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TRANSPORTATION EMISSIONS:

DECARBONIZING THE TRANSPORTATION SECTOR

Decarbonizing Ontario's transportation sector as quickly as possible is the best hope at achieving the 2030 carbon emission targets and reaching net-zero emissions by 2050. This requires a multi-pronged approach to electrification, focused on both passenger vehicles and public transit.

TRANSPORTATION EMISSIONS

While Ontario has successfully reduced GHG emissions 9 percent below 1990 levels, and 23 percent below 2005 levels, two sectors have seen emissions increase significantly over the same period – transportation and buildings. Despite increases in fuel efficiency over the last 30 years, Ontario's transportation emissions have increased by 41 percent since 1990, and now account for 1/3 of the province's total emissions[1]. This compares to ¼ of Ontario's total emissions in 1990. By comparison, electricity sector emissions dropped from approximately 26 megatonnes (Mt) CO2e (14 percent of total emissions) in 1990, to just 3.3 Mt in 2019 (2 percent of total emissions)[2], as the result of replacing coal generation with more nuclear and renewable power. Considering how clean Ontario's electricity grid has become, shifting these vehicles to electric power is one of the most effective ways to reduce the province's carbon emissions.

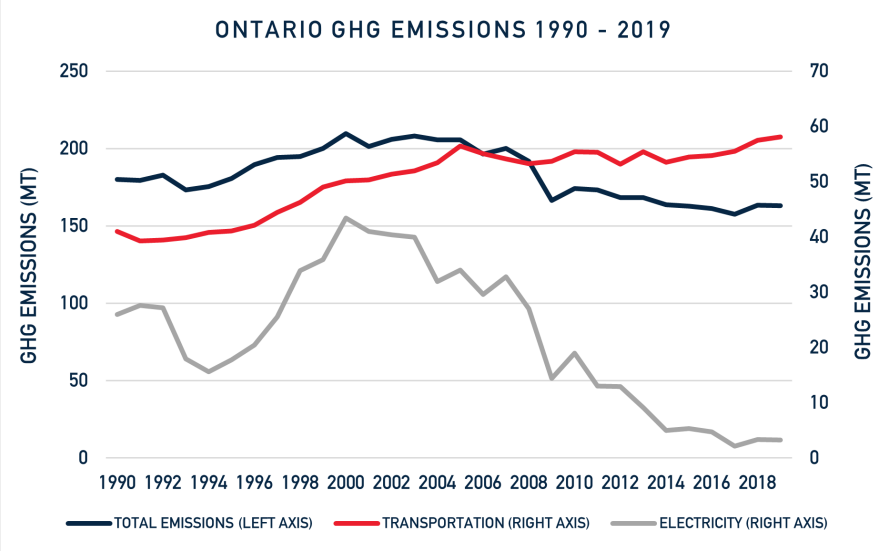
Of the 58.1 Mt of GHG emissions emitted by the province's transportation sector, 33.3 Mt – 62 percent – are generated by cars, light trucks, and motorcycles. In fact, these vehicles account for 20 percent of the province's overall GHG emissions[3].

If Ontario is going to meet its goal to reduce its carbon emissions by 30 percent below 2005 levels (let alone the Government of Canada's more aggressive goal to reach net-zero emissions by 2050), and achieve net-zero emissions by 2050, the quickest way to get there is to start by working to eliminate the 20 percent of total emissions generated by cars, light trucks, and motorcycles. Net-zero can't be achieved without doing so.

CO_2e: A measure used to compare the emissions from various greenhouse gases based on their global-warming potential (GWP), by converting amounts of other gases to the equivalent amount of carbon dioxide with the same global warming potential.

For example, the GWP for methane is 25 and for nitrous oxide 298. This means that emissions of 1 million metric tonnes of methane and nitrous oxide respectively is equivalent to emissions of 25 and 298 million metric tonnes of carbon dioxide.

