

Greenhouse Gas Emissions Performance for 2021 to 2023 (Phase 2) 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
CO₂ – Carbon dioxide
CO₂e – Carbon dioxide equivalent
CEPA – Canadian Environmental Protection Act, 1999
CH₄ - 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
N₂O – Nitrous Oxide
SI – Spark Ignition
WF – Work Factor

Executive summary

The *Heavy-duty Vehicle and Engine Greenhouse Gas Emission Regulations*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 heavy-duty vehicles and engines to meet increasingly stringent greenhouse gas emission standards and submit annual compliance reports.

These Regulations were amended in 2018 to introduce more stringent greenhouse gas emission standards beginning with the 2021 model year (Phase 2) for on-road heavy-duty vehicles and engines. This report summarizes the fleet average greenhouse gas emission performance of the 2021 – 2023 (Phase 2) model year heavy-duty vehicles and engines using 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 CO₂ performance value, the fleet average standard as well as the fleet average credit summary. This is the third such report. The first two reports covered the 2014-2020 model years and can be found [here](#) and [here](#).

Overall, based on the reported data required by the regulations, the Canadian heavy-duty vehicle fleet outperforms the applicable standard for almost all Phase 2 model years. The fleet performance for class 2B and 3 (non-vocational) heavy-duty vehicles shows a fleet average CO₂ emissions decrease of 9.26% from 2021 to 2023 model years. The fleet performance in model years 2021 to 2023 was also lower than the applicable standard for all model years. For vocational vehicles and tractors, the overall compliance values outperformed the standards for all classes of vehicles for one of the Phase 2 model years. From 2021 to 2023, emissions remained unchanged for class 2B to 5 vocational vehicles but decreased by 0.81% for class 6 & 7 vehicles and 9.25% for class 8 vehicles. Engine emissions decreased 2.78% for light heavy-duty compression-ignition engines, 1.89% for medium heavy-duty compression-ignition engines, and 3.12% heavy heavy-duty compression-ignition engines for the model years of 2021 to 2023. For the 2021 and 2023 model years, companies generated approximately 5 million Mg of net CO₂ emissions credits and 15.7 million credits since 2014. There are currently 8.0 million Mg of CO₂ credits available to offset deficits that may be incurred in future model years.

The objective of the Regulations is 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 introduction of these Phase 2 standards has led manufacturers to produce increasingly advanced vehicles that make use of innovations to improve engine efficiency and incorporate advanced technologies such as low rolling resistance tires, mass reductions, improved aerodynamics, increased use of auxiliary power units, reduced air conditioning leakage, improved transmissions, and reduced accessory loads. In addition, the number of zero-emission vehicles (ZEV) increased substantially from 2021 to 2023. ZEV penetration rose from 0.07% of the overall fleet to 2.6%.

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 third 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 2021 through 2023 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 two reports covered the 2014-2020 (Phase 1) model years and can be found [here](#) and [here](#).

Under these Regulations, companies must submit an end of model year report, no later than June 30th of the calendar year following a given model year, for all heavy-duty vehicles and heavy-duty engines that are imported or manufactured in Canada. This report covers the first three model years of what is considered “Phase 2” of the Regulations, specifically model years 2021-2023.

Note that the Regulations were amended in 2018 to introduce more stringent greenhouse gas emission standards beginning with the 2021 (Phase 2) model year for on-road heavy-duty vehicles and engines.

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.

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 report³.

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 CO₂ emission standard represents the volume weighted average CO₂ fleet target value for a particular model year. A CO₂ target value is determined on the basis of each individual vehicle sub-configuration which in turn is determined by a work factor (WF⁵). 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 CO₂ standard is calculated using the work factor for each vehicle, the applicable fleet standard can vary between model years based on fleet sales.

