Greenhouse Gas Emissions Performance for 2014 to 2020 (Phase 1) Heavy-duty Vehicles and Engines

In relation to the *Heavy-Duty Vehicle and Engine Greenhouse Gas Emission Regulations under the Canadian Environmental Protection Act, 1999*

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List of Acronyms

BHP-hr – Brake Horsepower hour

CO_2 – Carbon dioxide

CO_2e – Carbon dioxide equivalent

CEPA – Canadian Environmental Protection Act, 1999

CH_4 - Methane

CI – Compression Ignition

EPA – Environmental Protection Agency

GHG – Greenhouse Gas

g/mile – grams per-mile

GVWR – Gross Vehicle Weight Rating

GCWR – Gross Combined Weight Rating

HHDE – Heavy Heavy-Duty Engine

HDE – Heavy-Duty Engine

HDV – Heavy-Duty Vehicle

LHDE – Light Heavy-Duty Engine

MHDE – Medium Heavy-Duty Engine

N_2O – Nitrous Oxide

SI – Spark Ignition

WF – Work Factor

Executive summary

The *Heavy-duty Vehicle and Engine Greenhouse Gas Emission Regulation*[1] (Regulations) under the *Canadian Environmental Protection Act, 1999*[2] established greenhouse gas emission standards for new 2014 and later model years of heavy-duty on-road vehicles and engines offered for sale in Canada. These Regulations require importers and manufacturers of new vehicles to meet emission standards for greenhouse gases and establish annual compliance reporting requirements.

This report summarizes the fleet average greenhouse gas emission performance of the 2014 – 2020 (Phase 1) model year heavy-duty vehicles and engines. This is based on the compliance data submitted to Environment and Climate Change Canada through end-of-model-year reports pursuant to the Regulations. Each manufacturer's fleet is unique, therefore, the data presented in this report provides aggregated values for three separate categories for each model year: class 2B and 3 (non-vocational), Tractors and Vocational Vehicles, and Heavy-Duty Engines. The data depicts the fleet average CO_2 performance value, the fleet average standard as well as the fleet average credit summary. This is the second such report. The first report covered the 2014-2018 model years and can be found here (link).

Note that the Regulations were amended in 2018 to introduce more stringent greenhouse gas emission standards that begin with the 2021 (Phase 2) model year for on-road heavy-duty vehicles and engines. These Phase 2 model years are not included in this report and will be published in the future.

Overall, based on the reported data required by the regulation, the Canadian heavy-duty vehicle fleet outperforms the applicable standard for almost all Phase 1 model years. The fleet performance for class 2B and 3 (non-vocational) heavy-duty vehicles shows a fleet average CO_2 emissions decrease of 10.85% from 2014 to 2020. The fleet performance in model years 2019 and 2020 was also lower than the applicable standard for both model years. For vocational vehicles and tractors, the overall compliance values consistently outperformed the standards for all classes of vehicles for all Phase 1 model years. From 2014 to 2020, emissions decreased 4.71% for class 2B to 5 vocational vehicles, 4.93% for class 6 & 7 vehicles and 13.6% for class 8 vehicles. For heavy-duty engines, all three compression-ignition averaging sets consistently outperformed the standard for all model years in Phase 1. Engine emissions decreased 5.93% for light heavy-duty compression-ignition engines, 5.41% for medium heavy-duty compression-ignition engines, and 5.65% heavy heavy-duty compression-ignition engines for the model years of 2014 to 2020. Companies have generated approximately 10.7 million Mega-grams of CO_2 emissions credits over the 2014 -2020 model years, of which 7.3 million remain available for future use under Phase 2. All companies' credit balances were in compliance with the Regulations in Phase 1.

The objective of the Regulations was to reduce greenhouse gas emissions by establishing mandatory emission standards for new on-road heavy-duty vehicles and engines that are aligned with U.S. national standards. The development of common standards led manufacturers to produce more advanced vehicles. Note that the technologies intended to be adopted by manufacturers in response to Phase 1 of the Regulations were engine improvements, more use of low rolling resistance tires, mass reduction, improved aerodynamics, increased use of auxiliary power units, reduced air conditioning leakage, improved transmissions, and reduced accessory loads.

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[1] https://pollution-waste.canada.ca/environmental-protection-registry/regulations/view?Id=119

[2] https://www.canada.ca/en/environment-climate-change/services/canadian-environmental-protection-act-registry/publications/canadian-environmental-protection-act-1999.html

1. Purpose of this report

This is the second report summarizing the overall average greenhouse gas emission performance for the new Canadian fleets of on-road heavy-duty vehicles and engines. This report is based on the compliance data within the 2014 through 2020 end of model year reports submitted to Environment and Climate Change Canada pursuant to the *Heavy-duty Vehicle and Engine Greenhouse Gas Emission Regulations* (Regulations). The first report covered the 2014-2018 model years and can be found here (link). This report encompasses all model years covered under what is considered "Phase 1" of the Regulations in other words model years 2014-2020.

Under these Regulations, companies must submit an end of model year report for all heavy-duty vehicles and heavy-duty engines that are imported or manufactured in Canada, by June 30th of the calendar year following the calendar year corresponding to the model year in question to demonstrate compliance to the Regulations. Therefore, this second report considers all end of model year reports submitted before June 30th of 2021.

Note that the Regulations were amended in 2018 to introduce more stringent greenhouse gas emission standards that begin with the 2021 (Phase 2) model year for on-road heavy-duty vehicles and engines. These Phase 2 model years are not included in this report and will be published in the future.

