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Assessing Canada's 2025 passenger vehicle greenhouse gas standards: Benefits analysis

Authors: Francisco Posada, Aaron Isenstadt, Ben Sharpe, and John German

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Background

This paper is part of a series that reports on an analysis done by the ICCT of Canada-specific technology pathways, costs, and benefits of Canada's 2025 passenger vehicle greenhouse gas standards, as finalized in 2014 (Regulations Amending the Passenger Automobile and Light Truck Greenhouse Gas Emission Regulations, 2014). The analysis compares the standards presently in force to the alternative of following the Trump Administration's proposal to roll back the 2025 U.S. fuel economy and greenhouse gas emissions standards.

Such a comparison is relevant because Canada's passenger vehicle fuel efficiency regulation is structured in such a way as to tie Canada's standards directly to the U.S. regulation. If Canada maintains its regulatory status quo, its light-duty vehicle (LDV) greenhouse gas standards will automatically retreat to whatever level is the final outcome of the U.S. rulemaking process initiated in August 2018.

The ICCT analysis uses the U.S. Environmental Protection Agency's Optimization Model for Reducing Emissions of Greenhouse Gases from Automobiles (OMEGA) (U.S. Environmental Protection Agency [EPA], National Highway Traffic Safety Administration [NHTSA], and California Air Resources Board [CARB], 2016). The model evaluates the relative costs and effectiveness (CO_2 emission reduction) of vehicle technologies and applies them to a defined baseline vehicle fleet to meet a specified CO_2 emissions target.

For a detailed discussion of the Canadian baseline vehicle fleet defined for this project, a description of the OMEGA model and the inputs to the Canada-specific analysis, and a summary of the projected technology deployment in the Canadian vehicle fleet, with associated per-vehicle costs by car and truck class, see the other papers in this series (Posada, Isenstadt, Sharpe, & German, 2018a, 2018b, 2018c).

Consumer benefits and payback

From the consumer perspective, the inputs analyzed achieve benefits in terms of lower fuel consumption over the lifetime of the vehicle. Under all inputs, the upfront total manufacturing costs of more efficient technologies can be recouped within a few years of typical use, with further benefits accruing in the following years.

To illustrate the cumulative savings, Table 1 lists the costs for each year of ownership associated with buying, owning, and operating the average 2025 Canadian vehicle, as well as the fuel savings associated with the efficiency improvements. These costs and savings were compared to a 2025 vehicle manufactured to meet the 2020 emission standards. The table shows that a typical MY2025 vehicle that complies with the GHG 2025 standards would incur additional costs, but the savings would quickly accumulate and overshadow these costs. The analysis does not contain the effect of additional costs due to a bifurcated market, which are seven to 11 times smaller than annual fuel savings from operating efficient vehicles.

The values in Table 1 reflect a 3% discount rate, reference fuel price, and purchasing the vehicle in cash. Vehicle technology represents the cost of the higher fuel-efficiency technology implemented on the 2025 average vehicle, as compared to a 2025 vehicle meeting 2020 standards. Taxes and insurance are based on sale price,

Table 1. Technology costs, benefits, and payback period for the average MY 2025 vehicle purchased with cash in Canada as compared to GHG 2020 standards. All values in 2015 CAD.

2020 Rollback Scenario	Year of Ownership	Vehicle Technology	Vehicle Taxes	Insurance	Maintenance	Fuel Savings	Cumulative Operational Savings
EPA 2025	1	-1374	-75	-26	-10	542	-943
	2	0	0	-24	-10	499	-477
	3	0	0	-21	-9	455	-53
	4	0	0	-20	-9	436	354
	5	0	0	-19	-9	415	741
	6	0	0	-17	-8	393	1108
	7	0	0	-16	-8	370	1454
	8	0	0	-15	-8	345	1778
ICCT 2025	1	-866	-47	-16	-12	542	-400
	2	0	0	-15	-11	499	73
	3	0	0	-13	-11	455	504
	4	0	0	-13	-10	436	916
	5	0	0	-12	-10	415	1309
	6	0	0	-11	-10	393	1681
	7	0	0	-10	-9	370	2032
	8	0	0	-9	-9	345	2359

as well as depreciation for insurance, and also reflect this difference. Maintenance costs include replacement of tires, oil, filters, coolant, and spark plugs. Cumulative savings simply represent the sum of all costs and fuel savings. Since the standards under review apply only to MY 2021–2025, the costs and savings shown in Table 1 represent the difference between a MY 2025 vehicle that complies with the GHG 2025 standards and one that complies with the GHG 2020 standards. As shown, consumers see net savings in two to four years, assuming cash purchase. Using ICCT analysis, payback arrives between years one and two. Using EPA analysis, payback arrives between years three and four.

Of course, fuel savings continue to grow throughout the lifetime of the vehicle. Table 2 summarizes the lifetime incremental costs and benefits of the standards under EPA and ICCT technology cost assumptions, as well as the three fuel price cases. The results in Table 2 are rounded to two significant digits. Following EPA's calculations, the payback analysis discounts to the midyear point of the first year of ownership, which is why the technology costs are slightly lower than those shown in Posada et al. (2018c) tables 2 and 3.