Table 1: Class 2B and 3 (non-vocational) CO₂ emission target value calculations

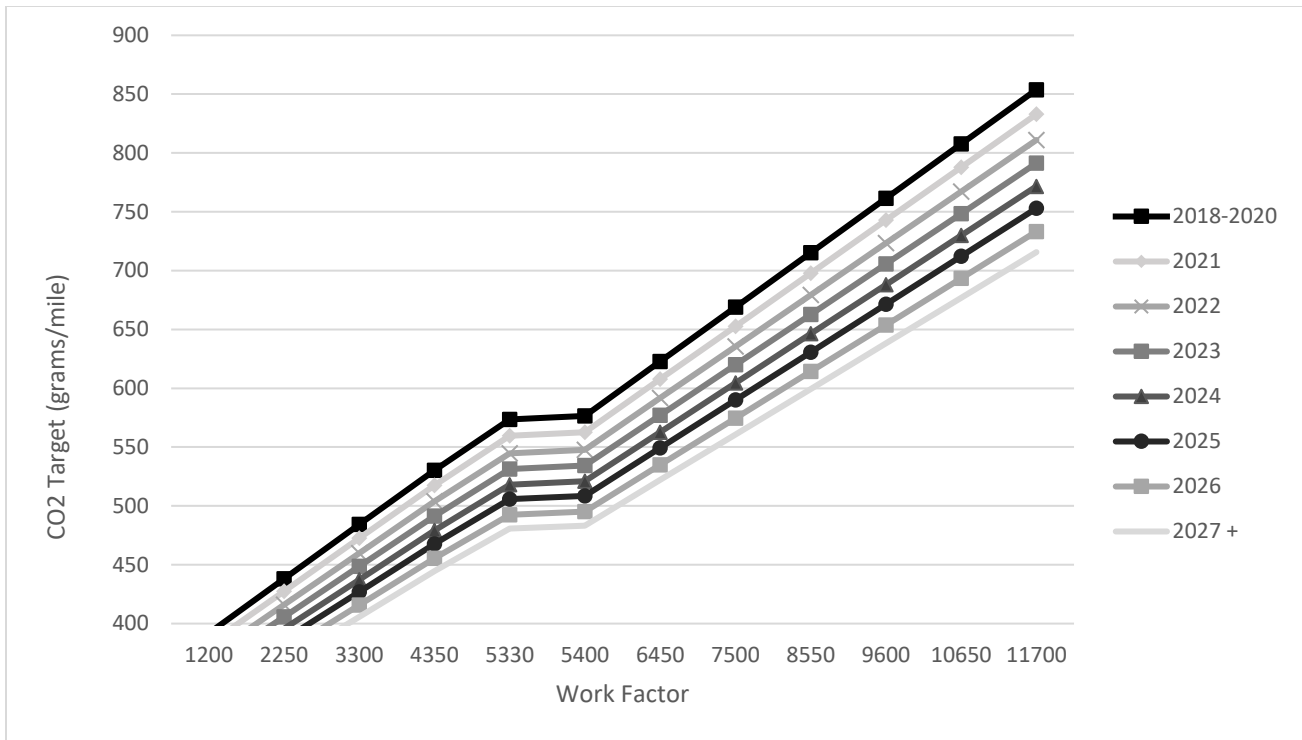
Model Year	Spark ignition CO ₂ emission target (grams of CO ₂ / mile)	Compression ignition CO ₂ emission target (grams of CO ₂ / mile)
2018 - 2020	$(0.0440 \times WF) + 339$	$(0.0416 \times WF) + 320$
2021	$(0.0429 \times WF) + 331$	$(0.0406 \times WF) + 312$
2022	$(0.0418 \times WF) + 322$	$(0.0395 \times WF) + 304$
2023	$(0.0408 \times WF) + 314$	$(0.0386 \times WF) + 297$
2024	$(0.0398 \times WF) + 306$	$(0.0376 \times WF) + 289$
2025	$(0.0388 \times WF) + 299$	$(0.0367 \times WF) + 282$
2026	$(0.0378 \times WF) + 291$	$(0.0357 \times WF) + 275$
2027 and beyond	$(0.0369 \times WF) + 284$	$(0.0348 \times WF) + 268$

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 CO₂ Emission target by work factor 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 CO₂ emission standards for vocational vehicles and tractors are shown in **Table 2** below.

For the purposes of fleet average CO₂ 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.

Phase 2 introduced many new subcategories within vocational vehicles and tractors. Each class of vocational vehicle has been further divided into three subcategories: multi-purpose vocational vehicle, regional vocational vehicle and urban vocational vehicle. There are also eight new categories of vocational vehicles that companies may elect to use. These vocational vehicles include motor homes, school buses and waste collection vehicles.

