ELECTRIC MOBILITY CANADA
ACCELERATING ELECTRIC TRANSPORTATION

MOBILITÉ ÉLECTRIQUE CANADA
ACCÉLÉRER L'ÉLECTRIFICATION DES TRANSPORTS

Why Electrify Medium- and Heavy-Duty Vehicles?

White paper

October 5, 2021

Executive Summary

Why should Canada work to electrify medium- and heavy-duty (MHD) vehicles?

1) **Massively lowering emissions: MHD buses and trucks** account for nearly **40 of greenhouse gas (GHG) emissions from transportation** while only making up 3% of the on-road vehicle stock. GHGs from trucking are projected to **surpass** those from passenger vehicles by 2030.

2) **Better air quality & lower healthcare costs:** MHD vehicles contribute disproportionately to black carbon and nitrogen oxide emissions. From Monday to Saturday, diesel trucks on highways emit **~80% of black carbon emissions** while representing only 1% of the vehicles. These pollutants cause ~15,000 premature deaths per year in Canada and ~$36 billion of direct welfare cost. Electric vehicles increasingly feature safety innovations that can reduce the frequency and severity of vehicle-related injuries and deaths for drivers and passengers. Thus, electrifying MHD vehicles will save not only thousands of lives but also billions of dollars.

3) **Economic prosperity:** Under stronger policies, Canada's zero-emission vehicle (ZEV) economy could grow from 2015 levels of **~$1B GDP and 10,000 jobs** to **$152B** and **1.1 million jobs** in 2040. New jobs will be created in resource development and processing, vehicle manufacturing, charging infrastructure manufacturing, utilities, operations and service, technology development, cybersecurity and IoT. Shifting from imported fuel to Canadian-made electricity will improve **energy security**, especially in Quebec and Atlantic Canada. Fleet owners will benefit from better **return on investment** thanks to lower maintenance, longer lifecycles, and lower operational costs of electric vehicles.

To realize these benefits, Canada must **implement a supportive ecosystem of policies and incentives** to accelerate the adoption of zero-emission MHD vehicles. A future whitepaper will elaborate on a specific set of recommendations.

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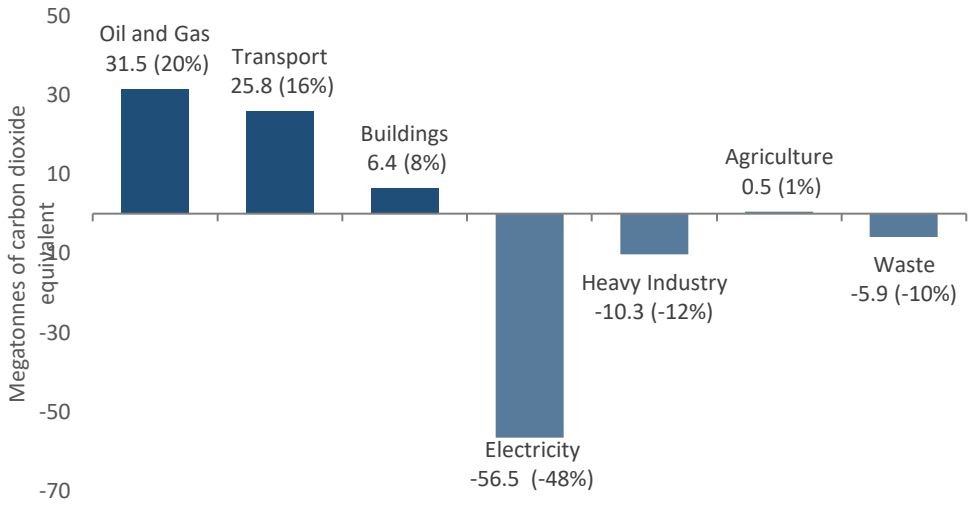
Zero-emission MHD vehicles provide enormous opportunities for Canada to reduce national GHGs, improve public health, and create employment and economic opportunities. Despite this, the public and policy discourse has focused in large part on passenger and light-duty vehicles. The following sections address the key reasons that Canada's focus must broaden to accelerate progress in electrifying the MHD sector.

1. Electrifying MHD Vehicles Is Critical to Reducing GHG Emissions

In April 2021, Canada announced a new GHG emissions target of 40% to 45% below 2005 levels by 2030. Canada has also committed to net-zero emissions by 2050. These are ambitious goals, given that in the 14 years between 2005 and 2019, Canada's GHG emissions decreased by only 1% (ECCC, 2021)[1]. Any effort to meet these emissions reductions will need to see **currently available technology** deployed at a much-accelerated pace, along with additional low-carbon innovations becoming available over time. It is well-understood that **electric vehicles** – as the most mature, readily-available and energy-efficient low-emission vehicle technology -- are critical in the fight against climate change.

