The Electrification of Transportation

Carbon Dioxide in the Environment

Carbon dioxide (CO_2) is a gas produced by both natural and human sources. Human activity has added more carbon dioxide into the atmosphere, primarily from the burning of fossil fuels.

When fossil fuels are burned, the gas acts like an invisible blanket, causing the Earth to slowly warm up. Carbon dioxide has been building up in the Earth's atmosphere over the years as more and more fossil fuels are used.

What are Fossil Fuels?

Fossil fuels are non-renewable sources of energy like coal, oil, natural gas, and radioactive elements. These sources are considered non-renewable because they do not replenish at the same rate they are used.

The Effect on Climate Change

Fossil fuels will continue to be the most prominent source of energy until significant change is made. This will lead to an increase of carbon dioxide emissions in the atmosphere, which are a major contributor to climate change. New technologies that reduce carbon dioxide are crucial to reduce the negative impact of fossil fuels on the environment.

What are Light-Duty Vehicles?

Light-duty vehicles, such as cars and SUVs, are smaller in scale than trucks, buses, or larger bodies of transportation.

The Electrification of Transportation

The electrification of transportation is the process of replacing technology that uses fossil fuels, such as light-duty vehicles, medium-duty vehicles, and heavy-duty trucks and buses, with technology that uses electricity as the main source of energy. This process can help mitigate greenhouse gas (GHG) emissions by reducing fossil fuel use in the transportation sector, one of the larger contributors to climate change in Canada.

This project was undertaken with the financial support of:
Ce projet a été réalisé avec l'appui financier de :
Environment and Climate Change Canada
Environnement et Changement climatique Canada

Why Electrify Transportation?

The primary goal is to reduce overall greenhouse gas emissions, which would then help mitigate the effect of climate change. Depending on the resources used to generate the electricity for transportation, it can significantly reduce carbon dioxide emissions from the transportation sector. The benefits that are associated with electricity as a fuel source will likely increase in the future as it continues to become less carbon intensive.

Figure 1: A clean energy economy created by decarbonizing our own electricity supply, courtesy of Portland General Electric.

Light-Duty Vehicles vs. Medium/Heavy-Duty Vehicles

Light-duty vehicles, such as small cars and SUVs, require the least amount of power, therefore making them the easiest to electrify out of all the transportation options. This is where the majority of electrification in the road transport sector is currently occurring. Widespread electrification faces many technological and economic challenges, including shorter supply, limited charging infrastructure, and high purchase amount due to battery costs.

Medium- and heavy-duty vehicles, such as pick-up trucks, fleet trucks, and school buses, require more power, which makes them more challenging to electrify. Larger vehicles are typically used for more long distance trips and longer-time use. These vehicles also have more advanced technology requirements in order to electrify. As technology advances with voltage, battery life, charging speeds, etc., this will help accelerate the electrification of larger vehicles.

Did you Know?

In 2019, the road transportation sector accounted for 21% of all of Canada's greenhouse gas emissions (Government of Canada, 2025).

Created by green LEARNING

With support from
This project was undertaken with the financial support of:
Ce projet a été réalisé avec l'appui financier de :
Environment and Climate Change Canada / Environnement et Changement climatique Canada

In partnership with
OCEAN WISE
CGE THE CENTRE FOR GLOBAL EDUCATION
TakingITGlobal INSPIRE INFORM INVOLVE

Electrification Around the World

Currently, electric vehicles in Canada account for 1.5% of total vehicle sales and are expected to have a rapid growth in sales towards 2030. We're seeing trends and evidence around the world of successful electric vehicle integration using clean energy. In Europe, it's projected that 55% of all new car sales may be fully electrified by 2030. The United Kingdom is also moving to end the sale of gas-powered vehicles by 2040. The future is looking bright and electric!

School Bus Electrification Project

School buses are a significant part of Canada's transportation sector. They typically run on fossil fuels, which contribute to the greenhouse gas emissions. Out of all the medium- and heavy-duty vehicles, school buses can be one of the simplest to convert due to their fixed travel routes and distances. The Canadian Electric School Bus Alliance (CESBA) develops strategies and recommendations that accelerate the electrification of school buses across Canada. Their goal is for all of Canada's existing school buses, 51,000 total, to be zero emission by 2040. Currently, 2,000 out of 51,000 running school buses are electric. Replacing all school buses with electric school buses (ESBs) could reduce greenhouse gas emissions by at least 1.17 million tonnes annually. For more information on CESBA's Pathways for electric school bus adoption, including the technological and economic barriers, check out this **document**!