These categories have their own averaging set, and their credits cannot be combined for the purposes of fleet averaging.

Class 8 tractors have been further subdivided into four GCWR weight classes; less than 43 998 kg, between 43 998 and 54 431 kg, above 54 431 kg but are not heavy-haul tractors, and heavy-haul tractors.

Table 2: CO₂ emission standards for vocational vehicles and tractors

Prescribed Classes of Vocational Vehicles and Tractors		CO ₂ emission standard (grams of CO ₂ per short ton-mile)
Class 2B, 3, 4 and 5		
multi-purpose vocational vehicles	spark-ignition	407
	compression-ignition	373
regional vocational vehicles	spark-ignition	335
	compression-ignition	311
urban vocational vehicle	spark-ignition	461
	compression-ignition	424
Class 6 and 7		
multi-purpose vocational vehicles	spark-ignition	293
	compression-ignition	265
regional vocational vehicles	spark-ignition	261
	compression-ignition	234
urban vocational vehicle	spark-ignition	328
	compression-ignition	296
low-roof tractors		105.5
mid-roof tractors		113.2
high-roof tractors		113.5
Class 8		
multi-purpose vocational vehicles	compression-ignition	261
regional vocational vehicles	compression-ignition	205
urban vocational vehicle	compression-ignition	308
tractors with GCWR of less than 43 998 kg	low-roof day cab	80.5
	low-roof sleeper cab	72.3
	mid-roof day cab	85.4
	mid-roof sleeper cab	78
	high-roof day cab	85.6
	high-roof sleeper cab	75.7
tractors with GCWR between 43 998 and 54 431 kg	low-roof day cab	82.8
	low-roof sleeper cab	74.8
	mid-roof day cab	87.9

	mid-roof sleeper cab	80.8
	high-roof day cab	88.2
	high-roof sleeper cab	78.4
tractors with GCWR of more than 54 431 kg other than heavy-haul tractors	low-roof day cab	53.5
	low-roof sleeper cab	47.1
	mid-roof day cab	55.6
	mid-roof sleeper cab	49.6
	high-roof day cab	54.5
	high-roof sleeper cab	47.1
heavy-haul tractors		52.4
Motor home		228
School Bus		291
Coach Bus		210
Other Bus		300
Waste collection vehicle		313
Concrete mixer		319
Mixed-Use vocational vehicle		319
Emergency vehicle		324

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 (usually fuelled by diesel), or spark ignition (usually fuelled by gasoline). The emissions from these engines are regulated separately from those of the vehicles they power.

All spark-ignition heavy-duty engines other than heavy-duty engines, must meet the standard of 627 grams of CO₂ per brake horsepower-hour⁶ (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).

Table 3: CO₂ emission standards for compression-ignition and heavy heavy-duty spark-ignition engines

Engine Type	CO ₂ emission standard (BHP-hr)
	MY 2021 to 2023
Light heavy-duty engine	563
Medium heavy-duty engine for vocational vehicles	545
Heavy heavy-duty engine for vocational vehicles	513
Medium heavy-duty engine for tractors	473
Heavy heavy-duty engine for tractors	447

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

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 traded or used to offset an emissions deficit 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

Most vehicles reported between 2021 and 2023 model years were class 2B and 3 pickup trucks and vans (non-vocational) at an average of 100,000 annually. As well, approximately 50,000 vocational vehicles and tractors were reported per model year. On average, ~42,600 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 2021 to 2023 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 CO₂ 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 Zero-Emission Vehicles

As fleet average emission standards have become more stringent under Phase 2, companies have increased the number of zero-emission vehicles (ZEVs) in their fleets. Figure 2 below illustrates the penetration of ZEVs in the heavy-duty vehicle fleet for the three model years. ZEV penetration rose from 0.07% in 2021 to 2.6% in 2023.