Among national greenhouse gas sources, the **oil and gas and transportation sectors were the largest GHG emitters**. Together, they contributed 52% of total emissions and emitted 377 megatonnes of carbon dioxide equivalent (Mt CO2 eq) in 2019. These figures have been **increasing** over the past decades, counteracting decreases in other sectors such as electricity and waste (Figure 1.1) (ECCC, 2021b).

Figure 1.1 Net changes in greenhouse gas emissions by economic sectors (2005 to 2019)



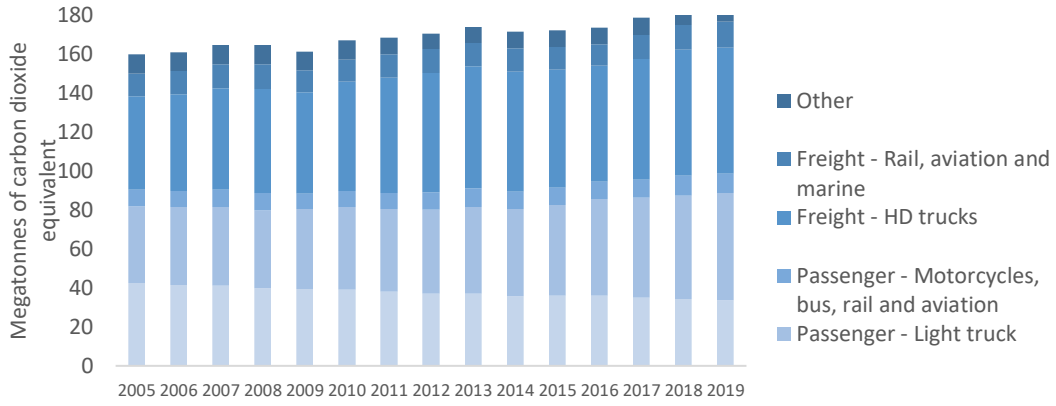
The transport sector, specifically, emitted 186 Mt CO2 eq in 2019, an increase of 16% compared to 2005 levels. Within this sector, **freight trucking and passenger bus account for nearly 40%** of total emissions (ECCC, 2021c), while only making up 3% of the on-road vehicle stock (Statistics Canada, 2020)[2]. Trucking

[1] Environment and Climate Change Canada (ECCC, 2021). *Greenhouse Gas Emissions*. Canada.ca. Available online at https://www.canada.ca/en/environment-climate-change/services/environmental-indicators/greenhouse-gas-emissions.html

[2] Statistics Canada, 2020. *Vehicle registrations, by type of vehicle*. 150.statcan.gc.ca. Available online at https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=2310006701

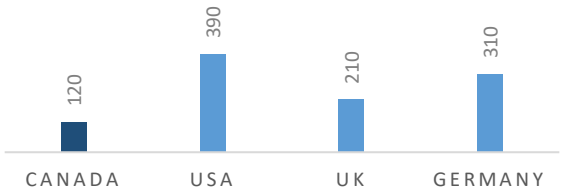
companies in Canada are highly concentrated in the four most populous provinces,[3] where the majority of the country's natural resources and manufacturing industry participants operate large MHD fleets. Between 2005 and 2019, **emissions from heavy-duty trucks grew by 35%** (Figure 1.2), and is projected to surpass those from passenger vehicles including cars and light trucks by 2030 (ECCC, 2019)[4]. Canada's federal government has also acknowledged the criticality of this issue and[5] therefore, the electrification of MHD vehicles offers a tremendous opportunity to significantly reduce carbon emissions.

Figure 1.2 Transport sector greenhouse gas emissions, Canada, 2005 to 2019



Given decreasing GHG emissions from the electricity sector (Figure 1.1) and the low carbon-intensity of our electricity grid (Figure 1.3), the **GHG impact of electrifying vehicles is even greater in Canada** than in most other jurisdictions.

Figure 1.3 Electricity grid CO2 emissions intensity (based on actual 2019 generation for USA, UK and Germany and 2018 generation for Canada).