Table 2. Summary of lifetime costs and benefits of the average MY 2025 Canadian vehicle, assuming a 3% discount rate (unless otherwise noted), when compared to an average vehicle manufactured to GHG 2020 standards. (All values in 2015 CAD and rounded to two significant digits.)

2020 Rollback Scenario	Fuel price assumption	Technology cost	Other costs	Lifetime fuel savings	Net lifetime benefit	Benefit-to-cost ratio
EPA 2025	**Reference**	1400	460	5500	3600	3.0
	Technology	1400	460	5300	3500	2.9
	Higher Carbon Price	1300	460	5300	3500	3.0
	Reference (7%)	1300	370	4300	2600	2.5
ICCT 2025	**Reference**	870	380	5500	4200	4.4
	Technology	850	370	5300	4100	4.4
	Higher Carbon Price	850	370	5300	4100	4.4
	Reference (7%)	850	290	4300	3100	3.7

The "Reference" case shows that the GHG 2025 standards have lifetime benefits that are 3 to 5 times the costs. Under EPA's technology cost inputs, the benefit-to-cost ratio is approximately 3, while under ICCT's technology inputs, the ratio is about 4–5. The low variation in the results is due to the relatively small differences in fuel prices. Even assuming a more conservative 7% discount rate, the benefits outweigh the costs nearly three times over: 3.7, using ICCT inputs, and 2.5, using EPA inputs.

A majority of new vehicles purchased in Canada in 2015 were financed (Financial Consumer Agency of Canada [FCAC], 2016). The average loan term for new-vehicle purchases was more than 72 months in 2015 (FCAC, 2016). Table 3 compares the operational savings—payback amount and time to payback—of MY 2025 vehicles manufactured to GHG 2025 standards and bought with cash or financed to vehicles manufactured according to GHG 2020 standards that were bought with cash or financed. For the purposes of this table, the financing is defined as a 72-month loan at an interest rate of 4.25%. For comparison, Table 3 also includes the cash purchase results presented in Table 1. As with the cash purchase, the 72-month loan assumes a 3% discount rate and Reference Case fuel prices. The vehicle cost columns are the sum of vehicle payments, taxes, and insurance.

Although the owner of a vehicle purchased with a loan experiences higher ownership costs after the first year, the fuel savings are the same. Under typical financing terms in Canada, a new MY 2025 vehicle built to GHG 2025 standards has immediate off-the-lot savings because the fuel savings are larger than the loan payments. The results of sensitivity analyses for low and high fuel prices and a 7% discount rate show the same immediate off-the-lot savings.

Annual fuel savings

Another way to view the benefits of the standards is in terms of the annual fuel costs for the owner of an average new car or average new truck. Since manufacturers have many pathways to comply with the GHG standards, individual car and truck models will beat their particular target while others may not. However, since a manufacturer's fleet needs to meet the standard, on average, it is reasonably accurate to assume that the average car and truck meet their respective targets. Figure 1 illustrates the annual fuel savings a new-vehicle purchaser would enjoy if the standards were maintained in Canada.

Table 3. Consumer payback amounts and time to payback of Canadian MY 2025 vehicles manufactured to GHG 2025 standards and purchased with cash or financed with a 72-month loan compared to vehicles manufactured to GHG 2020 standards. All values in 2015 CAD.

2020 Rollback Scenario	Year of Ownership	Vehicle Cost: Cash	Vehicle Cost: 72-month loan	Maintenance	Fuel Savings	Cumulative Operational Savings: Cash	Cumulative Operational Savings: 72-month loan
EPA 2025	1	-1475	-300	-10	542	-943	232
	2	-24	-279	-10	499	-477	442
	3	-21	-257	-9	455	-53	631
	4	-20	-248	-9	436	354	809
	5	-19	-239	-9	415	741	976
	6	-17	-229	-8	393	1108	1131
	7	-16	-16	-8	370	1454	1477
	8	-15	-15	-8	345	1778	1800
ICCT 2025	1	-929	-189	-12	542	-400	341
	2	-15	-176	-11	499	73	653
	3	-13	-162	-11	455	504	934
	4	-13	-157	-10	436	916	1203
	5	-12	-151	-10	415	1309	1456
	6	-11	-145	-10	393	1681	1694
	7	-10	-10	-9	370	2032	2045
	8	-9	-9	-9	345	2359	2372

Fleet-wide carbon emissions

Fleet-wide CO_2 emission reductions for LDVs that result from particular GHG standards can be assessed applying bottom-up models based on annual average CO_2 emission levels, new vehicle sales, and vehicle activity. With the average car and truck CO_2 emissions, the fleet-wide emissions impact further agglomerates savings across the entire fleet, maintaining the sales and car/truck market split each year.