Figure: 2 Percentage of ZEVs Reported from 2021 to 2023 model years

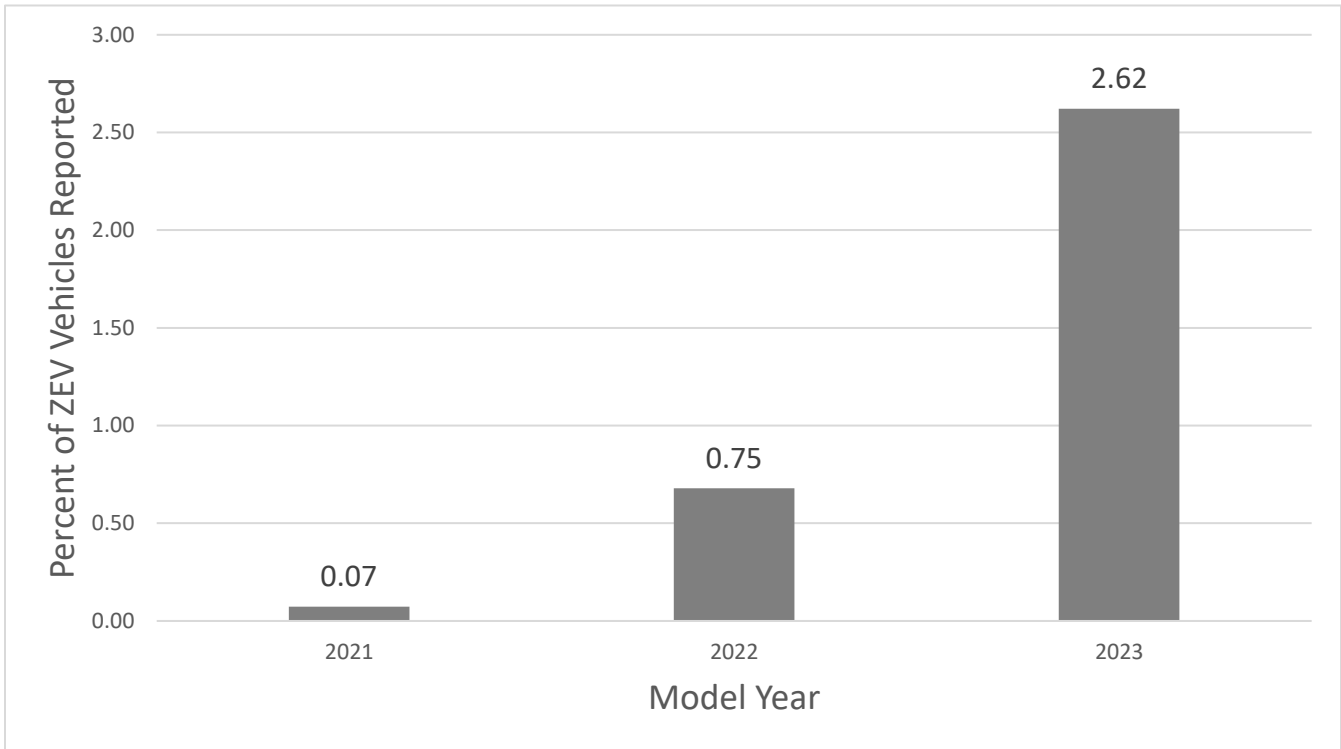


Table 4 shows the total number of ZEVs reported for each vehicle type. All three vehicle types showed significant increases with most ZEVs reported being Class 2B & 3 non-vocational vehicles.

