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Benefits of extending the EU heavy-duty CO_2 emissions standards to other truck segments

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Introduction

In February 2019, the European Union (EU) adopted its first-ever CO_2 emissions standards for heavy-duty vehicles (HDVs), mandating fleet-wide average emission reductions of 15% by 2025 and 30% by 2030 compared to their performance in the baseline period, which ran from July 2019 to June 2020 (European Commission 2019). This effort contributes to the EU's ambition to reduce transport-related CO_2 emissions by 90% by 2050 compared to 1990 levels, as part of the European Green Deal (Buysse, Miller, Díaz, Sen, & Braun, 2021).

The heavy-duty CO_2 standards currently only apply to the four largest vehicle segments, which together represented 77% of the sales of trucks above 7.5 tonnes during the baseline period (Ragon & Rodríguez, 2020). While these groups account for the largest share of the CO_2 emissions from trucks, a substantial portion of the HDV-related emissions remains uncovered by the current regulation. Additionally, semi-trailers, which are usually sold by separate manufacturers, have a significant impact on the CO_2 performance of long-haul tractor-trailers but are not included in the current scope of the regulation. By adding innovative technologies and devices to trailers, significant further CO_2 emissions reductions can be achieved (Sharpe & Rodríguez, 2018).

In 2022, a review of the heavy-duty CO_2 emissions standards will consider several adjustments to the regulation, including the possibility of extending the CO_2 emissions reduction targets to other vehicle segments, as well as setting specific targets for trailers. Experience shows that stringent emission standards can be effective in driving the development and deployment of innovative technologies, and that such progress does not materialize in the absence of regulatory pull (Mock, 2021). Thus, this study assesses the additional benefits that would result from extending the CO_2 standards to these other segments under several alternate scenarios and provides recommendations for the 2022 review of the standards.

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Methods

Scope

This study focuses on light and medium lorries, and heavy-duty trucks. These are classified into vehicle groups according to the segmentation in Table 1. Heavy-duty trucks consist of groups 1 through 17, with gross vehicle weights (GVW) at or above 7.5 tonnes. Among these, vehicle groups 4, 5, 9, and 10 represent the largest portion of the market and are already targeted by the current heavy-duty CO_2 standards, as highlighted in Table 1.

Table 1. Vehicle segmentation considered in this study

Axle type	Chassis configuration	Gross vehicle weight (tonnes)	Vehicle groups	Date of certification requirement	Currently covered by the HDV CO_2 standards?
4x2	Rigid	<7.5	**Light and medium lorries**	Not yet considered by the certification regulation	**No**
	Rigid/tractor	7.5 – 10	**1**	January 1, 2020 for all new registrations	
	Rigid/tractor	>10 – 12	**2**		
	Rigid/tractor	>12 – 16	**3**		
	Rigid	>16	**4**	January 1, 2019 for new produced vehicles July 1, 2019 for all new registrations	**Yes**
	Tractor	>16	**5**		
4x4	Rigid	7.5 – 16	**6**	Not considered by the certification regulation	**No**
	Rigid	>16	**7**		
	Tractor	>16	**8**		
6x2	Rigid	all weights	**9**	January 1, 2019 for new produced vehicles July 1, 2019 for all new registrations	**Yes**
	Tractor	all weights	**10**		
6x4	Rigid	all weights	**11**	July 1, 2020 for new registrations	**No**
	Tractor	all weights	**12**		
6x6	Rigid	all weights	**13**	Not considered by the certification regulation	
	Tractor	all weights	**14**		
8x2	Rigid	all weights	**15**		
8x4	Rigid	all weights	**16**	July 1, 2020 for new registrations	
8x6/8	Rigid	all weights	**17**	Not considered by the certification regulation	

Trucks in the regulated groups are further segmented into subgroups to account for their typical mission profile—urban delivery (UD), regional delivery (RD) or long-haul (LH)—as shown in Table 2 and explained in further detail in ICCT's policy update on the HDV CO_2 standards (Rodríguez, 2019). In this study, we modeled each of these subgroups individually in the CO_2 inventory.

Table 2. Vehicle sub-groups used in the policy design of the HDV CO_2 standards.

Group description	Group	Sub-group	Cabin type	Engine power
Rigid, 4x2 axle, GVW > 16 t	4	4-UD	All	< 170 kW
		4-RD	Day cab	≥ 170 kW
			Sleeper cab	≥ 170 kW and < 265 kW
		4-LH	Sleeper cab	≥ 265 kW
Tractor, 4x2 axle, GVW > 16 t	5	5-RD	Day cab	All
			Sleeper cab	< 265 kW
		5-LH	Sleeper cab	≥ 265 kW
Rigid, 6x2 axle	9	9-RD	Day cab	All
		9-LH	Sleeper cab	
Tractor, 6x2 axle	10	10-RD	Day cab	All
		10-LH	Sleeper cab	

The CO_2 emissions from truck groups 1, 2, 3, 11, 12, and 16 are determined and reported under the current regulatory framework—(EU) 2017/2400 and (EU) 2018/956—but are not included in the CO_2 standards. Finally, the remaining groups are not covered by either regulation. The light and medium lorries category is comprised of a number of N1 vans, as well as N2 vans and N2 box trucks, that are type-approved as heavy-duty vehicles—that is, have their engines type-approved as heavy-duty engines according to regulation (EU) 595/2009. While N1 vans are typically covered by light-duty vehicle regulations, depending on their technically permissible maximum laden mass, they can also be type-approved as heavy-duty vehicles. These vehicles were also included in this study. Similarly, some N2 vans are type-approved as light-duty vehicles and excluded from this study.

