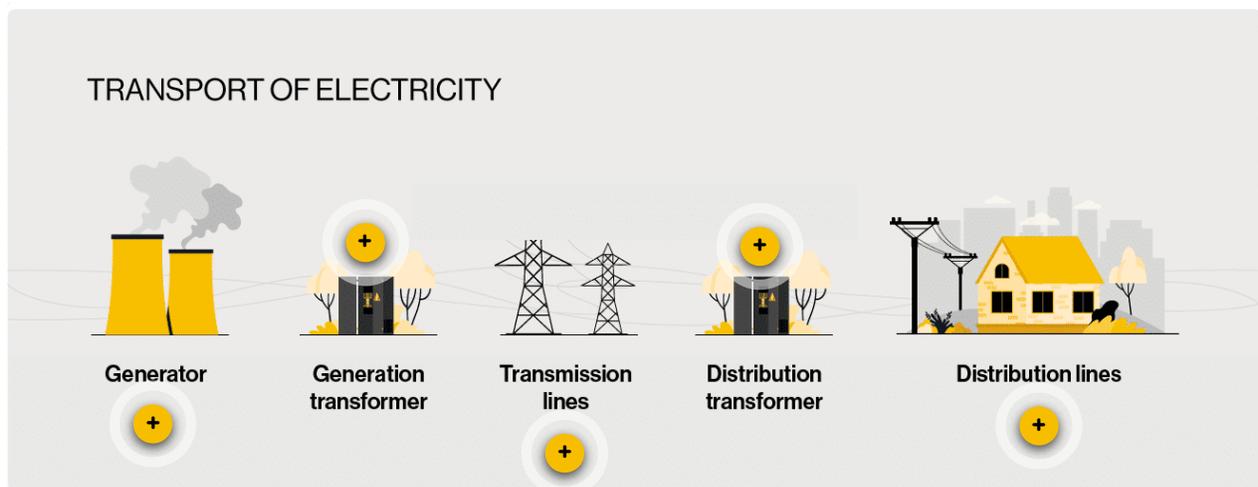
Generation



Transmission



Distribution



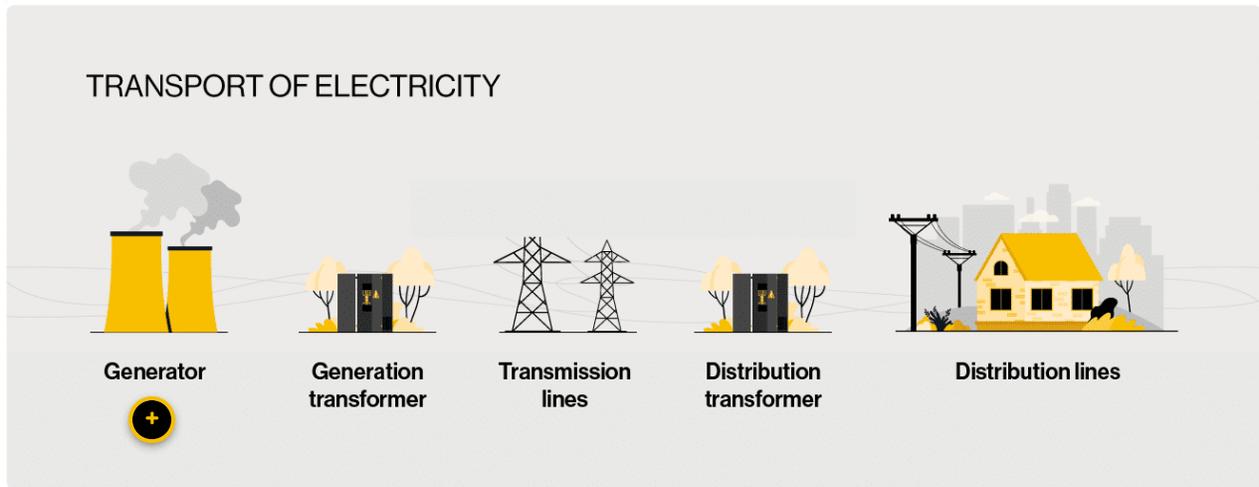
Generation



Transmission



Distribution



Generator

Electricity is generated or produced from a variety of sources including water, nuclear power, fossil fuels, sun, and wind, among others.