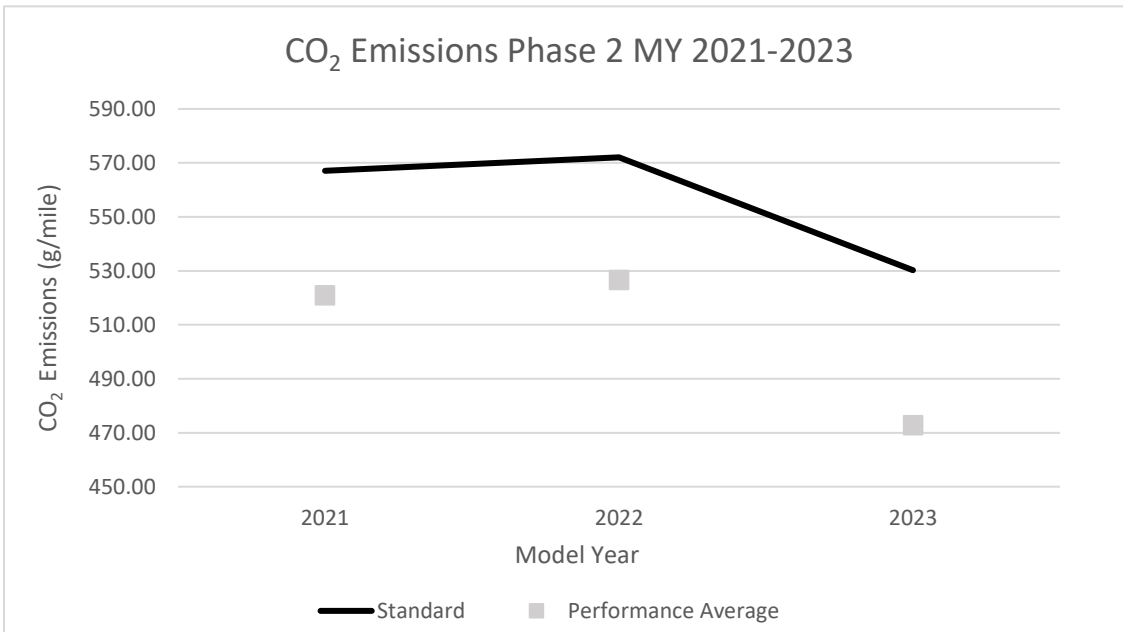
Table 4: Number of Zero Emission Vehicles reported by vehicle type

Model Year	Class 2B & 3 Heavy-Duty Non-Vocational Vehicles	Vocational Vehicles	Tractors
2021	0	85	3
2022	934	362	19
2023	3,233	387	84

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

The fleet average CO₂ emissions are shown in **Figure:** below along with the fleet average standard for model years 2021 through 2023. During this period, the fleet average CO₂ values decreased from 521 to 473 grams of CO₂ per mile while the overall fleet standard decreased in stringency (dashed line) from 567 to 530 grams of CO₂ per mile. Overall, the fleet average CO₂ emissions decreased by 9.26% from the 2021 to 2023 model years.

Figure: 3 Class 2B and 3 (non-vocational) fleet performance and standards from 2021 to 2023 model years