[3]Transport Canada, 2020. Transportation in Canada Overview Report 2020. Available online at: https://tc.canada.ca/sites/default/files/2021-07/transportation_canada_2020_overview_report.pdf

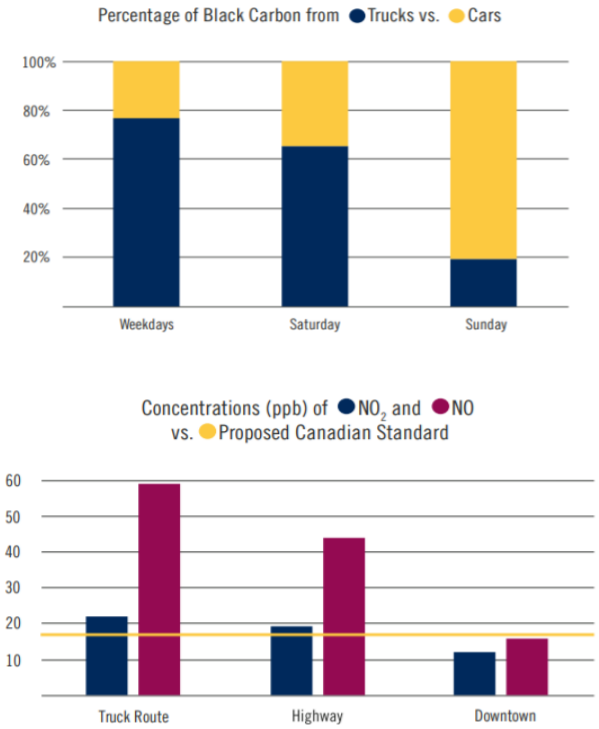
[4] Environment and Climate Change Canada (ECCC, 2019). *Canada's Fourth Biennial Report on Climate Change*. Page 122. Available online at https://unfccc.int/sites/default/files/resource/br4_final_en.pdf

[5] For example, see the *Heavy-duty Vehicle and Engine Greenhouse Gas Emission Regulations*, which set performance-based GHG emission standards for new on-road heavy-duty vehicles and their engines made in 2014 and later years. More stringent GHG emission standards are applicable for the 2021 model year and beyond.

2. Electrifying MHD Will Reduce Air Pollution and Enhance Public Health and Safety

Besides carbon emissions, the oil and gas and transport sectors are responsible for the majority of **air pollutants**. Together, they accounted for 68% of nitrogen oxides, 44% of volatile organic compounds, 43% of carbon monoxide, and 37% of black carbon emissions (ECCC, 2020)[6]. Notably, a near-road air pollution study by the University of Toronto and Southern Ontario Centre for Atmospheric Aerosol Research found that **large trucks contribute disproportionately to black carbon and nitrogen oxide emissions**. For example, on weekdays and Saturdays, diesel trucks at the highway site emit approximately 80% of black carbon emissions, while representing only 1% of the vehicles (SOCAAR, 2019)[7]. In addition, bus commuting in major Canadian cities such as Toronto, Ottawa, and Vancouver contribute significantly toward daily exposures of traffic-related air pollution of Canadians: 60-70% of certain fine particles (PM2.5), and 10-20% of black carbon exposure (Van Ryswyk et al., 2020)[8]

Figure 2.1 Emissions of black carbon and nitrogen oxide from trucks



Pollutants from the combustion of fossil fuels affect all aspects of health at all stages of life. According to the 2021 report from Health Canada titled *Health Impacts of Air Pollution in Canada*:

[6] Environment and Climate Change Canada (ECCC, 2020). *Air Pollutant Emissions*. Canada.ca. Available online at https://www.canada.ca/content/dam/eccc/documents/pdf/cesindicators/air-pollutant-emissions/2020/air-pollutant-emissions-en.pdf

[7] Southern Ontario Centre for Atmospheric Aerosol Research (SOAAR, 2019). *Near-Road Air Pollutant Pilot Study*. Page 8. Available online at https://www.socaar.utoronto.ca/wp-content/uploads/2019/10/SOCAAR-Near-Road-Air-Pollution-Pilot-Study-Summary-Report-Fall-2019-web-Final.pdf

[8] Van Ryswyk, K., Evans, G. J., Kulka, R., Sun, L., Sabaliauskas, K., Rouleau, M., . . . Weichenthal, S. (2020). *Personal exposures to TRAFFIC-RELATED air pollution in three Canadian bus transit systems: The urban Transportation Exposure Study.* Journal of Exposure Science & Environmental Epidemiology. Available online at https://www.nature.com/articles/s41370-020-0242-2.pdf

"Health Canada estimates that above-background air pollution, including air pollution from human sources in North America, contributes to 15,300 premature deaths per year in Canada. This includes an estimated 6,600 premature deaths in Ontario, 4,000 in Quebec, 1,900 in British Columbia and 1,400 in Alberta. National morbidity or nonfatal health outcomes include 2.7 million asthma symptom days and 35 million acute respiratory symptom days per year, with the total economic cost of all health impacts attributable to air pollution for the year being $120 billion (2016 CAD). This is equivalent to approximately 6% of Canada's 2016 real gross domestic product." (HC, 2021)[9].