Source: Eurostat Glossary: Carbon dioxide equivalent

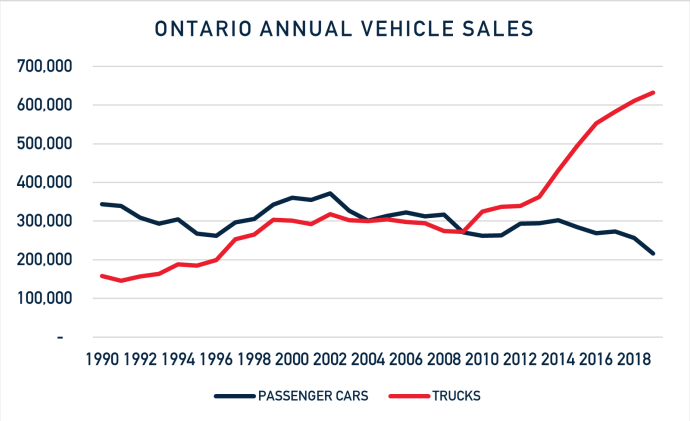


THE RISE OF THE LIGHT TRUCK

While fuel consumption per 100km has declined across all passenger automobile types since 2005, Ontario's transportation emissions have increased. This increase is largely attributable to a shift from people driving passenger cars to light trucks, such as SUVs. These light trucks consume almost twice as much fuel as passenger cars per 100km. Since 2005, passenger car sales in Ontario have decreased at an annual rate of 2.8 percent per year, while light truck sales have grown by an average rate of 5.8 percent during the same period. Since 1990, annual sales of passenger cars have decreased a total of 37 percent, while sales of light trucks in Ontario has skyrocketed, increasing 300 percent over the last 30 years.

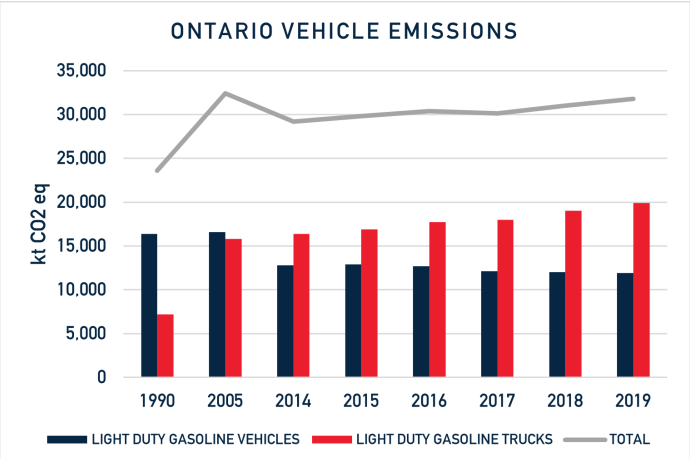
The rise of light truck sales in recent years coincides closely with the oil price crash of 2014, which brought gasoline prices down with it. With gasoline prices rising sharply,

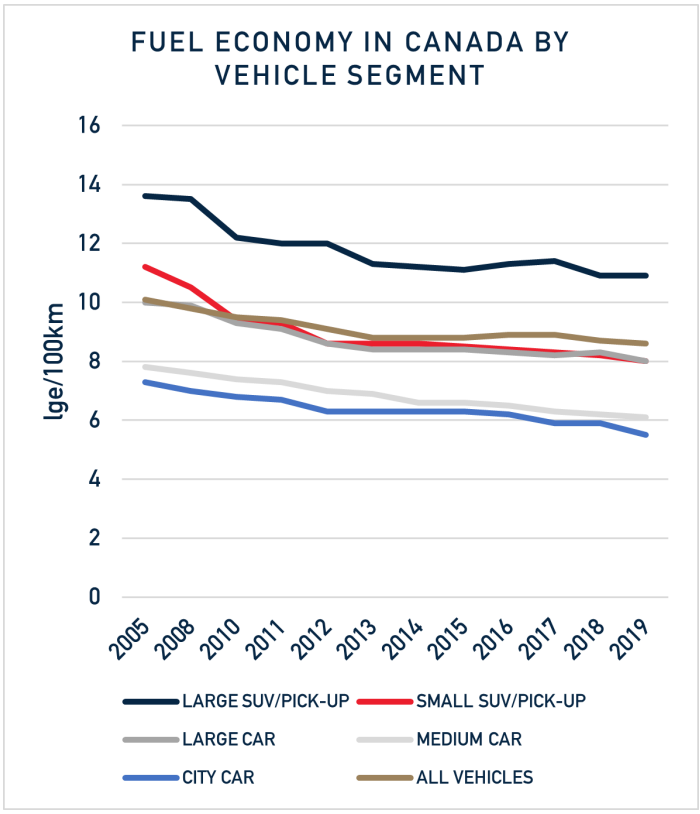
1 Canada's Official Greenhouse Gas Inventory. https://open.canada.ca/data/en/dataset/779c7bcf-4982-47eb-af1b-a33618a05e5b
2 ibid
3 Canada's Official Greenhouse Gas Inventory. https://open.canada.ca/data/en/dataset/779c7bcf-4982-47eb-af1b-a33618a05e5b