2. Overview of the Regulations

In March 2013, the Government of Canada published *the Heavy-duty Vehicle and Engine Greenhouse Gas Emission Regulations* (Regulations) under the *Canadian Environmental Protection Act, 1999* (CEPA). The objective of the Regulations was to reduce emissions by establishing mandatory emission standards for new on-road heavy-duty vehicles and engines that are aligned with U.S. national standards. The development of aligned standards was intended to lead manufacturers to produce more advanced vehicles. The Regulations establish progressively more stringent GHG emission standards that apply to Canadian companies which manufacture or import new on-road heavy-duty vehicles and engines for sale in Canada beginning with the 2014 model year. The Regulations apply to the entire spectrum of on-road heavy-duty vehicles, ranging from full-size pick-up trucks and vans to transport tractors manufactured primarily for hauling trailers, including a wide variety of specialized (vocational) vehicles, such as school, transit and intercity buses, as well as freight, delivery, service, cement, refuse and dump trucks

The Regulations establish emission standards for three distinct categories of vehicles and engines. Such is elaborated in the subsections below. These include:

1. Class 2B and 3 (non-vocational) Heavy-duty Vehicles

2. Tractors (Class 7 and 8) and Vocational Vehicles (includes Class 2B and 3 as well as Classes 4 through 8)

3. Heavy-Duty Engines that power vocational vehicles and tractors:

   a) Compression ignition heavy-heavy duty engines
   b) Compression ignition medium-heavy duty engines
   c) Compression ignition light-heavy duty engines
   d) Spark ignition heavy-duty engines

These Regulations also include an emissions credit mechanism whereby companies may earn credits or offset emission deficits based on whether their vehicles or engines are below or above the applicable standard. More details regarding the credit averaging system can be found in section 5 of this report[3].

2.1 Class 2B and 3 (non-vocational) Heavy-duty Vehicles

Class 2B and 3 (non-vocational) vehicles include heavy-duty pickup trucks and vans, with a GVWR of more than 8,500 to 14,000 lbs. (3,856 to 6,350 kg). This includes most pickup trucks and vans that are not subject to the *Passenger Automobile and Light Truck Greenhouse Gas Emission Regulations[4]*.

The regulatory CO_2 emission standard represents the volume weighted average CO_2 fleet target value for a particular model year. A CO_2 target value is determined on the basis of each individual vehicle sub-configuration which in turn is determined by a work factor (WF[5]). The WF is determined by the payload, towing and four-wheel drive capabilities of the vehicles and provides the flexibility for vehicles with larger payloads and larger towing capacities to meet a proportionally adjusted GHG standard. The emission targets are based on the specific vehicle's engine type; compression ignition (CI) or spark ignition (SI) as shown below in **Table 1**. The target value equation becomes more stringent with each model year as illustrated in **Figure: 1**, however since the average fleet CO_2 standard is calculated using the work factor for each vehicle, the applicable fleet standard can vary between model years.

Table 1: Class 2B and 3 (non-vocational) CO_2 emission target value calculations

Model Year	Spark ignition CO_2 emission target (grams of CO_2/ mile)	Compression ignition CO_2 emission target (grams of CO_2/ mile)
2014	$(0.0482 \times WF) + 371$	$(0.0478 \times WF) + 368$
2015	$(0.0479 \times WF) + 369$	$(0.0474 \times WF) + 366$
2016	$(0.0469 \times WF) + 362$	$(0.0460 \times WF) + 354$
2017	$(0.0460 \times WF) + 354$	$(0.0445 \times WF) + 343$
2018 - 2020	$(0.0440 \times WF) + 339$	$(0.0416 \times WF) + 320$

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[3] Section 2 and 4 of this report contain an overview of the regulatory standards and credit provisions. Readers may wish to consult the Regulations and supporting guidance document for a complete description of the Regulatory standards and credit provisions.

[4] https://pollution-waste.canada.ca/environmental-protection-registry/regulations/view?Id=104

[5] The formula to calculate the WF is described in s.22(3) of the *Heavy-duty Vehicle and Engine Greenhouse Gas Emission Regulations*