3.4 Average GHG Emissions Performance – Vocational Vehicles and Tractors

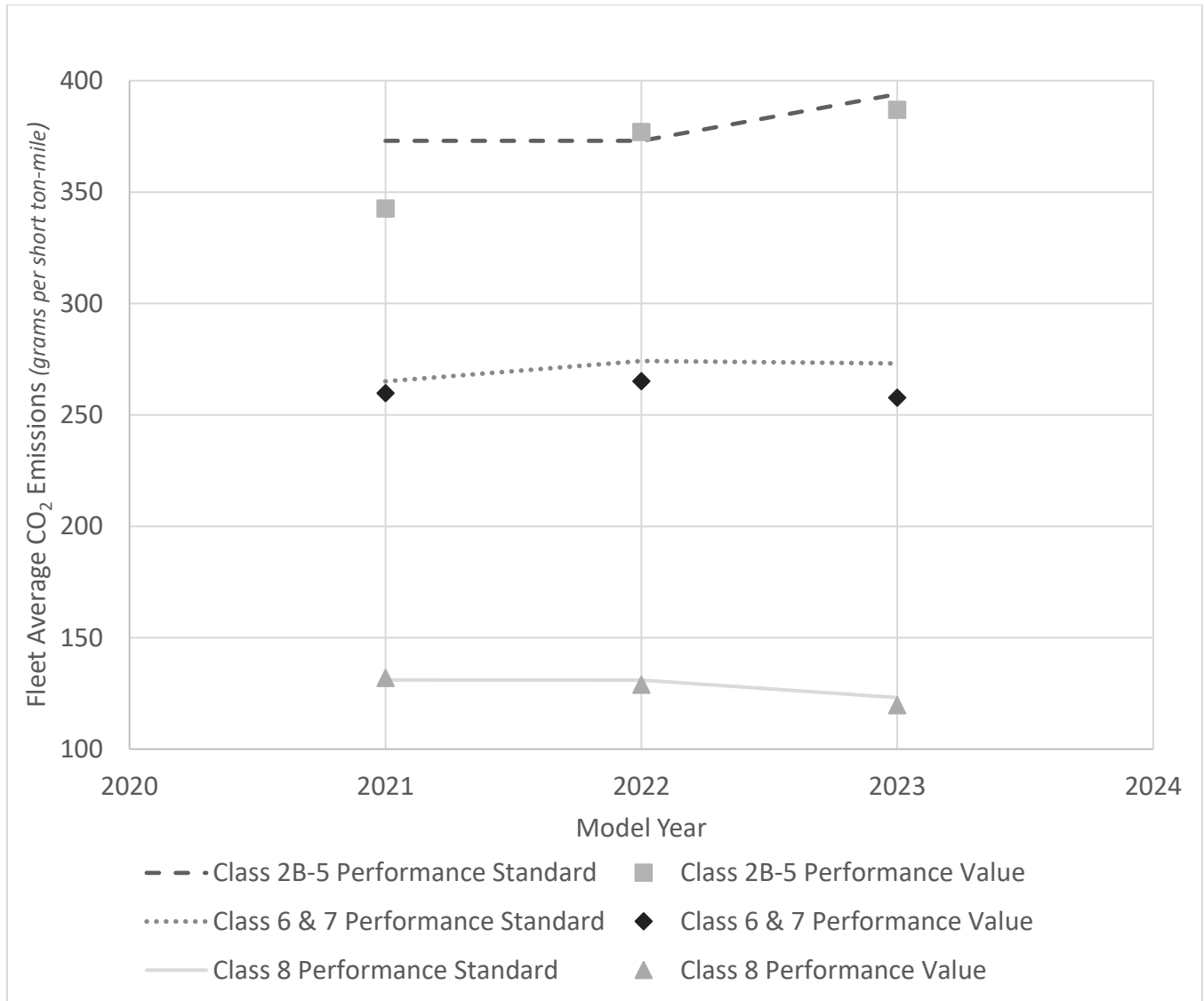
The requirements of the fleet averaging credit system influence how vehicles and engines are reported when evaluating the fleet performance of vocational vehicles and tractors. These products are divided into averaging sets as seen in **Figure:** .The emission credit system is further explained in Section 0 of this report.

Figure 3 shows the fleet performance of the three main averaging sets of vocational vehicles and tractors. These averaging sets are comprised of subcategories with their own emission standard. Therefore, a weighted average is used to determine the performance standards and values for each averaging set. For class 2B through 5 vocational vehicles, the fleet average CO₂ performance value is below the standard for two of the three model years

For the Class 6 and 7 vocational vehicles and tractors averaging set the fleet average CO₂ performance values decreased from 260 to 258 grams per short-ton-mile.

For the Class 8 vocational vehicles and tractors averaging set the fleet average CO₂ performance values are below the average standard for two of the three model years. From 2021 to 2023 the fleet average CO₂ values have decreased from 132 to 120 grams per short-ton mile.

Figure: 4 Vocational vehicle and tractor fleet performance and standards for 2021-2023 model years