coupled with planned increases in the federal carbon price, we may expect to see truck sales calm. However, a simple slowing of truck sales will not be enough to achieve the emissions reductions needed from the transportation sector in order to meet 2030 and 2050 climate targets.

Replacing fossil fuel-powered light trucks with electrified engines is necessary to achieve drastic reductions in transportation emissions. Some manufacturers have signalled their willingness to invest in making this shift, with both Ford and GM producing fully electric pickup trucks. However, producing the power and performance necessary to make electric pickups attractive to truck buyers currently comes with a pricetag prohibitive to many potential buyers, and there may be some hesitancy until the technology has proven itself. In the interim, hybrid light trucks that use less gasoline may be necessary to continue progress towards the 2030 and 2050 climate goals.





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ELECTRIC CARS – THE FUTURE IS NOW

While mass adoption of electric pickup trucks is likely several years away, the barriers to adopting electric cars are quickly disappearing. With electric vehicle ranges pushing over 400 km per charge, range anxiety is becoming a thing of the past. In Ontario, the Ivy partnership between Hydro One and Ontario Power Generation is creating hundreds of new fast-charging stations, including at OnRoute rest stations on major highways. Ivy's fast charging stations can charge at speeds up to 150 kW per second, adding as much as 100 km of range in 10 minutes. Charging speeds will vary depending on the charger and the car, with most vehicles being able to charge from 10 percent to 80 percent in between 15 to 45 minutes. Level 2 chargers, which are typically installed at homes or workplaces, can provide a full charge in approximately 8 to 9 hours.

This is a major step forward in creating the charging

infrastructure necessary to support EV adoption. And, while electric vehicles are still more expensive than their internal combustion counterparts, prices from some manufacturers are becoming more accessible.

Internal Combustion Engine (ICE): A conventional automobile, powered by the combustion of a petroleum-based fuel like gasoline, diesel, or a gasoline/ethanol blend. The most fuel efficient 2022 ICE vehicle has an EPA estimated tailpipe emissions of 227 g/mile.

Hybrid Electric Vehicle (HEV): HEVs are ICE vehicles with a battery system used to increase fuel efficiency. The battery in an HEV cannot be charged by the grid, instead they are recharged through braking. The most fuel efficient 2022 HEV has an EPA estimated tailpipe emissions of 151 g/mile.

Plug-in Hybrid Electric Vehicle (PHEV): PHEVs are electric vehicles that also have an internal combustion engine. The PHEV battery is smaller than what is found in a full electric vehicle but can still be plugged in and charged from the grid. This allows a PHEV to operate in zero-emission mode, typically for ranges of 30 to 60 km, while relying on the ICE engine for longer trips. The most fuel efficient 2022 PHEV has an EPA estimated tailpipe emissions of 74 g/mile.

Battery Electric Vehicle (BEV): BEVs are fully electric vehicles, with large batteries that are plugged in and charged from the electricity grid. BEVs are fully zero-emission vehicles, with all BEVs generating zero tailpipe emissions.

For example, in 2017 a new Chevrolet Bolt EV had a MSRP starting at $42,795 ($48,016 in 2022, adjusted for inflation), with an estimated battery range of 383km[4]. By comparison, the 2022 Bolt EV has a starting MSRP of $38,198 with an estimated range of 417km[5]. The 2022 Bolt EV is approximately 10 percent less expensive than the 2017 model without adjusting for inflation, and about 20 percent less expensive in real terms. However, the 2017 Bolt EV would have been eligible for a rebate of $12,389 under the province's now-cancelled Electric and Hybrid Vehicle Incentive Program (EHVIP), bringing the final starting price down to $30,406 ($34,116 in 2022, adjusted for inflation). With the EHVIP no longer active, the 2022 Bolt EV is eligible only for the Federal iZEV rebate of $5,000, bringing the final starting price to $33,198, 9 percent more expensive in nominal terms, and only 3 percent less expensive when adjusted for inflation. In short, while Chevrolet has reduced the price of the Bolt EV by 20 percent in real terms, the reduced government incentives mean prices paid by consumers have barely changed in five years.

