

CANADA'S ENERGY FUTURE

Overview

In this activity, students will work together to define the terms “energy conservation” and “energy efficiency”. While exploring the Giant Floor Map, students will consider which provinces and territories may face challenges with respect to energy conservation and efficiency, and why. They will review the need for common units of measurement when describing electricity production and consumption and will assess the relative capacities of generating facilities across the country. They will perform a regional analysis of electricity generation (and emissions), and will place their findings in the context of the national energy mix. A series of prompts are provided to inspire creative thinking about Canada’s options with respect to a transition to clean energy.

After completing the lesson, students will be able to answer the questions:

- How do we define “energy conservation” and “energy efficiency”?
- What is the relationship between geography, population size, infrastructure, the availability of different renewable energy sources, and energy demand in Canada’s different provinces and territories?
- What are the energy profiles of the different provinces and territories?
- What considerations are key when planning for a net-zero future?

Lesson implementation

Minds on (15 minutes)

Invite students onto the Giant Floor Map, and ask them to consider the following two questions as they explore the different symbols and data layers independently:

- What is energy conservation?
- What is energy efficiency?

Work as a class to come up with definitions for both terms.

Energy conservation is the effort to reduce wasteful energy consumption by using less energy. This can range from unplugging appliances when they are not in use to businesses turning off their lights and heating and cooling systems on evenings and weekends.

Energy efficiency involves using technologies that require less energy to satisfy the needs of an individual, organization or nation. For example, energy saving lightbulbs, smart appliances, and solar panel facades on buildings all reduce electricity demand and are more energy efficient than incandescent bulbs, outdated appliances, and traditional building designs.

Ask students to keep this in mind as they explore the map again, this time taking into consideration which provinces and territories may face challenges with respect to energy conservation and efficiency, and why. For example, regions that are larger in size may face challenges with respect to supplying green energy to homes and communities. Regions with harsher climates or larger populations may have higher energy demands. Regions which traditionally have relied on sources of energy that have increased greenhouse gas emissions may have more difficulty transitioning to non-emitting sources. Allow time for students to share their thoughts on the relationships between geography, population size, infrastructure, economy, the availability of different renewable energy sources, and energy demand.

Optional: Have students write their thoughts down on sticky notes and place them on the map. Then allow time for students to read all the sticky notes before having a class discussion.

Next, ask students if they noticed any units of measurement for energy on the map. There are two electricity units included: megawatts and kilovolts. Have they heard of these before?

Megawatts (MW) are used on the Giant Floor Map to indicate the maximum capacity of different electricity facilities to produce power. For example, the Bruce Nuclear Generating Station in Ontario (44.32°N, 81.57°W) has a maximum capacity of generating 6,232 MW of nuclear power during peak performance. The Robert-Bourassa hydroelectric facility in Quebec (53.79°N, 77.54°W) has a maximum generating capacity of 5,616 MW. By referring

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Time

70 minutes (can be divided)

Grade

8 - 10 (modifications provided for younger and older students)

Subjects

- Geography
- Social studies
- Environmental science
- Science
- Technology

Topics:

Energy consumption, production, and transmission; regional energy profiles; energy efficiency and conservation; net-zero scenarios

Materials:

- Electricity generation and emissions card (13)
- Energy profile cards (13)
- Energy profile teacher card (1)
- National energy comparison cards (13)
- Canada's net-zero future cards (13)
- **Optional:** Devices with an internet connection for research
- **Optional:** Sticky notes and pens/pencils

to power-generating facilities in this way, it is possible to understand their relative size and energy contributions.

Note: A megawatt hour (MWh) equals 1,000 kilowatts of electricity generated per hour and is a unit used to measure electrical output with respect to time.

Kilovolts (kV) measure the voltage (electric potential) of high-voltage electrical systems, like transmission lines. Transmission lines with higher kV measurements transport more high-voltage energy from generating facilities to their targets (e.g., cities, homes).

Encourage students to once again explore the map, this time paying close attention to the relative size (capacity) of the different electricity facilities and transmission lines. Prompt them with the following questions:

- Where are the largest generating facilities with the highest capacity located in Canada? Why might that be?
- Are there more large, medium, or small capacity facilities in Canada? How are they distributed?
- Do high capacity facilities tend to get their energy from emitting or non-emitting sources?
- Where is the highest concentration of transmission lines? Why might that be?
- Is there a relationship between the location of Canada's electricity grid (transmission lines) and its generating facilities?
- Which transmission line covers the greatest distance, and is it a high or low voltage line?