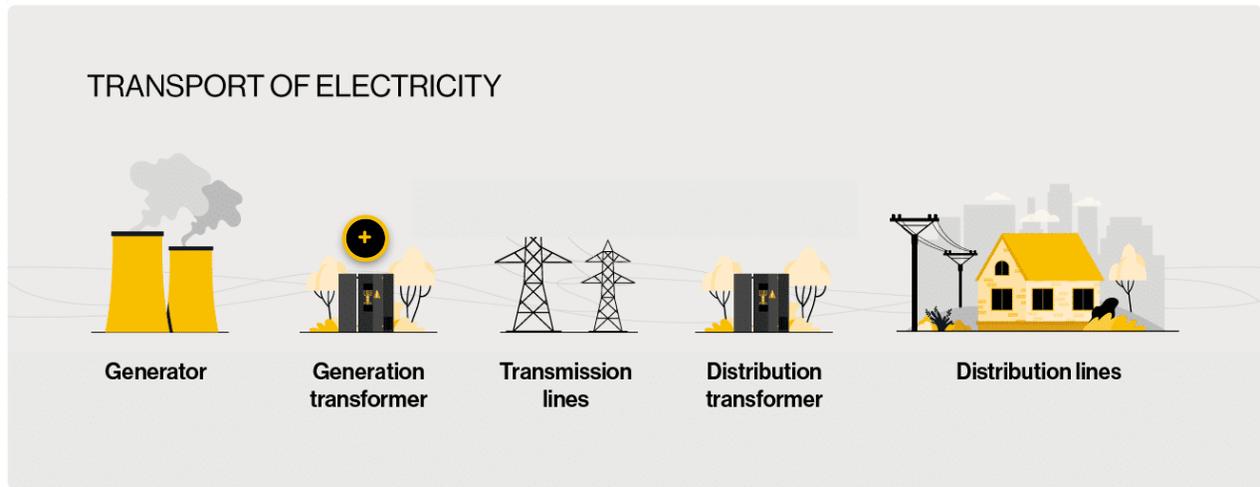
Generation



Transmission



Distribution



Generation transformer

Once generated, a generation transformer converts what typically starts out as low-voltage electricity to high-voltage for efficient transport.