Figure: 1 CO$_2$ Emission target by work factor under phase 1 of the HDV GHG regulations
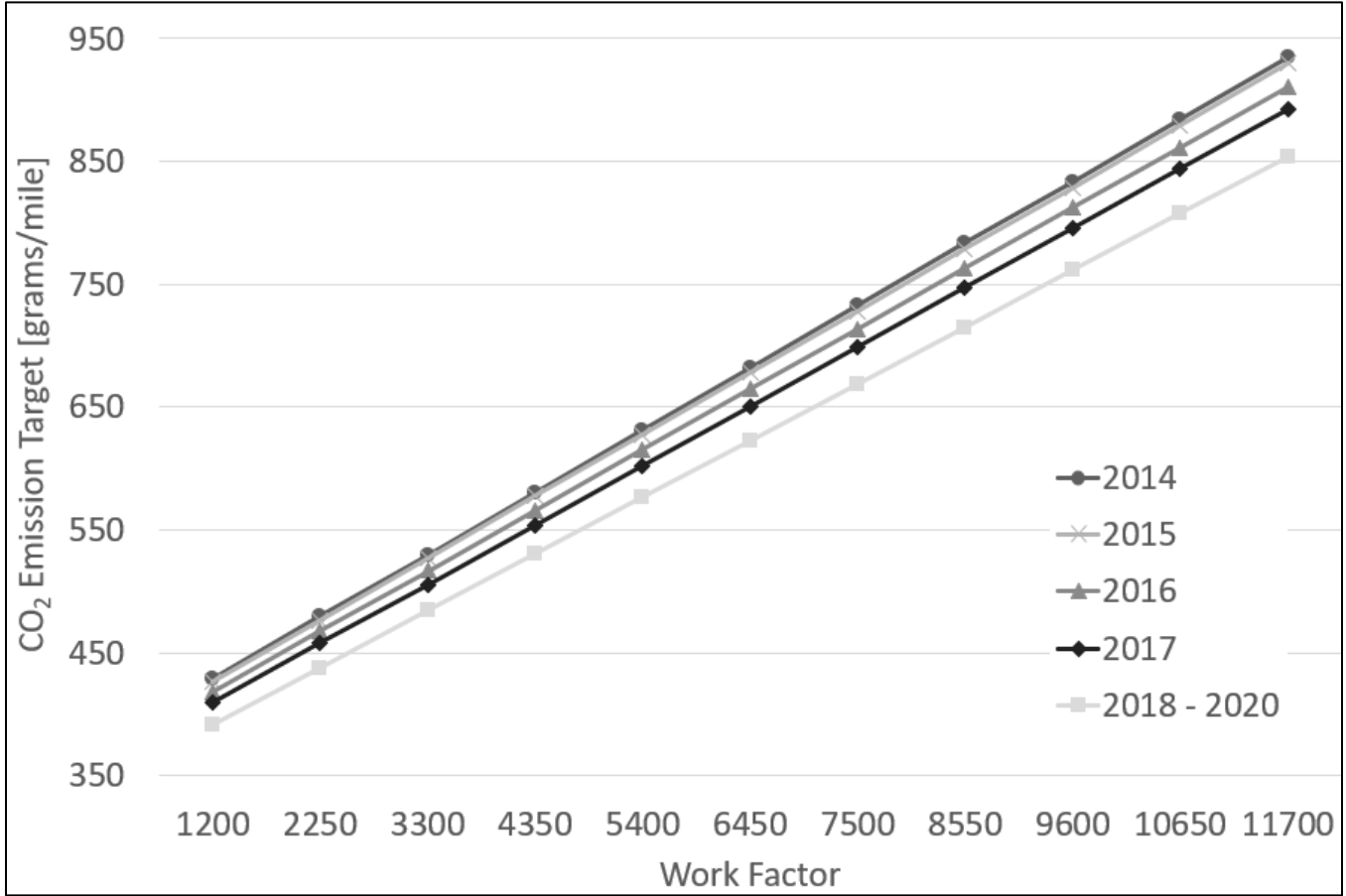
2.2   Vocational Vehicles and Tractors

Vehicles captured under this section include vocational vehicles and tractors. Vocational vehicles are Class 2B to Class 8 heavy-duty vehicles such as firetrucks, buses and delivery trucks whilst tractors include class 7 medium heavy-duty trucks and class 8 heavy-duty trucks that are designed to haul a trailer. For the purposes of emission standards, tractors are further subdivided into day cab or a sleeper cab, as well as low, mid and high roof. The CO$_2$ emission standards for vocational vehicles and tractors are shown in **Table *2*** and **Table *3*** below. For the purposes of fleet average CO$_2$ values and reporting of fleet emission performance, vocational vehicles and tractors are grouped into three averaging sets based on vehicle weight class (Class 2B through 5, Class 6 and 7, and Class 8). This is due to the requirements of the fleet averaging credit system which is explained in Section 4 below. Engines designed for use in these vehicles must also meet separate engine-based standards. These are described in sub-section 2.3.

Table 2: CO₂ emission standards for vocational vehicles

Class of vocational vehicle	CO₂ emission standard (grams of CO_2 per short ton-mile)	
	MY 2014 to 2016	MY 2017 to 2020
Class 2B, Class 3, Class 4 and Class 5	388	373
Class 6 and Class 7	234	225
Class 8	226	222

Table 3: CO₂ emission standards for tractors

Class of Tractor	CO₂ emission standard (grams of CO_2 per short ton-mile)	
	MY 2014 to 2016	MY 2017 to 2020
Class 7 low-roof tractors	107	104
Class 7 mid-roof tractors	119	115
Class 7 high-roof tractors	124	120
Class 8 low-roof day cab tractors	81	80
Class 8 low-roof sleeper cab tractors	68	66
Class 8 mid-roof day cab tractors	88	86
Class 8 mid-roof sleeper cab tractors	76	73
Class 8 high-roof day cab tractors	92	89
Class 8 high-roof sleeper cab	75	72

2.3   Heavy-Duty Engines

Heavy-duty engines include those engines which are installed in tractors or vocational vehicles. They are classified by application (for example vehicle size and type of vehicle containing the engine) and fuel type (including compression ignition which are typically diesel fueled or spark ignition (usually fuelled by gasoline). The emissions from these engines are regulated separately from those of the vehicles they power.

Beginning in 2016, all spark ignition heavy-duty engines must meet the standard of 627 grams of CO₂ per brake horsepower-hour [6] (g / BHP-hr). The stringency of the standards for compression ignition engines are based on engine type (including light-, medium- or heavy) and application (for example vocational or tractor). The standards presented in **Table 4** below increased in stringency after the 2016 model year.