3.5 Average GHG Emissions Performance – Heavy-duty Engines

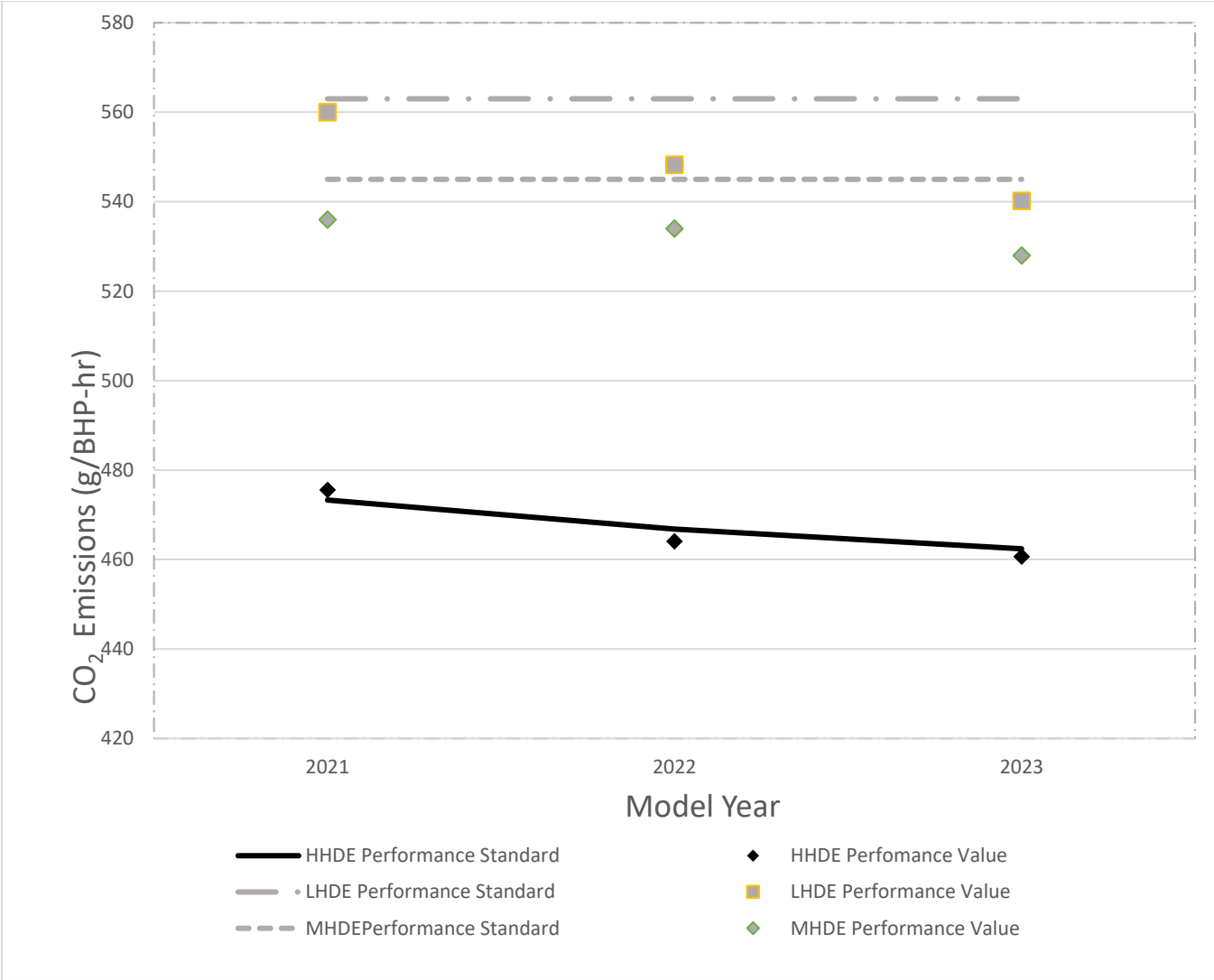
The fleet performance of heavy-duty engines is shown in **Figure: .**

For the heavy heavy-duty averaging set, the average fleet emissions are below the average standard for two of the three model years. From the 2021 through the 2023 model year the average CO₂ performance values have decreased from 476 to 461 grams per BHP-hr.

For the light heavy-duty averaging set, the average fleet emissions are below the average standard for all model years. From the 2021 through the 2023 model year the average CO₂ performance values have decreased from 560 to 544 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 2021 through the 2023 model year the average CO₂ performance values have decreased from 536 to 526 grams per BHP-hr.

Figure: 5 Engine fleet performance and standards for 2021 to 2023 model years



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 CO₂ 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 CO₂ 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 3**.

Table 3: 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 CO₂ emissions. Therefore, net credits are calculated for a company’s entire 2B and 3 fleet in a single averaging set. Deficits for N₂O and CH₄ levels above 0.05 g/mile are calculated and added to CO₂ 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 CO₂ 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 4 and **Table 5** 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 2021 and 2023 model years, companies have generated approximately 5 million Mg of CO₂ emissions credits and 15.7 million credits since 2014. There are currently 8.0 million Mg of CO₂ credits available to offset deficits for the 2024 model year.