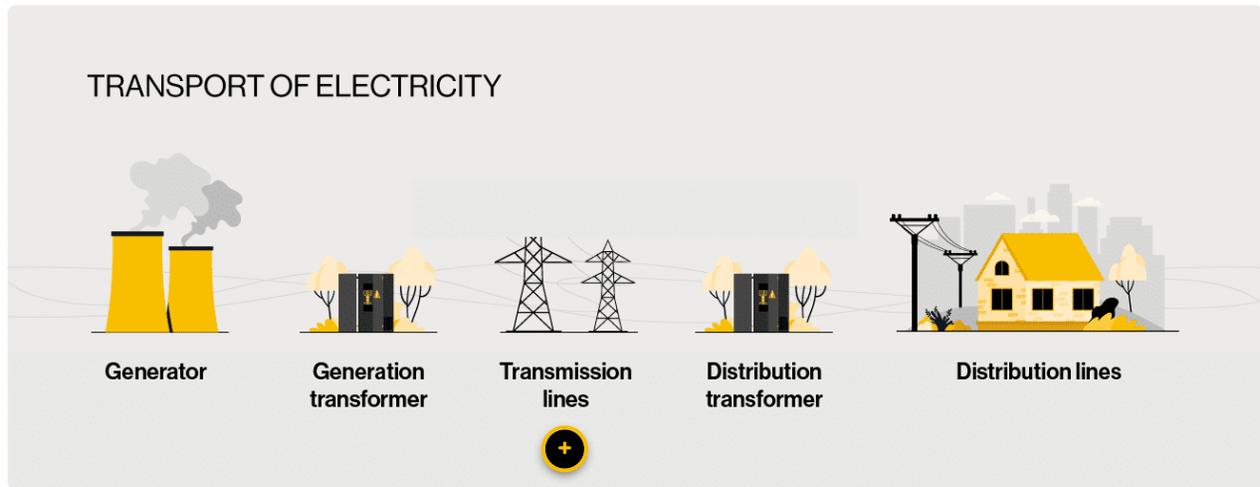
Generation



Transmission



Distribution



Transmission lines

Transmission lines, typically supported by large towers that traverse the country, carry the electricity over long distances.

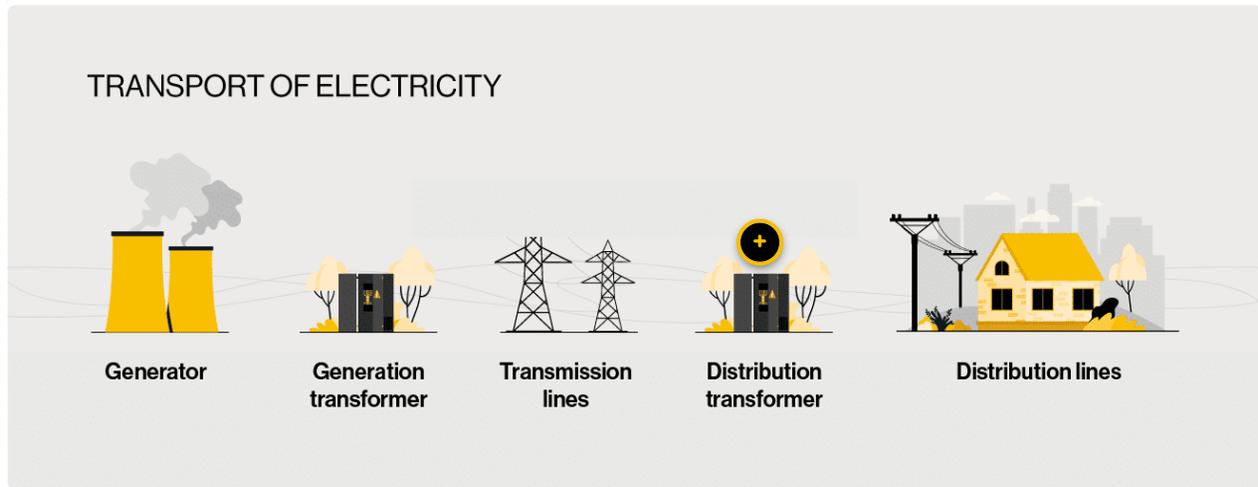
Generation



Transmission



Distribution



Distribution transformer

Distribution transformers then convert the high-voltage electricity from the transmission lines back to low-voltage for local distribution and end use.