There will come a time when the EV market matures to the point where government incentives are no longer necessary, but we are not there yet. Considering the urgent need to electrify our transportation sector, incentives have an important role to play in the transition from ICE vehicles. The evidence is easy to find: The removal of the EHVIP in 2018 turned Ontario from the leader in provincial EV sales to a distant 3rd, behind Quebec and British Columbia, both provinces with robust EV rebate programs. While we are seeing declining MSRPs on electric vehicles, reinstating provincial EV rebates to compliment the federal iZEV program could help accelerate adoption of EVs in Ontario, and dramatically reduce the province's transportation sector carbon emissions.

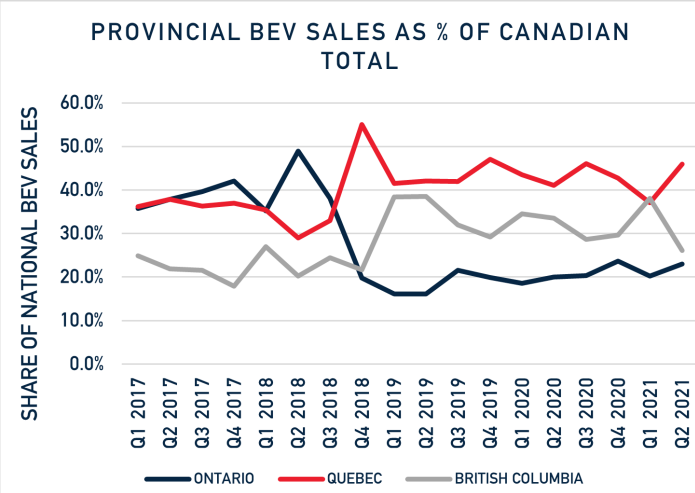
Government incentives for EV sales are also necessary to compete for limited supply of available electric vehicles. While the recent supply crunch suggests robust demand for electric vehicles exist, manufacturers have been directing available EVs to jurisdictions with robust consumer-side incentives, or with aggressive EV sales mandates[6]. In Canada, the bulk of EV deliveries have been to BC and Quebec.

Additionally, every new EV sold today is potentially a used EV available for purchase down the road, making zero emission vehicles accessible to more buyers. In short, with

4 https://media.gm.ca/media/ca/en/chevrolet/vehicles/Bolt-EV/2017.detail.html/content/Pages/news/ca/en/2017/Feb/0202_Bolt.html

5 https://www.chevrolet.ca/en/electric/bolt-ev

6 https://www.thestar.com/news/canada/2022/10/29/want-to-buy-an-electric-vehicle-in-toronto-good-luck-star-investigation-finds-wait-times-of-up-to-a-year.html



the right government policy, mass adoption of electric cars can quickly go from a goal to a reality.

The federal government has announced a complete phase-out of internal combustion engine vehicles by 2035, a move which is predicted to help put over 6 million electric vehicles on the road in Ontario by 2042. However, we cannot afford to wait to start the shift to electric vehicles. The province is committed to reducing emissions to 30 percent below 2005 levels by 2030, and part of the path to get there relies on 1.3 million electric vehicles in Ontario by that year. The Auditor General has stated that the province is not on track to meet its 2030 EV target, and consequently will fall short of its emissions reduction target which relies heavily on reducing transportation emissions[7].

To accelerate the shift towards electric cars and eliminate the 12 Mt of carbon emissions generated annually by internal combustion cars, we need a robust package of government policies to accelerate the shift. From investing in charging infrastructure, to competitive subsidies or tax rebates, government support for electric vehicle uptake is one of the quickest ways to reduce our carbon emissions.

EV CHARGING AND ELECTRICITY DEMAND

Dramatically shifting the province's transportation sector towards electric vehicles will have a significant impact on demand for electricity. Ontario's Independent Electricity Systems Operator (IESO) predicts that meeting the province's initial target of 1.3 million EVs by 2030 would increase the Ontario's annual electricity demand by approximately 4 TWh[8], about the same amount of power generated by Unit 3 at the Bruce Nuclear Generating Station in 2019[9]. If the province can achieve the federal government's target of 6.6 million EVs in Ontario by 2042, it would increase annual electricity demand just from EV charging by 24.2 TWh[10], which is about how much power the entire Pickering Nuclear Generating Station (slated to close in 2025) produces in a year. New generation will have to be found, not only to replace the loss of the Pickering Station, but also to meet the new demand created by electrifying transportation.