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[6] Brake Horsepower or BHP means a unit of brake power that is equal to 745.7 watts, expressed in horsepower

Table 4: Heavy-duty compression ignition engine CO$_2$ emission standards

Engine Type	CO$_2$ emission standard (BHP-hr)	
	MY 2014 to 2016 MY	**MY 2017 to 2020**
LHDE for Vocational Vehicles	600	576
MHDE for Vocational Vehicles	600	576
HHDE for Vocational Vehicles	567	555
MHDE for Tractors	502	487
HHDE for Tractors	475	460

3. Annual Reporting

Under the Regulations, companies are required to submit an annual end of model year report that is used to assess compliance to the applicable standard for its fleets of Class 2B and 3 (non-vocational) vehicles, heavy-duty engines, and tractors and vocational vehicles. Companies with a fleet average below the standard accrue emission credits that can be used to offset an emissions deficit, or traded, to achieve compliance to the Regulations. Companies with a fleet average exceeding the standards accrue an emissions deficit that must be offset within three model years.

3.1 Reported Products

Companies submitted a report pursuant to the Regulations for each of the model years covered in this document. The compliance reports from the top five manufacturers and importers within each sector (including class 2B and 3 (non-vocational), tractors, vocational vehicles and heavy-duty engines) represented the vast majority of vehicles and engines reported within each category. For example, in the case of Class 2B and 3 (non-vocational), five companies represented over 99% of their class's respective imported into and/or manufactured total units in Canada. In the case of vocational vehicles and tractors and their engines, five companies represented 86% and 100% respectively for model years 2019 and 2020.

The majority of vehicles reported between 2019 and 2020 model years were class 2B and 3 pickup trucks and vans (non- vocational) at an average of 108,000 annually. As well, approximately 60,000 vocational vehicles and tractors were reported per model year. On average, 39,000 engines were reported per model year. Performance results are presented at the fleet level based on data obtained from annual compliance reports submitted by companies to ECCC pursuant to the Regulations. The data presented below are based on aggregated values for all companies and are intended to depict the overall average year over year performance for Class 2B and 3 (non-vocational) vehicles, tractors and vocational vehicles, and heavy-duty engines over the 2014 to 2020 model years. It should be noted that each company's fleet is unique; ECCC evaluates individual submissions to assess each company's compliance with the regulatory standards. Nonetheless, the results are presented as an average of the standard value by classes at the fleet level for each of the categories. This provides a measure of the overall trend of the fleet average CO$_2$ value and the fleet average standard for each category. For a full description of the fleet average performance and percentage reduction in each category, see Appendix I.

3.2 Average GHG Emissions Performance – Class 2B and 3 Heavy-duty Vehicles

The fleet average CO_2 emissions are shown in **Figure: 2** below along with the fleet average standard for model years 2014 through 2020. During this period, the fleet average CO_2 values decreased from 568 to 528 grams of CO_2 per mile while the overall fleet standard decreased in stringency (dashed line) from 614to 584 grams of CO_2 per mile. Overall, the fleet average CO_2 emissions decreased by 5.3% from the 2014 to 2020 model years.

Figure: 2 Class 2B and 3 (non-vocational) fleet performance and dtandards under phase 1 of the HDV GHG regulations
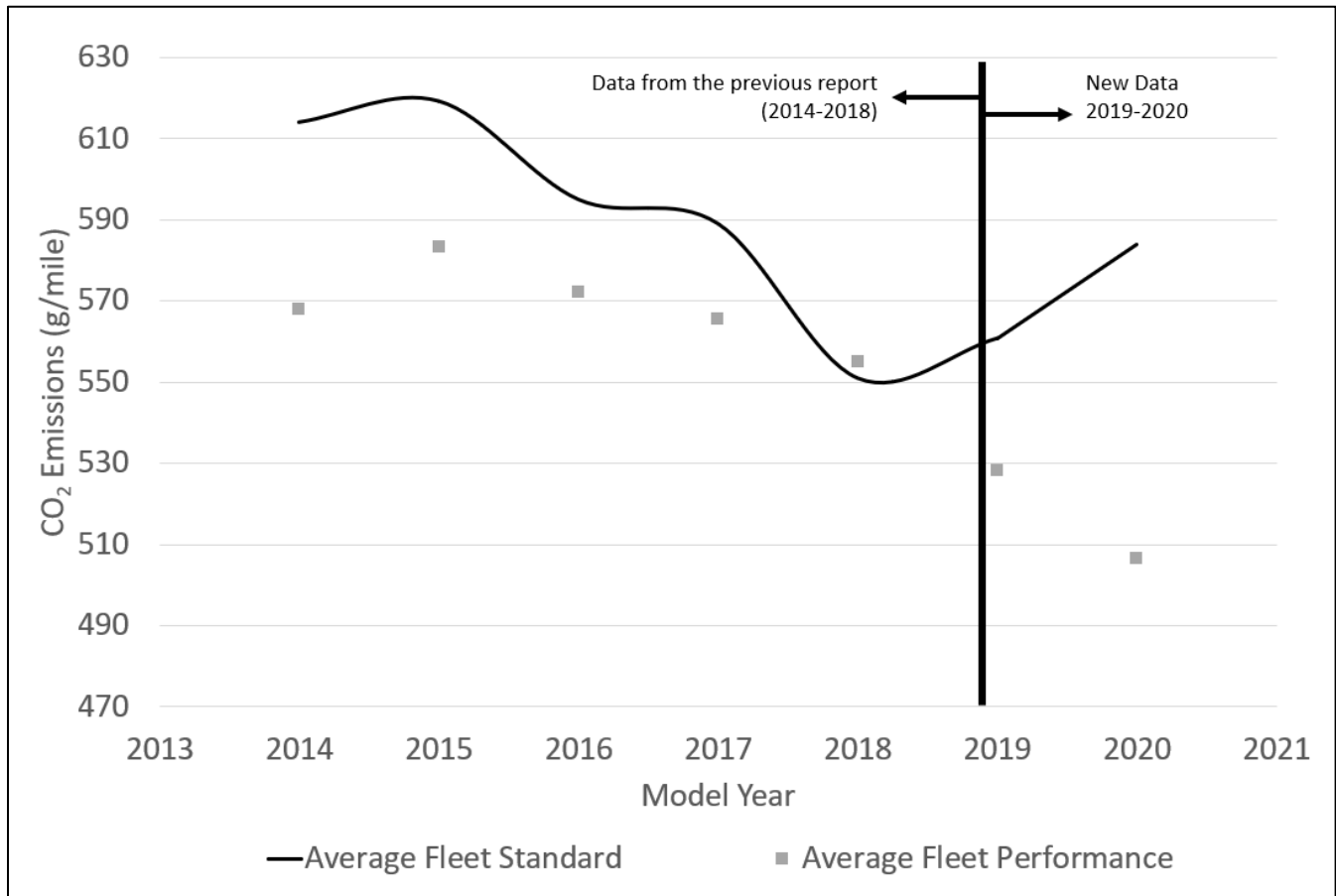
3.3 Average GHG Emissions Performance – Vocational Vehicles and Tractors