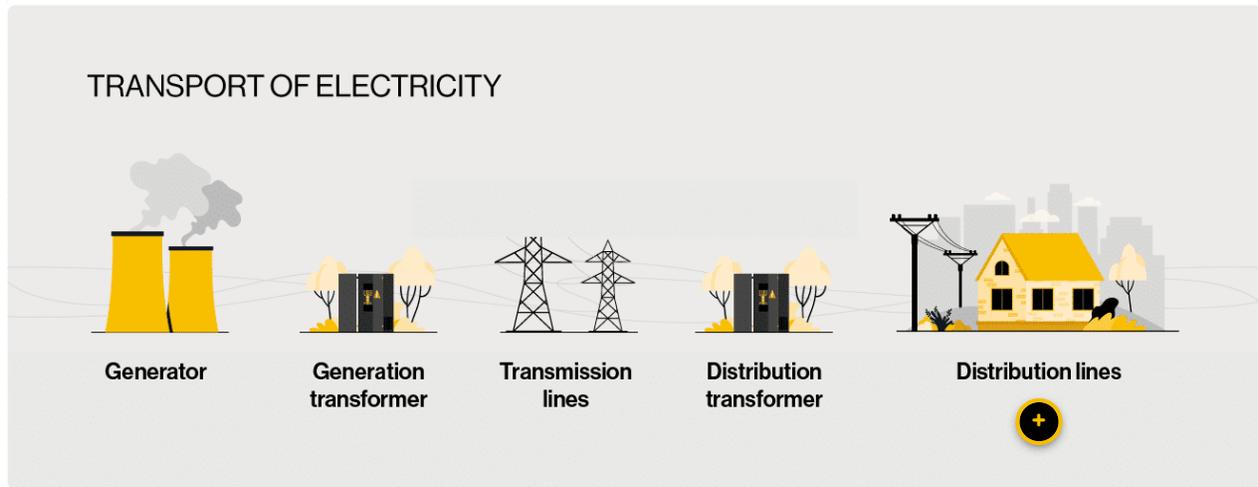
Generation



Transmission



Distribution



Distribution lines

Distribution lines, both underground and overhead, then carry the lower-voltage electricity to homes and other locations where it's needed, providing the power we rely on every day.



Read all the information and complete each activity to continue with your training.

The grid network

Generation, transmission, and distribution will always be important functions along the electricity grid, although new configurations and models are emerging. These involve a greater diversity of more widely distributed generation sources, smart grids, and built-in intelligence and resilience, and a blurring of the lines between the three basic functions.

Distributors, for example, are increasingly connecting and even owning generation sources within their service territories, and some consumers are taking a much more active role in managing their energy demand and how it gets met.

Eight percent of the world's population still gets by without electricity. As of 2022, 80% of those without electricity are living in Sub Saharan Africa.



To learn more

Natural Resources Canada

Source: nrcan.gc.ca

GO TO WEBSITE

World Bank Group

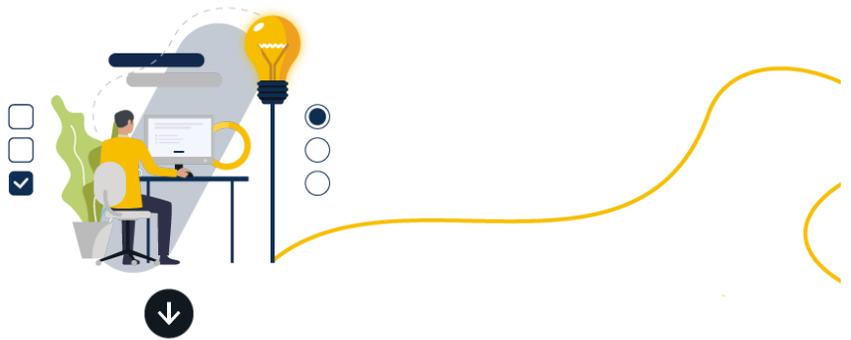
Source: worldbank.org

GO TO WEBSITE

United Nations

Source: unstats.un.org

GO TO WEBSITE



Knowledge check

Which of the following statements about the electrical grid are true?

Select all that apply, then select *SUBMIT*.

The three sectors of electricity's lifecycle are generation, transmission, and distribution.

Low-voltage electricity is more efficient to transport than high-voltage electricity.

The conversion of electricity to a higher or lower voltage is done by transformers.

Distribution lines, typically supported by large towers that traverse the country, carry the electricity over long distances.

SUBMIT



Read all the information and complete each activity to continue with your training.

Key takeaways



Electricity is a form of energy caused by the flow of electrons. The flow of an electric current is measured in amps, the force or pressure applied to electrons is measured in volts, and the measure of electrical power (or demand) is measured in watts (amps × volts).