Watt Hour (Wh): We measure electricity in terms of power (watt) over time (hour). Most people are familiar with a kilowatt hour (KWh), as that is how our electricity use is measured on our hydro bills. One KWh is the equivalent of using 1,000 watts for one hour. Using a 100-watt lightbulb for ten hours would use 1 KWh of electricity. Similarly, using ten 100-watt lightbulbs for 1 hour would use 1 KWh of electricity.

When we discuss grid level electricity generation or demand, we use figures like gigawatt hours (GWh), which is one million KWh, and terawatt hours (TWh), which is equal to one billion KWh.

The Pickering Nuclear Generating Station has a nameplate capacity of approximately 3,100 MW. So, if it ran at 100% capacity for a full year, it would generate 3,100 MWh every hour, 24 hours a day, for 365 days, or 27.16 TWh over the course of a year.

7 https://www.auditor.on.ca/en/content/annualreports/arreports/en19/2019AR_v2_en_web.pdf

8 https://www.ieso.ca/-/media/Files/IESO/Document-Library/planning-forecasts/apo/Annual-Planning-Outlook-Jan2020.ashx

9 https://www.brucepower.com/wp-content/uploads/2020/01/2020_OntarioEnergyReport-1.pdf

10 https://www.ieso.ca/-/media/Files/IESO/Document-Library/planning-forecasts/apo/Dec2021/2021-Annual-Planning-Outlook.ashx

Unlike electrifying other sectors of the provincial economy, electrifying transportation will primarily impact electricity demand during off-peak hours, as that is when most electric vehicles are expected to be charged. Additionally, since EV batteries drain faster in cold weather, greater charging demand would be expected during winter months, when the province is currently a net-exporter of power to Quebec.

By increasing demand during what have historically been periods of lower electricity demand in the province, Ontario could potentially see lower electricity rates for consumers as the fixed costs of electricity generation are spread over a larger rate base in what are currently off-peak hours.

The result of a widespread transition to EVs is not just a dramatic increase in overall electricity demand, but a significant restructuring of the province's traditional demand patterns. Ontario should seek to leverage this restructuring to limit peak energy generation where feasible.

PUBLIC TRANSIT

An additional way to minimize transport emissions in cities is to encourage alternative forms of travel, like walking, cycling, and public transit, and to build our urban environments around these modes of transportation.

A report by the US Department of Transportation estimated that a bus with average occupancy (56 percent of seats occupied) produces about 33 percent fewer carbon emissions per passenger kilometer than a single-occupant car generates, while a bus full of passengers produces approximately 80 percent fewer carbon emissions.[11]

Emissions reductions can be even more dramatic if we invest in electrifying our public transportation system and take advantage of Ontario's clean electricity grid. A study published in the Journal of Transportation Research compared the lifecycle emissions of various forms of alternative energy for buses across different jurisdictions – the European Union, the United States, and Sweden – based on the carbon intensity of the electricity grid. The study determined that for electricity grids with a carbon intensity below 200g CO2e/kwh, "electric buses come out best among all options."[12]

Lifecycle emissions: The total emissions impact of the entire lifecycle of a product, from material extraction and manufacturing to operating emissions and end-of-life decommissioning.

The study's inclusion of Sweden as an examined region provides an excellent stand-in for Ontario. The carbon intensity of Sweden's grid is approximately 40g CO2e/kwh[13], while Ontario's carbon intensity, according to the IESO, is even lower at 26g CO2e/kwh.[14]

The study estimated the total lifecycle emissions of all-electric buses based on Sweden's grid-intensity to be approximately 16g CO2e per passenger kilometer, assuming average occupancy. This is less than 10 percent of the 180g CO2e per passenger kilometer emitted simply from operating an internal combustion bus[15], at average capacity. We can expect emissions to be even lower when powered by Ontario's cleaner electricity grid.