The requirements of the fleet averaging credit system influence how vehicles and engines are reported when evaluating the fleet performance of vocational vehicles and tractors. These products are divided into three averaging sets based on vehicle weight class as seen in **Figure: 3** and further described in **Table 5** below. The emission credit system is further explained in Section 4 of this report.

For all the various averaging sets, there is one applicable standard for the 2014 – 2020 model year and a more stringent standard beginning for the 2017 model year. For class 2B through 5 vocational vehicles, the fleet average CO_2 performance value is the average of all vehicles reported, including those from companies who

opted out of credit averaging. The fleet average CO_2 performance value is consistently just below the standard. From the 2014 model year through the 2020 model year, the fleet average CO_2 performance values decreased from 386 to 368 grams per short-ton-mile.

The Class 6 and 7 vocational vehicles and tractors averaging set comprise a number of subcategories with different standards. Therefore, the fleet average CO_2 standard can also vary from year to year depending on the sales mix in a given year. From 2014 to 2020 the fleet average CO_2 performance values decreased from 231 to 220 grams per short-ton-mile.

The Class 8 vocational vehicles and tractors averaging set also contain a number of subcategories with different standards creating a possible average fleet standard variance from year to year. From the 2014 through 2020 model years, the fleet average CO_2 performance values are also just below the average standard. From 2014 to 2020 the fleet average CO_2 values have decreased from 189 to 143 grams per short-ton mile.

Figure: 3 Vocational vehicle and tractor fleet performance and standards under phase 1 of the HDV GHG regulations
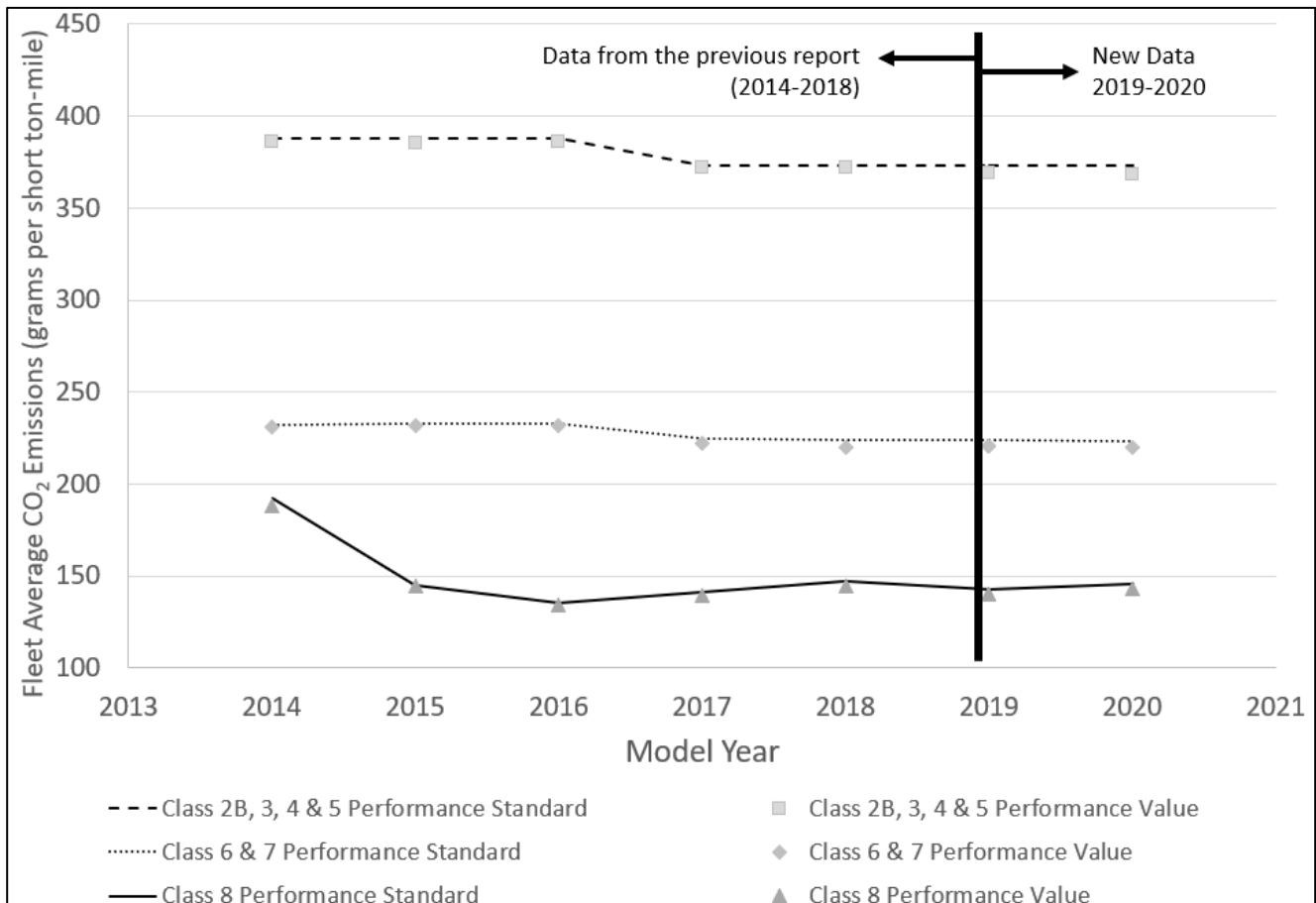
3.4 Average GHG Emissions Performance – Heavy-duty Engines

