Activity Title: Exploring Electricity

Recommended Grades

Grade 5, Grade 6

Curriculum Connections

Energy

- 5 – forces act without contact (magnetism, gravity used in electricity generation)
- 6 – analyze various energy sources

Earth Systems

- 5 – natural resources, conservation, climate
- 6 – climate change, greenhouse gas emissions

Time

45-60 minutes

Skills Focused On

- Critical Thinking
- Hypothesizing

Materials Needed

Printable Version

- Printed cards (1 set of 10 per pair/small group - can be used for both activities)
  - https://www.futureenergysystems.ca/public/download/files/267318
- Paper copies of the Electrical Generation Quiz (1 per student or pair)
  - https://www.futureenergysystems.ca/public/download/files/253433

Online Version

Note these quizzes may have sound (will read each card aloud - helpful for those with low vision). Recommend students wear headphones or mute their computers.

- Canada's Electricity Quiz: https://wordwall.net/play/91382/980/694
  - In this quiz, match the percentage to each energy source used in Canada. Which energy sources does Canada use the most?
  - Data from CER from 2021.
  - Tidal and Geothermal power have been omitted - 0% in 2021.
- Alberta's Electricity Quiz: https://wordwall.net/play/91383/219/716

- In this quiz, match the percentage to each energy source used in Alberta. Which energy source does Alberta use the most?
- Data from CER from 2021.
- Tidal, Geothermal, and Nuclear have been omitted - 0% in 2021.

- Renewable or Nonrenewable Quiz: https://wordwall.net/play/91382/947/848
  - Which energy sources are renewable? Test your knowledge with this sorting quiz.
- Greenhouse Gases Quiz: https://wordwall.net/play/91383/551/584
  - Which energy sources directly release greenhouse gases? Test your knowledge with this sorting quiz.

Background Information

Everyone has turned on the lights before, or plugged in their phone or computer. But where does that electricity come from?

There are many sources of electricity. Some are non-renewable (once it is used, it is gone), like oil, natural gas, coal and nuclear. Others are renewable (replenished as fast (or faster) as we use them), like wind, solar, hydropower, biomass (plant matter) and geothermal (using the heat from below the Earth's crust).

Some sources of energy produce electricity by generating heat which creates steam. This steam spins a turbine which is attached to a generator, producing electricity! Other sources are generated by directly spinning a turbine using water or wind. Solar panels generate electricity by interacting with sunlight.

See the table below to learn more about energy sources included in this activity.

Fossil Fuels	Millions to hundreds of millions of years ago, the remains of plants and animals built up in thick layers on the earth's surface and ocean floors, sometimes mixed with sand, silt, and other materials. Over time, these layers were buried under sand, silt, and rock. Pressure and heat changed some of this carbon and hydrogen-rich material into coal, oil, and natural gas. By burning fossil fuels, we harness the energy originally captured by ancient microorganisms through photosynthesis. However, the carbon dioxide originally captured by those microorganisms is also released into the atmosphere, causing Earth to warm up.
Natural Gas (a fossil fuel)	Natural gas is mostly (95%) methane. It originates from the remains of plants and animals. It is the cleanest burning fossil fuel.
Oil (a fossil fuel)	Oil, also known as petroleum, is an energy rich liquid form of naturally-occurring hydrocarbons (organic compounds made of hydrogen

	and carbon). It originates from marine life and vegetation that died and was buried millions of years ago.
Coal (a fossil fuel)	Coal is a sedimentary rock made primarily of carbon. It contains the energy stored by plants that lived in swampy forests and were buried hundreds of millions of years ago. It is the dirtiest fuel and the single largest source of global temperature rise.
Biomass	If we burn plants that died millions of years ago to create energy, couldn't we burn plants that were alive more recently? Yes, we can! Although biomass does release carbon dioxide into the air when burned for electricity generation, it is considered carbon neutral so long as we are replanting because as the plants grow they take in carbon dioxide to make food through photosynthesis. Unlike fossil fuels, biomass is also considered renewable so long as we grow more plants to replace the plants which we burn. In Canada, most biomass energy comes from wood, but we can also use other plants, plant waste, and organic sources. Since we use plants to build our homes, for the clothes we wear, and for food, we have to think about how much we want to use for electricity generation. Research is also focusing on development of biofuels, which are fuels produced using biomass (including plants, vegetable oils, animal fats, etc). However, biofuels are more used for transportation than electricity production, so they won't be the focus of this activity.
Wind	As the Sun heats the Earth, differences in temperature cause some air to rise while other air sinks. This creates wind – a renewable resource. We can harness the wind using turbines, which convert the kinetic (moving) energy of wind into electrical energy. Since the wind isn't blowing all the time, it is an intermittent energy source. If we wanted to use wind as our only source of energy, it would be important to find ways to store energy from windy days to use on less windy days.
Solar	The Sun will be around for another 4-5 billion years – so we don't need to worry about running out of sunlight! Solar panels are made from photovoltaic cells which produce excited electrons when exposed to light. Unfortunately, solar panels aren't very efficient, converting only 15-20% of possible energy to electricity. Scientists are working on ways to make solar panels better. Like wind, solar is intermittent, which means we are also looking for new ways to store solar energy so we can use it on cloudy days and at night. There are also other ways to get energy from the sun, like solar thermal