A recent white paper by the International Council on Clean Transportation estimated the lifecycle emissions of electric passenger vehicles in the EU and the USA, and when we compare the lifecycle emissions of electric buses to passenger vehicles in these regions, we see that all-electric buses have approximately 40 percent fewer lifecycle emissions per passenger kilometer[16].

11 https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/PublicTransportationsRoleInRespondingToClimateChange2010.pdf

12 Life cycle assessment of city buses powered by electricity, hydrogenated vegetable oil or diesel, Nordelöf et al., https://www.sciencedirect.com/science/article/pii/S1361920919302792#f0005

13 https://app.electricitymap.org/zone/SE

14 https://www.ieso.ca/-/media/Files/IESO/Document-Library/gas-phase-out/Decarbonization-and-Ontarios-Electricity-System.ashx

15 https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/PublicTransportationsRoleInRespondingToClimateChange2010.pdf, author's calculations

16 https://theicct.org/publication/a-global-comparison-of-the-life-cycle-greenhouse-gas-emissions-of-combustion-engine-and-electric-passenger-cars/, author's calculations

The Toronto Transit Commission, Toronto Hydro, and PowerON – a subsidiary of Ontario Power Generation – are currently working together to electrify the TTC's bus fleet, North America's largest transit electrification project to date. Electrification of Ontario's municipal transit fleets will be a critical step in reducing transportation emissions and meeting the province's climate change goals.

MOVING FORWARD

Decarbonizing Ontario's transportation sector as quickly as possible is the best hope at achieving the 2030 carbon emission targets and reaching net-zero emissions by 2050. This requires a multi-pronged approach to electrification, focused on both passenger vehicles and public transit.

The provincial government should immediately re-establish and enhance the Electric and Hydrogen Vehicle Incentive Program (EHVIP), and work with the federal government's Incentives for Zero-Emission Vehicles (iZEV) program to make it as robust as possible. The recent supply crunch in the EV market suggests that additional incentives are no longer required to spur demand for new EVs, but support is required to make purchasing an electric vehicle an accessible option for more Ontarians. A reincarnated provincial EHVIP should be an income tested benefit, to ensure emission-free vehicle ownership is accessible to as many Ontarians as possible.

While there is understandable hesitancy to subsidize the purchase of electric luxury vehicles, necessitating a cap on the MSRP of vehicles eligible for the program, a reinstated EHVIP program should make an exception for all-electric light trucks. The reality is light trucks represent too large of a percentage of Ontario vehicles, and too great a share of the province's transportation emissions, to avoid incentivizing the switch to electric. Incentivizing the purchase of electric trucks, and all electric vehicles, will help create a robust used vehicle market in the next three to five years, making electric vehicle ownership more accessible to a greater number of Ontarians.

In conjunction with the EHVIP rebate, the provincial government should also introduce a program similar to the SCRAP-IT rebate in British Columbia, which provides a $500 incentive for car buyers trading in their internal combustion vehicle for a new or used EV.

Additionally, incentivizing the adoption of electric vehicles now also spurs demand for greater access to charging infrastructure. Investments in charging infrastructure need to happen as soon as possible, not only to reduce range anxiety and build confidence in the viability of electric vehicles, but also to allow local distribution companies time to identify and upgrade potential deficits in the distribution system.

At the municipal level, multi-unit residential buildings with parking, city-run and privately operated parking lots, and large shopping centres should be required to provide a minimum number of EV charging stations to make EV adoption viable in urban centres. Additionally, the province should work with municipalities to explore the viability of on-street charging stations and leverage the Ontario Energy Board to require local distribution companies to provide on-street charging to meet local demand on a cost-recovery basis.

In cities and suburbs, investment in electrified public transit needs to be a top priority, with a goal to require all-electric buses and commuter rail in public transit networks across Ontario by 2035. This cost burden is not one that policymakers can expect cities to bear. Investments in public transit electrification should been seen as climate action, not transit policy, and as such should be paid for by the provincial and federal governments.

Finally, if as a society we are to collectively invest in transforming the transportation sector to an electric future, we need to ensure our electricity grid remains as clean, or cleaner, than it currently is. That means planning to meet the future demand of electrification by investing in new sources of carbon-free generation, like nuclear, hydroelectric, and renewable energy. The province must ensure that natural gas is never used to provide baseload power and should work to minimize the use of natural gas whenever possible. ■

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