On a fleet-wide basis, maintaining the 2025 GHG standards leads to 54.1 Mt CO_2 (million tons of CO_2) saved over the lifetime of MY 2021–2025 vehicles. If the standards remain at their 2025 levels through MY 2050, these savings balloon to over 630 Mt over the life of all vehicles sold through MY 2050. Note that showing the full benefits of the regulation requires long-term analysis because the most efficient vehicles manufactured in MY 2025 and onward would not, upon entering the Canadian fleet, immediately displace older and less-efficient models.

The 2025 GHG emissions savings are equivalent to 23.0 billion liters of gasoline over the lifetime of MY 2021–2025 vehicles, and 269 billion liters over the lifetime of MY 2021–2050 vehicles. At fuel prices used in the National Energy Board of Canada's Reference Case, the MY 2021–2025 savings are $34.7 billion CAD.

By 2030, maintaining the 2025 GHG standards leads to annual fuel savings of 4.6 billion liters, or $7.0 billion CAD. This level of savings is equivalent to an annual reduction in CO_2 emissions of 10.7 Mt. These annual savings increase every year as older vehicles are replaced by vehicles that meet GHG 2025 standards. For example, by 2050, when most vehicles in the fleet meet GHG 2025 standards, annual savings reach 10.7 billion liters, $15.8 billion CAD, and 25.1 Mt CO_2, as compared to a fleet that only meets GHG 2020 standards (Figure 2).

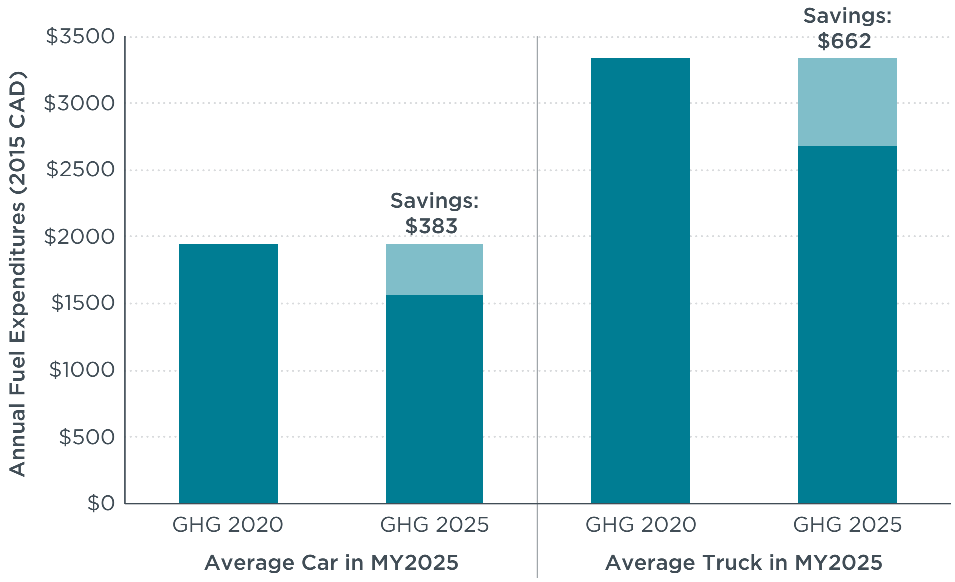

Figure 1. Annual fuel expenditures for the average MY2025 new car and new truck

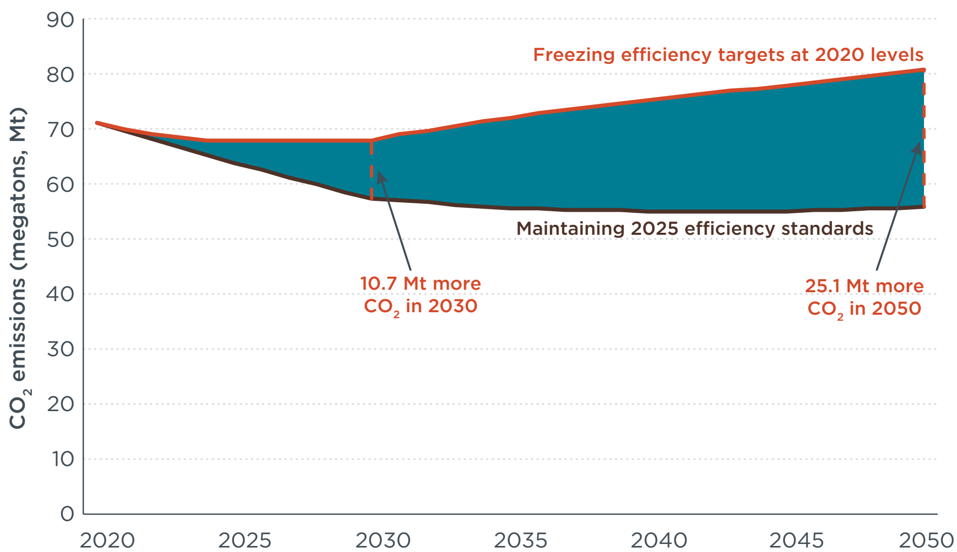

Figure 2. CO_2 emissions from Canada's LDV fleet under scenarios that freeze standards to 2020 levels or maintain the 2025 standards currently in place.

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