The fleet performance of heavy-duty engines is divided into four averaging sets as shown in **Figure: 4** below and further described in **Table 5**.

For the heavy heavy-duty compression ignition averaging set, the average fleet emissions are consistently below the average standard for all model years. From the 2014 through the 2020 model year the average CO_2 performance values have decreased from 500 to 472 grams per BHP-hr.

For the light heavy-duty compression ignition averaging set, the average fleet emissions are below the average standard for all model years. From the 2014 through the 2020 model year the average CO_2 performance values have decreased from 588 to 552 grams per BHP-hr.

For the medium heavy-duty compression ignition averaging set, the average fleet emissions are below the average standard for all model years. From the 2014 through the 2020 model year the average CO_2 performance values have decreased from 566 to 536 grams per BHP-hr.

The spark ignition heavy-duty engine performance values have matched the standard of 627 grams per BHP-hr from the 2016 through the 2020 model years.

Figure: 4 Engine fleet performance and standards under phase 1 of the HDV GHG regulations
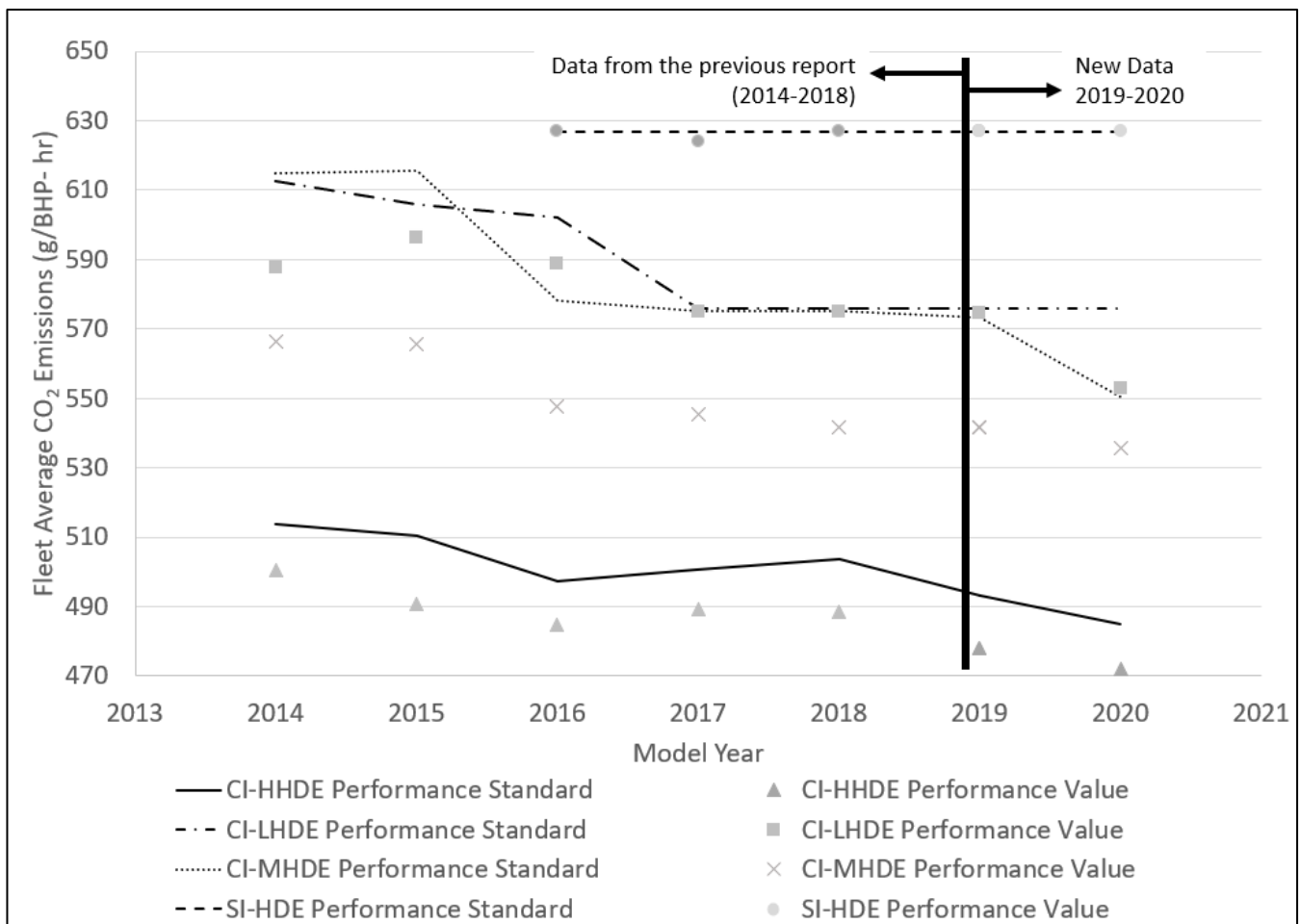
4. CO₂ Emission Credit System

The Regulations include a system of emission credits to help meet overall environmental objectives in a manner that provides the regulated industry with compliance flexibility. The system allows companies to generate, bank and trade emission credits. Under this system, companies may elect to manufacture or import a mix of vehicles and engines whose performance may be less or more stringent than the CO_2 emission standards, provided that their average fleet emission level does not exceed the applicable emission standard.