CanmetENERGY Ottawa Research Project

This project was created to identify optimal pathways for Medium- and Heavy-Duty Vehicle (MHDV) electrification. Data collection and analyses will be conducted on the technological and economic impact and barriers that are currently restricting full-scale electrification. This project will run from 2023 to 2028.

This project was undertaken with the financial support of:
Ce projet a été réalisé avec l'appui financier de :
Environment and Climate Change Canada
Environnement et Changement climatique Canada

Positive and Negative Impacts

The electrification of transportation has both positive and negative impacts on the climate, the environment, the economy, and the surrounding communities. It can be challenging for companies and governments to electrify vehicles while also considering the environmental impact or economic barriers involved. As more research becomes available and technology continues to advance, it becomes easier to understand the benefits and costs of the technology.

Did you Know?

In Canada, 80% of our electricity is generated from low-emission hydro, nuclear, or renewable sources, making the move to electric vehicles more sustainable (PwC, 2026).

Advantages

- Electrification of transportation can improve air quality by reducing overall air pollution where vehicles are operating, mainly due to no tailpipe emissions
- The overall reduction of greenhouse gas emissions by reducing fossil fuel use can help mitigate the effects of climate change
- Using renewable energy instead of non-renewable energy is more beneficial long-term as it's more sustainable
- Electrification of vehicles can help reach net-zero goals in different countries
- Overall maintenance costs are lower for electric vehicles - no oil changes or car maintenance required

Disadvantages

- The environmental benefits of electric vehicles can be lower when the electricity used to charge them is generated from fossil fuels
- Widespread electrification of light-, medium-, and heavy-duty vehicles face many economic and technological challenges
- Electric vehicles have higher upfront costs for consumers compared to gas-powered vehicles, mainly due to the battery costs
- It can take decades for existing internal combustion engine vehicles (gas-powered vehicles) to be completely retired and replaced by an alternative, making the integration of electric vehicles even slower than expected

This project was undertaken with the financial support of:
Ce projet a été réalisé avec l'appui financier de :
Environment and Climate Change Canada / Environnement et Changement climatique Canada

Policies in Canada

Canada has created electric vehicle (EV) charging strategies to further develop existing infrastructure. Since 2015, Canada has invested $1 billion to make electric vehicles more affordable and charging stations more accessible to Canadians. A coast-to-coast network of charging stations along the Trans-Canada highway is currently being integrated, as well as adding more chargers in local areas.

The Canadian government has replaced the Electric Vehicle Availability Standard policy with new tailpipe emissions standards for 2027-2035. This new policy will put the country on a trajectory to reach EV sales share of 75% by 2035 and 90% by 2040. Originally, Canada wanted to reach 100% zero-emission light-duty passenger vehicles sales by 2035.

Did you know?

Canada has introduced a rebate program from 2026-2030, where consumers can get a rebate for purchasing a new electric vehicle. For more information, **click here!**

The Role of Battery Technology

The technology used to power laptops and cell phones is the same lithium-ion battery used in electric vehicles, just on a larger scale. Since the integration of phones and laptops, battery capabilities have changed and improved in size, power, and how long they last. This will be the same for electric vehicles, where one of the biggest barriers to full-scale electric vehicle integration is the cost and power of batteries.

As more research becomes available, newer battery designs will be created to increase battery capacity, improve speed charging time, extend driving range, and further cut cost for consumers.

Next Steps in the Electrification of Transportation

Although the electrification of transportation is rapidly increasing in Canada with the continued evolution of lower-cost electric vehicle options for consumers, this transition will not happen overnight. With the new government policy in effect, Canada is well on its way to becoming more electric. The biggest component to the success of vehicle electrification is time and more research. Check out our *'Electrifying the Future of Transportation'* landing page on our website **here** for more resources!

This project was undertaken with the financial support of:
Ce projet a été réalisé avec l'appui financier de :
Environment and Climate Change Canada
Environnement et Changement climatique Canada

Additional Resources

Learning Resources

On our website, we have multiple resources that may be helpful to you. These resources are ideal for people learning about electric vehicles or charging stations, and may help with your project in a student or learner capacity.