	power plants! But these newer technologies don't give us much electricity yet, so we won't be focusing on them. When you see solar energy in this activity, we are talking about solar panels.
Nuclear	Nuclear energy on Earth is produced by a process called fission, where a large atom such as Uranium is split apart. Splitting atoms releases a lot of energy, with efficiency comparable to fossil fuel plants (around 33-37%). Nuclear power plants have a small carbon footprint, similar to solar and wind farms, as no greenhouse gases are released. Unlike wind or solar energy, nuclear power plants can produce electricity 24/7. Researchers are looking for ways to make nuclear power plants even more efficient, and for ways to reduce nuclear waste, which can be harmful to living things if not properly stored. Nuclear fuels like Uranium are not considered renewable, since there is only a limited amount of Uranium here on Earth. However, only small amounts of Uranium are needed to produce a lot of electricity.
Hydro	Hydropower produces energy from moving water. As water flows through a dam, it spins a turbine which is attached to a generator, creating electricity. Hydropower supplied a whopping 60% of Canada's electricity in 2021, the largest source of all. Since water moves due to differences in elevation, gravity, and the water cycle, hydropower is a renewable resource. It also does not release any greenhouse gases. However, creating a lake (reservoir) using a dam can cause serious disruptions to the environment.
Tidal	The pull of our moon's gravity creates tides – the gradual rising and falling of our oceans. Since the moon and oceans aren't going anywhere, tidal power is a renewable resource. It also produces no greenhouse gases. Tidal power is a newer technology that is very expensive. There also aren't a lot of places with sufficiently large tides to warrant placing a tidal power generator. However, recent improvements in technology mean that tidal power may become more competitive in the future. As of August 2025, there are no operational tidal energy plants in Canada. There have been plants in Nova Scotia in the past; these ceased operation due to technical difficulties.
Geothermal	The centre of the Earth is very hot. By drilling down into Earth's crust, we can access some of that thermal (heat) energy and convert it into electricity using a generator. We can also use it to heat water or heat our homes directly. Unlike solar or wind energy, geothermal energy can produce electricity 24/7. It is a renewable resource which produces

	negligible greenhouse gases. In 2023, Alberta opened the first geothermal power plant in Canada. It does not produce much of our total electricity yet, but it is a promising source for the future.

Developing renewable technologies is key to reducing the effects of climate change, as oil, natural gas, and coal are large producers of greenhouse gases. Combining new renewable technology with current sources for electricity generation is a major focus of research.

According to the National Energy Board (2023), the electricity sector has reduced greenhouse gas emissions more than any other sector, cutting emissions by more than half from 2005 to 2021.

Hydropower, a renewable resource, is Canada's largest source of electricity, averaging around 61% of total generation in 2021. Hydropower usage does vary a lot between provinces, though, with most hydropower being generated in the Yukon, BC, Manitoba, Ontario, Quebec, and New Brunswick. Nuclear, similarly, is only produced in Ontario and New Brunswick. Coal and oil have reduced since 2005, while natural gas has increased due to goals to reduce emissions. Renewable energy sources have generally increased since 2005, with wind increasing the most.

In Alberta in 2021, electricity generation was primarily from coal and natural gas, with coal decreasing since 2005 and natural gas increasing. Since June 2024, Alberta has phased out coal-fired electricity generation!

For more information and source material, see "Additional Resources" at the bottom of this document.

Activity Instructions

Activity 1: Renewable or Nonrenewable?

Which sources of electricity generation are renewable, and which aren't?

If using paper cards, students should work in pairs or small groups to sort the ten electricity generation sources into "renewable" and "nonrenewable" categories.

If using the virtual quiz, students can work alone or in pairs.

Hint: There are 6 renewable resources.