Action (50 minutes)

Part 1: Energy profiles

Explain to students that an understanding of electrical units, the ways in which electricity is generated and transported in Canada, and the relative supply and demand associated with each province and territory is fundamental to the success of Canada's two-part plan to ensure a cleaner and greener future for our society and the planet. Humanity's reliance on fossil fuels and other greenhouse gas emitting energy sources has affected the planet in many ways, including increasing global temperatures, more frequent high-intensity storms, intense droughts, sea level rise, biodiversity loss, crop destruction, and health risks.

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Learning objectives

Upon completion of the lesson students will be able to:

- Describe Canada's energy mix, with particular emphasis on the electricity sector.
- Define key terms related to energy.
- Explain why energy production and consumption varies according to geographical and societal factors.
- Think critically about the benefits and risks of a transition to net-zero.

Connections to the Canadian Geography Learning Framework

Geoinquiry

- Ask geographic questions
- Interpret and analyze
- Communicate

Geospatial skills

- Foundational elements
- Spatial representations

Concepts of geographic thinking

- Interrelationships
- Geographic perspective

Canada has committed to the following actions to address these ongoing risks:

- Reducing emissions across the entire economy to reach an **emissions reduction target of 40 to 45 per cent below 2005 levels by 2030**.
- **Achieving net-zero emissions by 2050**.

Take this opportunity to discuss any vocabulary that students are unfamiliar with. The Government of Canada has a comprehensive **glossary** of energy-related terms which can be used as a reference.

Students will now have the opportunity to review in detail the energy profiles of each province and territory with the goal of understanding the significance of transitioning to zero-emission clean energy sources. Divide students into 13 groups, one for each province and territory. Provide each group with an **Electricity generation and emissions card** and an **Energy profile card**.

Explain to them that the **Electricity generation and emissions card** shows a comparison of provincial and territorial greenhouse gas (GHG) emissions and electricity generation. The **Energy profile cards** provide a snapshot of the relative amount of electricity generated by various energy sources across the provinces and territories. However, the provinces and territories are not labelled. Therefore, it is up to each group to investigate the data (using the data on the **Electricity generation and emissions card** as reference) and make an educated guess about which province or territory they are profiling. Time to do some detective work!

The data on the **Energy profile cards** is split into three charts:

- Electricity generation modelled for the year 2022
 - i.e., what things are like today
- Electricity generation projections for the year 2050 according to current measures
 - i.e., what conditions will look like in 2050 if we simply continue with our current policies and practices in place as of March 31, 2023
- Electricity generation projections for the year 2050 according to a model that sees Canada and the world achieving net-zero GHG emissions by 2050
 - i.e., what energy generation will look like if we are successful at reaching our net-zero emissions goal

Note: For a deeper explanation of the projections, please visit the Government of Canada's report on **Canada's Energy Future 2023: Energy Supply and Demand Projections to 2050**.

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Have students explore the Giant Floor Map, using the symbols on the map and the cards you provided to formulate an educated guess as to which province or territory they are profiling. For example, if hydropower is prominent on their profile card, have them start by finding all the provinces and territories with significant hydroelectric facilities. Then, through the process of elimination they can come up with an educated guess. Have them come to you with their guess and match the colour code on their profile card to the colour code on your **Energy profile teacher card** to confirm their guess. Once their guess is confirmed, request that students sit on the map around their province or territory and discuss the energy profile in more detail.

- Does the profile on their card make sense in relation to the number and size of facilities mapped on the Giant Floor Map?
- Is there anything surprising about the relative amounts of electricity generation by source?
- What are the unique geographical characteristics of the different provinces and territories that allow for such a diverse array of energy sources?
- Does their province or territory have high emissions relative to the number of energy sources?
- Do the 2050 scenarios make sense and do students feel like they are attainable?
- Why would the scenarios predict higher hydro, wind, or solar generation in different provinces and territories?
- What are the environmental and social implications of divesting from fossil fuels and prioritizing cleaner alternatives?
- Where will future generation facilities need to be located to support a growing population?
- From which non-emitting source does Canada obtain the majority of its electricity?