Depending on the characteristics of the fleet, compliance using fleet averaging may or may not be required. For the purpose of a company's participation in the CO_2 emission credit system, a company can group vehicles or engines into fleets which are set out in the Regulations and can be seen in **Table 5**.

Table 5: Summary table of averaging sets and fleets for credit averaging purposes

Averaging sets (pursuant to subsection 1(1) of the Regulations)	Fleets* (pursuant to section 18 of the Regulations)
Class 2B and Class 3 heavy-duty vehicles and cab-complete vehicles	Class 2B and Class 3 heavy-duty vehicles and cab-complete vehicles
Class 2B, Class 3, Class 4 and Class 5 vocational vehicles	Class 2B, Class 3, Class 4 and Class 5 vocational vehicles
Class 6 and Class 7 heavy-duty vehicles	Class 6 and Class 7 vocational vehicles
	Class 7 low-roof tractors
	Class 7 mid-roof tractors
	Class 7 high-roof tractors
Class 8 heavy-duty vehicles	Class 8 vocational vehicles
	Class 8 low-roof day cab tractors
	Class 8 low-roof sleeper cab tractors
	Class 8 mid-roof day cab tractors
	Class 8 mid-roof sleeper cab tractors
	Class 8 high-roof day cab tractors
	Class 8 high-roof sleeper cab
Heavy-duty spark-ignition engines	Heavy-duty spark-ignition engines
Light heavy-duty engines that are compression-ignition	Light heavy-duty engines that are compression-ignition engines and designed to be used in vocational vehicles
Medium heavy-duty engines that are compression-ignition engines	Medium heavy-duty engines that are compression-ignition engines and designed to be used in vocational vehicles
	Medium heavy-duty engines that are compression-ignition engines and designed to be used in tractors
Heavy heavy-duty engines that are compression-ignition engines	Heavy heavy-duty engines that are compression-ignition engines and designed to be used in vocational vehicles
	Heavy heavy-duty engines that are compression-ignition engines and designed to be used in tractors

*All fleets have an applicable corresponding standard value

For class 2B and 3 (non-vocational) vehicles, fleet averaging is always required for CO_2 emissions. Therefore, net credits are calculated for a company's entire 2B and 3 fleet in a single averaging set. Deficits for N_2O and CH_4 levels above 0.05 g/mile are calculated and added to CO_2 credit balances. For other vehicle classes, such as tractors and vocational vehicles, fleet averaging is only required if one or more of the vehicles exceed the emission standards. In addition, for tractors and vocational vehicles, credit averaging is optional for companies where every vehicle in the fleet meets the applicable standard. For this group, credits are categorized into three averaging sets based on vehicle weight class (Class 2B through 5, Class 6 and 7, and Class 8), and cannot be transferred between these averaging sets. For engines, credits are split into four averaging sets based on engine classification (SI, CI-light heavy-duty, CI-medium heavy-duty, CI-heavy heavy duty). Credits are not transferable between the averaging sets and companies where every engine in the fleet meets the standards are not required to adhere to the CO_2 emission credit system.

The ability to earn and bank credits, including early credits, is an important aspect of the Regulations. It is intended to give manufacturers planning flexibility to meet the increasingly more stringent emission standards for subsequent model years. The credits represent the emission reductions that manufacturers have achieved in excess of those required by the regulatory standards. The ability to accumulate credits allows manufacturers to implement an orderly and predictable phase-in of emissions control technology. Credits obtained for an averaging set of heavy-duty vehicles or heavy-duty engines of a given model year may be used for that averaging set up to five model years following the model year for which the credits were obtained, after which the credits are no longer valid and expire.

Because each manufacturer's fleet is unique, the data presented in this section are also based on the aggregated values for all companies and are intended to depict the average results.

Table *6* and **Table 7** below illustrate the net credits earned each model year for heavy-duty vehicles and heavy-duty engines. Heavy-duty vehicles include class 2B and 3 (non-vocational) vehicles, class 2B through 5 vocational vehicles, class 6 to 7 vocational vehicles, and class 8 tractors. The heavy-duty engines are separated into light heavy-duty engines intended for use in class 2B through 5 vehicles, medium heavy-duty engines intended for class 6 and 7 tractors, and heavy heavy-duty engines intended for class 8 tractors.

For the 2019 and 2020 model years, companies have generated approximately 3 million Mg of CO_2 emissions credits and 10.7 million credits since 2014. There are currently 7.3 million Mg of CO_2 credits available to offset deficits for the 2021 model year.