SOLUTIONS

Renewable Resources: Wind, Solar, Geothermal, Hydro, Tidal, Biomass (as long as you grow plants to replace those you used)

Nonrenewable Resources: Natural Gas, Oil, Coal, Nuclear

Activity 2: Which Energy Sources Directly Release Greenhouse Gases?

Which energy sources release greenhouse gases directly? Greenhouse gases include carbon dioxide, methane, and nitrous oxide.

If using paper cards, students should work in pairs or small groups to sort the ten electricity generation sources into two categories, “releases greenhouse gases directly” and “doesn’t release greenhouse gases directly.”

If using the virtual quiz, students can work alone or in pairs.

Hint: Only sources which are alive or were once alive are capable of releasing CO_2.

SOLUTIONS

Directly Release Greenhouse Gases: Oil, Coal, Natural Gas, and Biomass

Note that biomass can be carbon neutral / part of a closed cycle if new plants are grown to replace the plants which are used to create electricity.

Do NOT Directly Release Greenhouse Gases: Wind, Solar, Geothermal, Hydro, Tidal, Nuclear

Activity 3: Where is Your Electricity From?

Which energy sources produce most of the electricity in Alberta in 2021? How about Canada?

We recommend students start by identifying which energy sources we do NOT use in Alberta (Tidal, Geothermal, Nuclear) and Canada (Tidal, Geothermal). Note that as of 2023 we do have a geothermal power plant in Swan Hills, Alberta, but we are using the most recent federal data, which is from CER in 2021. Geothermal is still a very small amount of our electricity production.

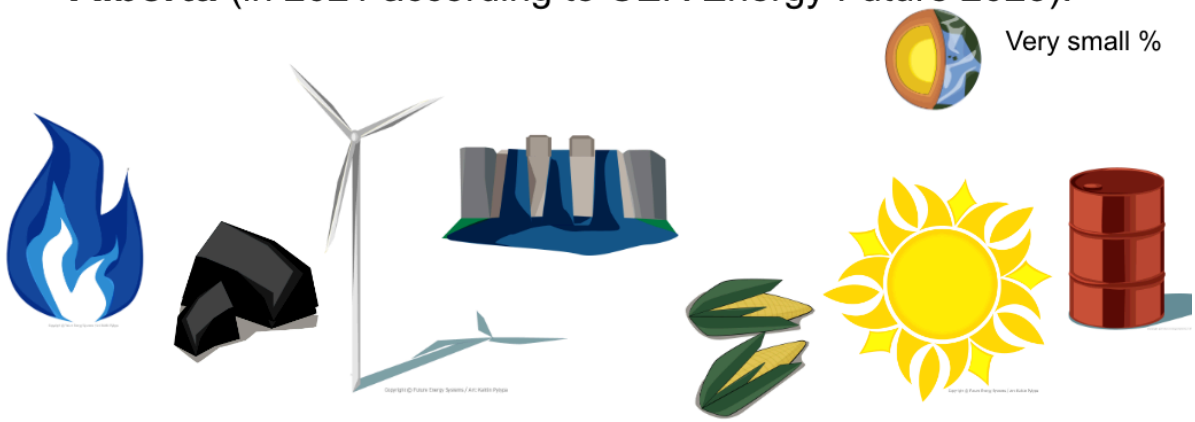
If using paper cards, students should work in pairs or small groups to sort energy resources from greatest (most electricity produced) to least (smallest amount of electricity produced).

If using the paper quiz or virtual quiz, students can work alone or in pairs.

See solutions on next page.

ALBERTA SOLUTION

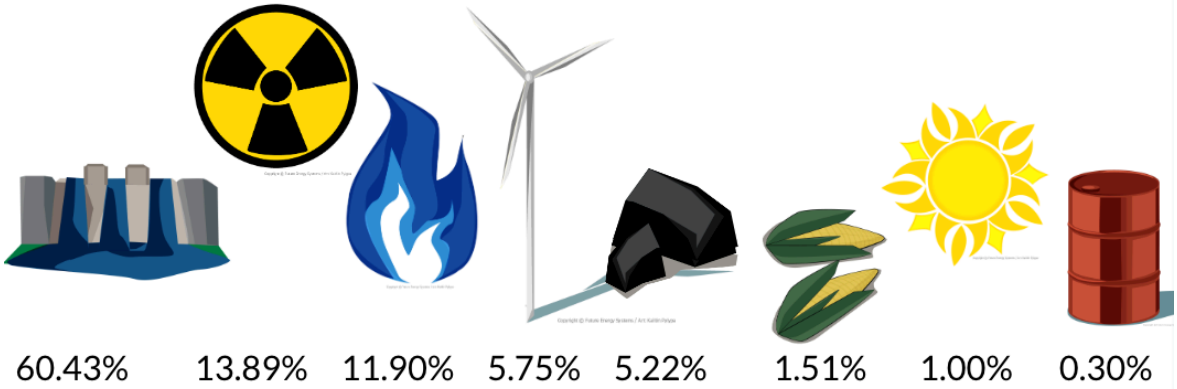
Place the sources of electricity generation in order for **Alberta** (in 2021 according to CER Energy Future 2023).