Table 4: Yearly net credits earned for heavy-duty vehicle averaging sets (Mega grams of CO₂)

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
2021	241,053	144,079	85,993	-336,919
2022	490,055	172,722	215,638	248,994
2023	1,038,771	153,440	303,161	959,069
	Concrete Mixer	Emergency Vehicle	Oher Bus	School Bus
2021	2,868	538	67,883	57,280
2022	6,567	705	37,757	144,708
2023	4,590	1,465	38,021	315,042
	Coach Bus		Waste Collection Vehicle	
2021			848	
2022	1,238		336	
2023	1,073		1,566	

Table 5: Yearly net credits earned for heavy-duty engine averaging sets (Mega grams of CO₂)

Model Year	CI - LHDE (CI 2b-5)	CI - MHDE (CI 6-7)	CI - HHDE (CI 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
2021	14,229	6,217	-60,876	0
2022	26,934	67,780	126,126	0
2023	72,290	77,407	226,568	0

5. Overall Industry Credit Performance

The results from the 2021 to 2023 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).

Credit accumulation has generally increased from the 2021 to the 2023 model year. Vehicle credits earned in 2023 were significantly higher for the Class 8 and Class 2B and 3 averaging sets than previous years. This was largely due to the increase in ZEV sales.

For the 2021 and 2023 model years, companies have generated approximately 5 million Mg of CO₂ emissions credits and 15.7 million credits since 2014. There are currently 8.0 million Mg of CO₂ credits available to offset deficits for the 2024 model year. All companies' credit balances were in compliance with the Regulations in Phase 2.

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. federal standards. The development of common standards led manufacturers to produce more advanced vehicles, which enhanced their competitiveness. The regulated parties have met the regulatory requirements for 2021-2023 MYs. Note that the technologies intended to be adopted by manufacturers in response to Phase 2 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
2021	567.02	520.99	-8.12	373	342.65	-8.14	265.06	259.81	-1.98	131.05	132.05	0.76
2022	572.06	526.61	-7.95	373	377.07	1.09	274.19	265.18	-3.29	130.95	128.95	-1.52
2023	530.23	472.76	-10.84	393.96	386.96	-1.78	273.12	257.71	-5.64	123.13	119.84	-2.76
Total Fleet Average Reduction MY 2021 through MY 2023(%)	9.26			0			0.81			9.25		

	Other Bus			Coach Bus			Cement Mixer			Emergency Vehicle		
	Standard	Value	% wrt Standard	Standard	Value	% wrt Standard	Standard	Value	% wrt Standard	Standard	Value	% wrt Standard
2021	300	289.48	-3.51	-	-	-	319	307.87	-3.49	324	316.50	-2.31
2022	300	297.03	-0.99	210	206.67	-1.59	319	302.08	-5.30	324	313.71	-3.17
2023	300	277.97	-7.34	210	205.30	-2.24	319	301.41	-5.51	324	309.52	-4.47

Total Fleet Average Reduction MY 2021 through MY 2023(%)	3.98	0.66	2.10	2.21
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	School Bus			Waste Collection Vehicle		
	Standard	Value	% wrt Standard	Standard	Value	% wrt Standard
2021	291	0	-100	313	302.17	-3.46
2022	291	0	-100	313	306.57	-2.06
2023	291	0	-100	313	305.00	-2.56
Total Fleet Average Reduction MY 2021 through MY 2023(%)	0			-0.94		

Model Year	CI - LHDE (CI 2b-5)			CI - MHDE (CI 6-7)			CI - HHDE (CI 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
2017	576.00	575.00	-0.17	575.29	545.27	-5.22	500.70	489.44	-2.25	627.00	627.00	0
2018	576.00	575.00	-0.17	575.33	541.71	-5.84	503.71	488.50	-3.02	627.00	627.00	0
2019	576.00	574.60	-0.24	573.48	541.84	-5.52	493.34	478.07	-3.10	627.00	627.00	0
2020	576.00	552.77	-4.03	550.60	535.56	-2.73	484.96	472.12	-2.65	627.00	627.00	0
2021	563	560.01	-0.53	544.75	536.41	-1.54	473.29	475.57	0.48	627.00	627.00	0
2022	563	548.32	-2.61	544.76	533.89	-2.00	466.75	464.11	-0.56	627.00	627.00	0
2023	563	544.43	-3.30	544.26	526.28	-3.30	462.24	460.71	-0.37	627.00	627.00	0
Total Fleet Average Reduction MY 2021 through MY 2023 (%)	2.78			1.89			3.12			0		