Table 6: Yearly net credits earned for heavy-duty vehicle averaging sets (Mega grams of CO_2)

Model Year	Class 2B & 3 Heavy-Duty Non-Vocational Vehicles	Class 2B to 5 Heavy-Duty Vocational Vehicles	Class 6 & 7 Heavy-duty Vehicles	Class 8 Heavy-duty Vehicles
2014	336,776	6,106	2,693	43,691
2015	408,827	8,954	4,943	141,208
2016	246,584	6,649	7,881	286,626
2017	310,747	2,780	10,724	169,614
2018	-64,020	1,395	16,100	243,182
2019	103,000	10,820	17,885	347,615
2020	465,169	7,194	26,668	501,030

Table 7: Yearly net credits earned for heavy-duty engine averaging sets (Mega grams of CO_2)

Model Year	CI - LHDE (Cl 2b-5)	CI - MHDE (Cl 6-7)	CI - HHDE (Cl 8)	SI-HDE
2014	17,153	244,618	1,070,897	NA
2015	14,451	303,087	917,542	NA
2016	21,394	144,749	504,936	0
2017	835	348,835	722,318	0
2018	873	245,537	898,155	0
2019	2,090	131,200	720,239	0
2020	22,152	94,849	615,897	0

5. Overall Industry Credit Performance

The results from the 2014 to 2020 model year regulatory reports indicate that the average emission rate of the Canadian fleet is below the average standard for all three sub-categories of heavy-duty vehicles (class 2B and 3, vocational vehicles and tractors, and heavy-duty engines).

The credit accumulation rate has generally increased from the 2019 to the 2020 model year compared to the 2018 model year.

Under Phase 1, companies have generated approximately 10.7 million Mg of CO_2 emissions credits over the 2014 through 2020 model years, of which 7.3 Mg of CO_2 emissions credits remain available for future use under Phase 2 model years. All companies' credit balances were in compliance with the Regulations in Phase 1.

The objective of the Regulations was to reduce greenhouse gas emissions by establishing mandatory emission standards for new on-road heavy-duty vehicles and engines that are aligned with U.S. national standards. The development of common standards led manufacturers to produce more advanced vehicles, which enhanced their competitiveness. Note that the technologies intended to be adopted by manufacturers in response to Phase 1 of the Regulations were engine improvements, more use of low rolling resistance tires, mass reduction, improved aerodynamics, increased use of auxiliary power units, reduced air conditioning leakage, improved transmissions, and reduced accessory loads.

Appendix I: Summary Tables of Fleet Performance for Heavy-Duty Vehicles and Engines

Model Year	Class 2B & 3 Non-vocational Heavy-duty Vehicles			Class 2B to 5 Heavy-duty Vehicles			Class 6&7 Heavy-duty Vehicles			Class 8 Heavy-duty Vehicles		
	Standard	Value	% wrt Standard	Standard	Value	% wrt Standard	Standard	Value	% wrt Standard	Standard	Value	% wrt Standard
2014	614.03	568.06	-7.49	388	386.19	-0.47	231.86	231.02	-0.36	166.29	165.20	-0.66
2015	619.24	583.23	-5.82	388	385.65	-0.60	232.95	231.81	-0.49	145.19	144.40	-0.54
2016	594.98	572.20	-3.83	388	385.76	-0.58	232.98	231.47	-0.65	135.68	133.89	-1.32
2017	589.00	565.55	-3.98	373	371.79	-0.33	224.71	222.28	-1.08	141.35	139.21	-1.51
2018	550.90	555.14	0.77	373	372.06	-0.25	224.17	220.19	-1.77	147.19	144.74	-1.67
2019	560.76	528.23	-5.80	373	369.11	-1.04	224.20	220.64	-1.59	142.76	140.16	-1.82
2020	583.95	506.42	-13.28	373	368.01	-1.34	223.27	219.62	-1.63	145.81	143.45	-1.62
Total Fleet Average Reduction MY 2014 through MY 2020(%)	**10.85**			**4.71**			**4.93**			**13.16**		

Model Year	CI - LHDE (Cl 2b-5)			CI - MHDE (Cl 6-7)			CI - HHDE (Cl 8)			SI-HDE		
	Standard	Value	% wrt Standard	Standard	Value	% wrt Standard	Standard	Value	% wrt Standard	Standard	Value	% wrt Standard
2014	612.60	587.60	-4.08	614.78	566.20	-7.90	513.82	500.38	-2.61	N/A	N/A	N/A
2015	605.92	596.14	-1.61	615.57	565.64	-8.11	510.46	490.62	-3.89	N/A	N/A	N/A
2016	602.09	588.93	-2.19	578.03	547.53	-5.28	497.19	484.67	-2.52	627.00	627.00	0.00
2017	576.00	575.00	-0.17	575.29	545.27	-5.22	500.70	489.44	-2.25	627.00	627.00	0.00
2018	576.00	575.00	-0.17	575.33	541.71	-5.84	503.71	488.50	-3.02	627.00	627.00	0.00
2019	576.00	574.60	-0.24	573.48	541.84	-5.52	493.34	478.07	-3.10	627.00	627.00	627.00
2020	576.00	552.77	-4.03	550.60	535.56	-2.73	484.96	472.12	-2.65	627.00	627.00	627.00
Total Fleet Average Reduction MY 2014 through MY 2020 (%)	5.93			5.41			5.65			0.00		

Appendix II: Summary Table of Credit Balances of Heavy-Duty Vehicles and Engines Remaining after 2020

Vehicle and Engine Averaging Set	Heavy-Duty Vehicles Averaging Sets				Heavy-Duty Engines Averaging Sets		
	Class 2B and Class 3 (Non-Vocational)	Class 2B, 3, 4 and 5 (Vocational)	Class 6 and 7 (Vocational)	Class 8 (Non Vocational)	CI - LHDE (Cl 2b-5)	CI - MHDE (Cl 6-7)	CI - HHDE (Cl 8)
Mega-grams of CO_2	1,125,500	43,899	79,257	1,548,066	47,344	965,170	3,461,545