- From the first lamp in 1873 and the first form of commercial electricity in 1881, the Canadian electricity industry has grown by leaps and bounds. Canada is now the fourth-largest generator of hydroelectricity in the world.
- The three main sectors of electricity's life cycle are generation, transmission, and distribution, and together they form the world's largest machine.

You have completed the module. You may now proceed to the final assessment.





Module assessment

Now that you have completed Module 1: **Introduction to Electricity Fundamentals**, it is time to take the final assessment.

This assessment consists of 10 questions that will evaluate your understanding and ability to apply the concepts covered in this module.

You must answer all the questions correctly to successfully complete the module, but you are allowed unlimited attempts.

Good luck!

Question

01/10

Which of the following statements is true?

Select all that apply, then select SUBMIT.

- As a manufactured energy form, electricity possesses unparalleled flexibility, and it can be stored easily.

- As a manufactured energy form, electricity is possesses unparalleled flexibility and it can be stored with difficulty.

Question

02/10

What was the increase in cost for electricity between 2015 and 2023?

Select your answer, then select *SUBMIT*.

4%

6%

8%

9%

Question

03/10

How would you define electricity?

Select your answer, then select SUBMIT.

- The flow of atoms
- The flow of protons
- The flow of electrons
- The flow of matter

Question

04/10

If you need to calculate the number of electrons that pass a given point per second, which unit of measurement would you use?

Select your answer, then select *SUBMIT*.

- Volts
- Amps
- Watts
- Kilowatt-hours

Question

05/10

You are checking your electricity bill to see how much electricity you used in your home over the past month. Which units are used to measure consumption per 60-minute period?

Select your answer, then select *SUBMIT*.

- Kilowatt-hours
- Kilowatts
- Gigawatt-hours
- Watts

Question

06/10

An appliance has a typical demand or load of 2,000 watts. If the current is 20 amps, what is the voltage?

Select your answer, then select *SUBMIT*.

- 10 volts
- 100 volts
- 20,000 volts
- 40,000 volts

Question

07/10

Match each person with their claim to fame.

Click and drag each name on the left to their corresponding accomplishment on the right, then select SUBMIT.

⋮ Thomas Edison

Theories of magnetism

⋮ Michael Faraday

Electric generator

⋮ Roger Bacon

Light bulb

Question

08/10

Which of the following statements about the history of electricity in Canada is false?

Select your answer, then select SUBMIT.

- The first form of commercial electricity in Canada was hydroelectric power.
- In 1873, the first arc lamp was switched on in front of the Davis Hotel in Ottawa.
- In 1921, Ontario Hydro became the largest utility in the world.
- Canada's first nuclear power plant was opened in Rolphton, Ontario in 1962.

Question

09/10

Which component of the electrical grid operates at the highest voltage levels?

Select your answer, then select SUBMIT.