Making the transition to electric MHD vehicles is **critical to enhance Canadian public health and save thousands of lives**, especially in urban areas. There is also an important economic benefit tied to reduced air pollution. According to a 2017 report by the International Institute for Sustainable Development (IISD), smog cost Canadians $36 billion in 2015. This is equivalent to $4,300/year for a family of 4 (Figure 2.2) (IISD, 2017)[10]. Electrifying MHD vehicles, thus, will also save billions of dollars.

Figure 2.2 Summary of direct welfare costs of pollution in Canada in 2015

Category	Estimated direct welfare cost in 2015	Reliability of estimate	What is and is not covered
Criteria air pollutants ($PM_{2.5}$ and ground-level ozone)	**Central estimate**: $36 billion **Range**: $26 billion to $47.5 billion	High	Represents the cost of $PM_{2.5}$ and ozone in terms of premature mortality and morbidity; other criteria air pollutants are excluded but are likely much smaller.

There is also a growing consensus that electric and automated vehicles create significant potential to improve operator and passenger safety. ZEVs are tested to the same high standard as other vehicles and are increasingly being recognized by industry for strong crash-test[11] and other results.[12] Further, innovations and new safety standards including electronic logging devices for commercial carriers – intended to strengthen road safety in Canada by mitigating the risk of fatigue-related collisions – can be adopted and implemented in parallel with MHD electric vehicle fleet conversions.

[9] Health Canada (HC, 2021). *Health Impacts of Air Pollution in Canada*. Available online at https://www.canada.ca/content/dam/hc-sc/documents/services/publications/healthy-living/2021-health-effects-indoor-air-pollution/hia-report-eng.pdf

[10] International Institute for Sustainable Development (ISSD, 2017). *Cost of Pollution: Smog*. Available online at https://www.iisd.org/system/files/publications/costs-of-pollution-in-canada.pdf

[11] Insurance Institute for Highway Safety, 2021. Available online at https://www.iihs.org/news/detail/with-more-electric-vehicles-comes-more-proof-of-safety

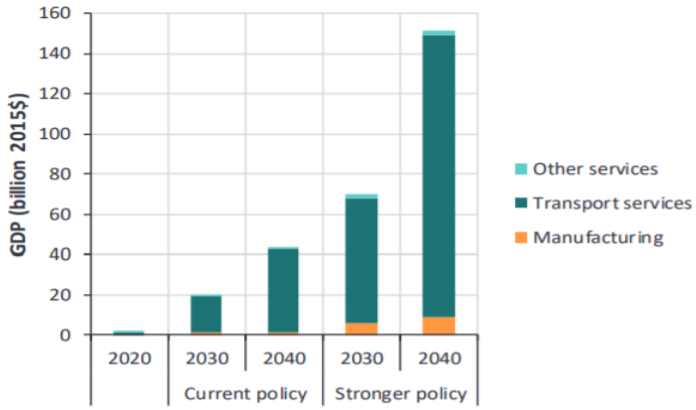
[12] Highway Loss Data Institute, December 2020. Vol. 37, No. 25. Available online at https://www.iihs.org/media/ca2618fc-c875-4246-8a9f-5977f3b702f6/Ewxm_A/HLDI%20Research/Bulletins/hldi_bulletin_37-25.pdf

3. Electrifying MHD Will Create Jobs and Economic Opportunities

As the world transitions to electric vehicles, there is **massive potential for job creation and economic growth** by building a strong domestic zero-emission vehicle supply chain, including supporting services and infrastructure. According to a report Navius Research Inc. prepared for the International Council on Clean Transportation (ICCT):

> *"At present, Canada's zero-emission vehicle (ZEV) economy accounts for **about $1.1 billion of GDP (2015$) and employs around 10 thousand people** (see Figure 3.1). In response to current policy, this economy is projected to **grow to $43 billion of GDP and 342 thousand workers by 2040**. It could grow further under stronger policy, to $152 billion and 1.1 million workers in 2040." (ICCT, 2020)*[13]

Figure 3.1 Growth in Canada's ZEV-economy in response to policy



Canada's MHD vehicle manufacturing sector has grown over the years, and there are opportunities to capitalize on our existing supply chains to build the stock and production of electric MHD vehicles in Canada. With Canadian companies making electric buses, school buses and trucks such as NovaBus, NewFlyer, Lion Electric, Girardin, plus multinational OEMs such as BYD located in Canada, there is great potential for job creation. Some of these companies also partner with local suppliers, further contributing to growth by generating thousands of indirect jobs.