Optional: Have groups pair up and compare their analyses.

Students are likely interested in understanding how their province or territory compares to others in terms of electricity generation by energy source. Distribute a **National energy comparison card** to each group and have them place their province or territory in the context of all regions in Canada.

- Which provinces are the most similar or different with respect to their energy profiles?
- Are these similarities/differences caused by geographical, social, or economical factors?

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Part 2: Pathways to net-zero

There are many possible routes to net-zero for Canada, and many drivers inside and outside of Canada's control that will play a role in our ability to achieve our 2050 emissions goals. Businesses, industries, and governments are beginning the important work of deciding what can be done in the short term through policy and practice, and what should be done long term as we approach 2050. There are many recommendations being made and significant research and investments going towards mapping out our pathway to net-zero. Everyone's ideas and contributions matter – especially those of today's youth who will become tomorrow's leaders and workforce. Randomly distribute a **Canada's net-zero future card** to each group. Each card contains a series of prompts to promote group discussion while using the Giant Floor Map for inspiration. Allow time for all groups to complete their card.

Optional: Allow students to write their ideas on sticky notes.

Invite students to share their thoughts with the whole group and, if possible, record keywords and ideas that are most common (you can build a word cloud as a class using websites like [MonkeyLearn](#) or [WordItOut](#)).

Summarize the key learnings of the activity by employing the keywords the students shared during their reports.

Conclusion (5 minutes)

Now that students have a deeper understanding of Canada's energy mix and the challenges and benefits of transitioning to cleaner energy production, ask them what they feel their role should be in working towards a net-zero future. What are some next steps they could take to actively contribute to positive solutions for society and the environment? Brainstorm some ideas as a class and choose one that is actionable – make a commitment to maintaining that action for the remainder of the school year!

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Modifications

There are many ways in which this activity can be modified for different age groups. Here are some of our suggestions:

Younger students

- Choose one province or territory to explore together. Focus on map elements (roads, water, location of cities) and using the legend, and explain the relative importance of different energy sources using age-appropriate terms.
- Ask students to take a look at the map. What natural resources do they see? Ask students to think about how people use the land. What does it mean to be “nature-positive?” How might climate change be affecting peoples’ relationship with the land?
- Choose a prompt and simplify it for a group discussion.

Older students

- Do students want to learn even more about [provincial and territorial energy profiles](#)? Invite them to lead an independent research project on a region of their choosing.
- If your students are keen to continue the conversation and explore the projection data further, have them use the interactive tool [Exploring Canada's Energy Future](#), which allows for the exploration of data on the basis of modelled scenarios, emissions data, electricity generation, and more.
- Have students browse the list of participating organizations in the [Net-Zero Challenge](#) and challenge them to assess the impact and sustainability of their commitments – could their actions serve as models for other organizations, or schools even?
- Canadian Geographic magazine has published a [comprehensive review](#) detailing Canada's journey to net-zero, complete with commentary from leaders in today's energy transition. Have students read the article, watch the videos, and write a response to the editors of the magazine.

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Extend your learning

Once students have had a chance to learn about scenarios and considerations related to Canada's net-zero commitment, encourage them to take their learning beyond the classroom! Here are some suggested extension activities:

- Have students analyze what goes into a [Canadian residential electricity bill](#). They can prepare a list of questions to bring home and discuss with parents or guardians. Someday, they too will have to pay for electricity – why not begin the journey of understanding what that process involves?
- Have students select a [Market Snapshot](#) and write an opinion piece about what they have read. They could also perform independent research to see if the information presented is accurate and objective by researching in more detail the parties involved or the story being shared. Invite a speaker to the classroom who could share their perspective on a particular subject of interest to students.
- Become a part of [Canada's success story!](#) Review Canadian success stories related to clean energy and write a summary and actionable list of recommendations for inclusion in the school paper or local newspaper. Share this list on the school's social media feed or display it at the local library.

Supporting resources

- [Government of Canada: Energy conversion tables](#)
- [Government of Canada: Canada's Energy Future 2023 – Energy Supply and Demand Projections to 2050](#)
- [Government of Canada: Energy Fact Book](#)
- [Canadian Centre for Energy Information](#)
- [Climate Institute of Canada: Canada's Net Zero Future](#)