- Generation
- Distribution
- Transformers
- Transmission

Question

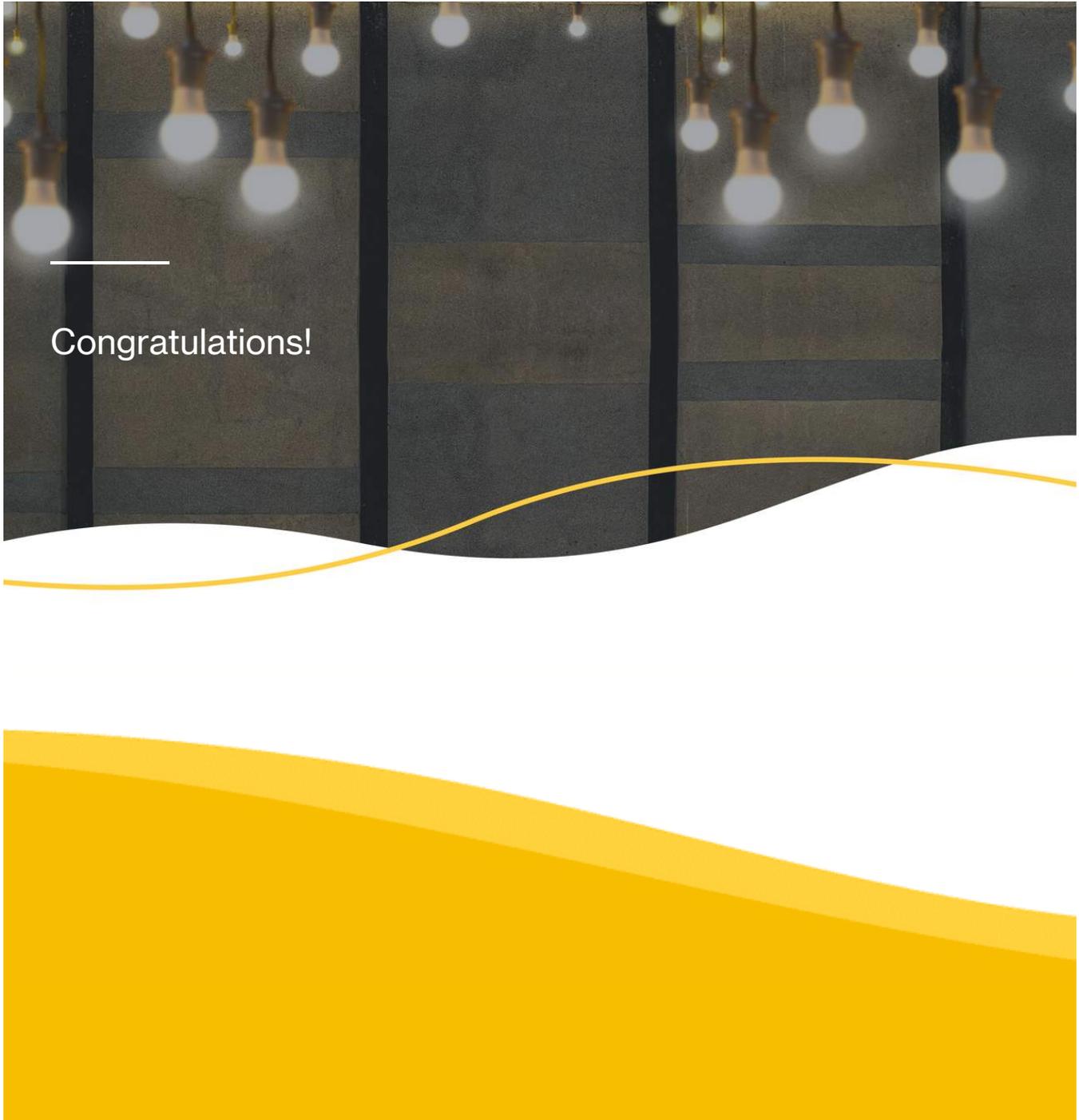
10/10

You need to explain the electrical grid to someone who is new to the subject. How would you describe the chronology of steps in the electricity life cycle?

Click and drag each activity on the left to its corresponding step on the right, then select *SUBMIT*.

<p>⋮ Electricity is generated or produced from a variety of sources.</p>	<p>Step 1</p>
<p>⋮ A generation transformer increases the electricity voltage for efficient transport.</p>	<p>Step 2</p>
<p>⋮ Transmission lines carry the electricity over long distances.</p>	<p>Step 3</p>
<p>⋮ Distribution transformers lower the voltage for local distribution.</p>	<p>Step 4</p>
<p>⋮ Distribution lines, both underground and overhead, carry the electricity to consumers.</p>	<p>Step 5</p>

Attestation



Congratulations!

You have successfully completed Module 1:
Introduction to electricity fundamentals.

You should now be able to:

- **Explain** the role of Electricity Canada
- **Identify** key electrical terms and their definitions
- **Outline** the history of electricity in Canada
- **List** the various sectors of electricity's lifecycle



You can now exit the module.

EXIT MODULE