Percentages vary based on the data source.

CANADA SOLUTION

Place the sources of electricity generation in order for **Canada** (in 2021 according to CER Energy Future 2023).



Percentages vary based on the data source.

Discussion/Extensions

What surprised you?

- Students are frequently shocked that oil is so low. This is because we primarily use oil for other things (cars, industry, exports), not electricity generation. Make sure you stress that this activity is focused on electricity.
- Students are also often surprised that solar is so low. This is because solar panels are not very efficient, and solar energy is intermittent.
- Some students don't realize we have nuclear power plants at all, much less that they produce a good chunk of our energy federally! This is because there is nuclear power in Ontario, which is the most populous province.
- Note that Alberta has gone from using over 20% coal in 2021 to 0% in 2024 – for electricity anyway! (We do still use coal for other purposes.)

If you had to choose four energy sources to power the world when you're 30 years old, which would you choose?

- This could be a quick poll, an in-depth class discussion, or even an essay prompt.
- Note that no sources of energy are without downsides. Even solar panels require us to dig into the Earth for minerals needed to produce them. Think about greenhouse gases, renewability, and efficiency.

Additional Resources

"Renewable or Non-Renewable Energy, Test Your Knowledge?" and "Where Is Your Electricity From?" experimental videos produced by Future Energy Systems - provides background information and instructions for these activities:

https://www.youtube.com/watch?v=EfPZsyL-hps&list=PLwhyRzP6sRaRKyl8GLlaKHHQGudzHAqPw&index=7 (Renewable or Nonrenewable) and https://www.youtube.com/watch?v=GaEcoKql1Ys&list=PLwhyRzP6sRaRKyl8GLlaKHHQGudzHAqPw&index=18&pp=iAQB (Where is Your Electricity From?)

Learn more about Future Energy Systems (https://www.futureenergysystems.ca/) and access more learning content, including storytimes, lab tours, ask an experts and more (https://www.futureenergysystems.ca/engage/learning https://www.youtube.com/channel/UCJr8N9KyFJ6d-t36TPtUlwg).

Learn more about energy resources at the links below.

Alberta Government. 2025.
https://www.alberta.ca/energy-and-minerals

Clean Energy BC. 2020.
https://www.cleanenergybc.org/

Environment and Climate Change Canada. 2018.
https://www.canada.ca/content/dam/eccc/documents/pdf/climate-change/emissions-inventories-reporting/nir-executive-summary/National%20Inventory%20Report%20Executive%20Summary%202018.pdf

Natural Resources Canada. 2019.
https://www.nrcan.gc.ca/science-data/data-analysis /energy-data-analysis/energy-facts/20061

Natural Resources Canada. 2015.
https://natural-resources.canada.ca/energy-sources

U.S. Energy Information Administration - Energy Explained
https://www.eia.gov/energyexplained/

National Geographic - Encyclopedic Entry - Natural Gas
https://education.nationalgeographic.org/resource/natural-gas/

Explainer: Where Fossil Fuels Come From
https://www.snexplores.org/article/explainer-where-fossil-fuels-come

U.S. Department of Energy
https://www.energy.gov/sites/prod/files/2014/06/f16/lesson297.pdf

Natural Resources Canada - Geothermal Energy
https://natural-resources.canada.ca/energy-sources/renewable-energy/geothermal-energy

Natural Resources Canada - Bioenergy Systems
https://natural-resources.canada.ca/energy-sources/renewable-energy/bioenergy-systems

Client Earth - Fossil Fuels and Climate Change: the facts
https://www.clientearth.org/latest/news/fossil-fuels-and-climate-change-the-facts/

Learn more about the data for Canada's federal and provincial electricity generation at the links below.

Raw Data Appendices:
https://apps.cer-rec.gc.ca/ftrppndc/dflt.aspx?GoCTemplateCulture=en-CA

CER Summary and Analysis:
https://www.cer-rec.gc.ca/en/data-analysis/energy-markets/provincial-territorial-energy-profiles/provincial-territorial-energy-profiles-canada.html

https://www.cer-rec.gc.ca/en/data-analysis/canada-energy-future/2023/results/