EV Conversion Simulator

In collaboration with our ETF automotive instructors for both projects, Funktion Designs, and other volunteers, we've developed an EV conversion simulator. This simulator was designed to give you an introduction to the process of converting a gas-powered vehicle into an electric vehicle, and the differences between the two.

LINKED HERE

ETF Charging Ahead Educator Video

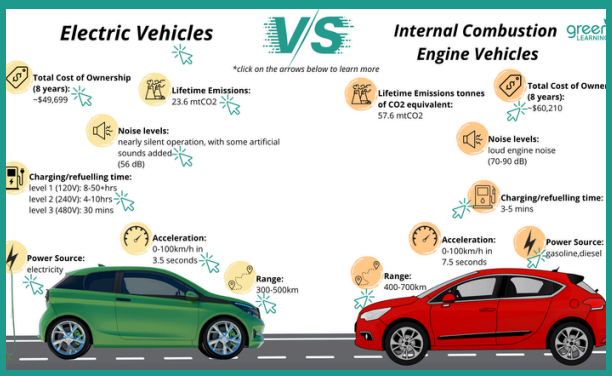
GreenLearning's Charging Ahead Workshop for Educators webinar gives an in-depth look at our Electrifying the Future Pilot Project in Alberta, where educators can hear directly from the automotive teachers in charge of the EV conversion project and get a behind-the-scenes look.

LINKED HERE

ETF Charging Infrastructure Video

Get a behind-the-scenes look at the Ontario ETF project. In this video, you see how the EV charging infrastructure at a school supports student learning, the transition to clean transportation, and the emerging career pathways for students.

LINKED HERE



Motor Controller Simulator

In collaboration with UCalgary's Relectric Car Team and Funktion Design, we've built a motor controller simulator. This introductory-level simulator allows learners to explore how the various components of an EV are wired together, and the role they play in making the EV move.

LINKED HERE

EV vs ICE Vehicle Interactive Infographic

Check out this interactive graphic on the differences between electric vehicles (EV's) and internal combustion engine vehicles (ICE).

LINKED HERE

References

Canada, Natural Resources. “New Refuelling Options for Drivers along Trans-Canada Highway.” Canada.ca, Government of Canada, 6 Apr. 2022, www.canada.ca/en/natural-resources-canada/news/2022/04/new-refuelling-options-for-drivers-along-trans-canada-highway.html. Accessed 24 Mar. 2026.

Canada, Transport. “Greenhouse Gas Emissions.” Transport Canada, 27 June 2022, tc.canada.ca/en/corporate-services/transparency/corporate-management-reporting/transportation-canada-annual-reports/2021/greenhouse-gas-emissions.

“Canadian Electric School Bus Alliance - Green Communities Canada.” Green Communities Canada, 23 Mar. 2026, greencommunitiescanada.org/program/canadian-electric-school-bus-alliance/. Accessed 24 Mar. 2026.

Cleary, Kathryne. “Electrification 101.” Resources for the Future, 5 Dec. 2019, www.rff.org/publications/explainers/electrification-101/.

“Electrifying Transportation.” Portland General, portlandgeneral.com/energy-choices/electric-vehicles-charging/electrifying-transportation.

Fong, Francis, and Likeleli Seitlheko. “Same, but Less: Prime Minister Carney Announces New EV Rebate and Auto Sector Strategy.” TD Economics, 2026, economics.td.com/ca-new-electric-vehicle-guidelines.

IEA. “Electrification - Energy System.” International Energy Agency, 11 July 2023, www.iea.org/energy-system/electricity/electrification.

PricewaterhouseCoopers. “Electrification of Transportation Will Change the Utility Business.” PwC, www.pwc.com/ca/en/industries/power-utilities/publications/electrification-of-transportation.html. Accessed 2026.

Qmerit. “Electrification and Sustainable Transportation - the Future of Trains, Boats, Airplanes, and More.” Qmerit, 2023, qmerit.com/blog/electrification-in-high-gear-trains-boats-and-more/.

Team, Driivz. “What Is Electrification of Transportation?” Driivz, 1 Mar. 2022, driivz.com/glossary/transportation-electrification/.

“Transport – Electrification — En-ROADS User Guide.” Docs.climateinteractive.org, docs.climateinteractive.org/projects/en-roads/en/latest/guide/transport_elec.html.

This project was undertaken with the financial support of:
Ce projet a été réalisé avec l'appui financier de :
Environment and Climate Change Canada / Environnement et Changement climatique Canada