In addition to jobs associated with vehicles, there is significant **job creation potential linked to the charging infrastructure** – from engineering, manufacturing, installing and maintaining **not only the chargers but the complete power infrastructure and IT systems** needed to provide power and manage these new **distributed energy systems**. The sector currently employs thousands of Canadians, from EV charger manufacturers to manufacturers of electrical distribution equipment, to electrical and civil engineers, general contractors, IT / IoT designers, systems integrators and cybersecurity experts. For context, a typical light-duty EV charging installation employs 5-10 different jobs functions and the installation of charging equipment can generate 9.76 direct, indirect and induced jobs for every million

[13] International Council on Clean Transportation (ICCT, 2020). *Simulating zero emission vehicle adoption and economic impacts in Canada*. Available online at https://theicct.org/sites/default/files/publications/ZEV-impacts-Canada-Navius-042020.pdf

invested (Statistics Canada, 2020)[14]. Installation processes and costs for MHD vehicles are more complex and costly than light-duty vehicles, and thus will increase demand for installation professionals. The installation and maintenance of EV charging stations and depots for MHD fleets, which will be **large-scale electrical-digital hubs** will require a large reskilling of the existing labour force.

MHD electrification represents a major **revenue growth opportunity** for the Canadian utility sector, particularly generators. In addition, shifting the source of transportation fuel from imported fossil fuels to locally generated power will help to **improve energy security**, especially in provinces such as Quebec and Alberta where more than half the oil used is imported from foreign sources (Canada's Oil and Natural Gas Producers, 2019).[15]

Similarly, Canada's mining industry is capable of playing an essential role in Canada's transition to a low carbon future by producing and processing the critical metals and minerals required for EVs and sustainable energy developments. These include nickel, copper, iron ore, metallurgical coal, zinc, cobalt, lithium and others. In addition to adopting **sustainable and responsible mining practices**, Canada's mining companies and other natural resource industry participants can become strategic adopters, ambassadors and beneficiaries of emerging EV technology. Alternatively, if Canada does not support the development of a domestic EV industry, we will be forced to import vehicles and supporting services in order to reach our electrification and GHG reductions goals, losing well-paid Canadian jobs and the opportunity to grow an entire Canadian ecosystem of expertise in the process. It is crucial for the Canadian government to **adopt an early investment strategy** for this sector in order to stabilize and improve Canada's trade imbalance and create the opportunity to become a global leader in the development and production of electric MHD vehicles. Such a position will also help to stimulate foreign investment.

Finally, electric MHD vehicles offer the economic benefit of a **higher long-term return on investment (ROI)** for their owners. Canadian fleet operators who transition to electric vehicles have the benefits of lower maintenance, longer lifecycles, lower operational costs all leading to a lower total cost of ownership for the right applications. Furthermore, Canada is home to world leaders in battery reuse and recycling, where second life for batteries and their materials promotes a circular economy within Canada.

Conclusion

Electrifying MHD vehicles will unlock immense environmental, social, and economic opportunities for Canada. It's vital that Canada implement a supportive ecosystem of policies and incentives to accelerate our progress.

[14] Statistics Canada, 2020. *Input-output multipliers, detail level*. 150.statcan.gc.ca. Available online at https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3610059401&pickMembers%5B0%5D=2.5&pickMembers%5B1%5D=4.29&cubeTimeFrame.startYear=2013&cubeTimeFrame.endYear=2017&referencePeriods=20130101%2C20170101

[15] Canada's Oil and Natural Gas Producers, 2019. *Canada's Oil Imports*. Available online at https://www.capp.ca/energy/markets/

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5. Environment and Climate Change Canada (ECCC, 2020). *Air Pollutant Emissions*. Canada.ca. Available online at https://www.canada.ca/content/dam/eccc/documents/pdf/cesindicators/air-pollutant-emissions/2020/air-pollutant-emissions-en.pdf
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10. Insurance Institute for Highway Safety, 2021. Available online at https://www.iihs.org/news/detail/with-more-electric-vehicles-comes-more-proof-of-safety
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12. International Council on Clean Transportation (ICCT, 2020). *Simulating zero emission vehicle adoption and economic impacts in Canada.* Available online at https://theicct.org/sites/default/files/publications/ZEV-impacts-Canada-Navius-042020.pdf
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