Finally, we also considered semi-trailers due to their significant contribution to the CO_2 performance of tractor-trailers. This truck type represents the largest portion of currently regulated trucks with 67.5% of regulated truck sales during the baseline period. Trailers are typically sold by separate manufacturers, and current policy developments consider the extension of the certification regulation (EU) 2017/2400 to trailer-related CO_2 emissions (Applus IDIADA, Transport & Mobility Leuven, & TU Graz, 2019). Trailers present important CO_2 emissions reduction potential via the addition of aerodynamic features, light-weighting, and rolling resistance reduction (Sharpe & Rodríguez 2018). Therefore, we also assessed the potential benefits of such a policy intervention on CO_2 emissions savings.

This analysis focuses on total fleet emissions in the period 2020–2035, corresponding to a 16-year period following the end of the baseline period. This timeframe was selected to align with the European Commission's regulatory impact assessment of the heavy-duty CO_2 standards (European Commission, 2018).

Scenarios for the extension of the CO_2 standards

In our baseline scenario, we estimated the total CO_2 emissions from all considered vehicle segments over the 2020–2035 period (in megatonnes, Mt), assuming that no HDV CO_2 standards were adopted. The baseline scenario was validated against the regulatory impact assessment of the HDV CO_2 standards, therefore ensuring that the findings in this analysis are coherent with what was estimated by the European Commission.

In the *Adopted policy* scenario, we applied the fleet-average CO_2 emissions reduction targets set by the current regulation—that is, 15% by 2025 and 30% by 2030—only to vehicle groups 4, 5, 9, and 10, modeling each subgroup individually. All other vehicle segments remained unregulated and followed the corresponding CO_2 emissions reduction trajectory described below, whereby we assume a 0.5% yearly reduction in distance-specific CO_2 emissions. We considered four scenarios for the extension of the scope of the CO_2 standards, as summarized in Table 3.

Table 3. Scenarios for the extension of the HDV CO_2 standards to other vehicle segments. Vehicle groups subject to CO_2 reduction targets in each scenario are highlighted in green.

Baseline	Adopted policy scenario	Currently certified scenario	Trailer scenario	All heavy trucks scenario	Light and medium lorries scenario
Light and medium lorries	Light and medium lorries	Light and medium lorries	Light and medium lorries	Light and medium lorries	**Light and medium lorries**
1	1	**1**	**1**	**1**	**1**
2	2	**2**	**2**	**2**	**2**
3	3	**3**	**3**	**3**	**3**
4	**4**	**4**	**4**	**4**	**4**
5	**5**	**5**	**5**	**5**	**5**
6	6	6	6	**6**	**6**
7	7	7	7	**7**	**7**
8	8	8	8	**8**	**8**
9	**9**	**9**	**9**	**9**	**9**
10	**10**	**10**	**10**	**10**	**10**
11	11	**11**	**11**	**11**	**11**
12	12	**12**	**12**	**12**	**12**
13	13	13	13	**13**	**13**
14	14	14	14	**14**	**14**
15	15	15	15	**15**	**15**
16	16	**16**	**16**	**16**	**16**
17	17	17	17	**17**	**17**
Trailers	Trailers	Trailers	**Trailers**	**Trailers**	**Trailers**

In the *Currently certified* scenario, building on the *Adopted policy* scenario, the current reduction targets were also applied to groups 1, 2, 3, 11, 12, and 16 (see Table 1), as the CO_2 emissions from these segments are already being determined under the scope of the certification regulation.

In the *Trailer* scenario, the same targets were also applied to the groups in the previous scenario. Additionally, for vehicle groups 5 and 10, we assume that the standards also introduced specific targets for CO_2 reduction from semi-trailers. We assume this only applied to box-type semi-trailers—i.e. curtainside, refrigerated, and dry van trailers—which together represented 69% of the trailer market in 2016 (Sharpe & Rodríguez, 2018). We applied the same market share for box-type semi-trailers through the entire modelling period. While we did not attempt to examine a possible policy design to include trailers into the CO_2 standards, we assumed that the stringency of the targets was sufficient to reduce CO_2 emissions of regional delivery and long-haul tractor-trailers in 2030 by 7% and 10%, respectively. This is informed by the technology potential of semi-trailers in these two truck applications (Rodríguez 2018).

In the *All heavy trucks* scenario, the vehicle reduction targets are were also applied to the groups of the *Trailer* scenario, as well as to groups 6, 7, 8, 13, 14, 15, and 17—that is, to all heavy truck segments. Finally, in the *Light and medium lorries* scenario, we assumed that the reduction targets were also applied to light and medium lorries—that is, N1 and N2 vehicles not exceeding 7.5 tonnes of GVW and type-approved as heavy-duty vehicles.

CO_2 inventory model

For this study, we developed an inventory model to estimate the CO_2 emissions from the entire truck fleet in Europe in the period 2020–2035. Our CO_2 inventory was based on a number of inputs obtained for each truck segment, according to the market segmentation described in this section. These inputs included truck sales data, annual distance travelled, survival rates, distance specific CO_2 emissions, as well as scenarios for the reduction trajectories of these emissions with time, depending on whether or not a vehicle segment is subject to CO_2 emissions reduction targets.

Based on these inputs we estimated, for each vehicle segment, the lifetime CO_2 emissions of all trucks that would operate at least partly in the 2020–2035 period, and only accounted for the CO_2 emitted during that time period. The method used to obtain this result is further detailed in Figure 1. Although the CO_2 emissions were estimated for 2020–2035 only, the entire modelling period was 1991–2035, to account for older trucks that will be on the road in the 2020–2035 timeframe. We assumed an average vehicle lifetime of 30 years—that is, in 2020, the oldest trucks on the road were registered in 1991.

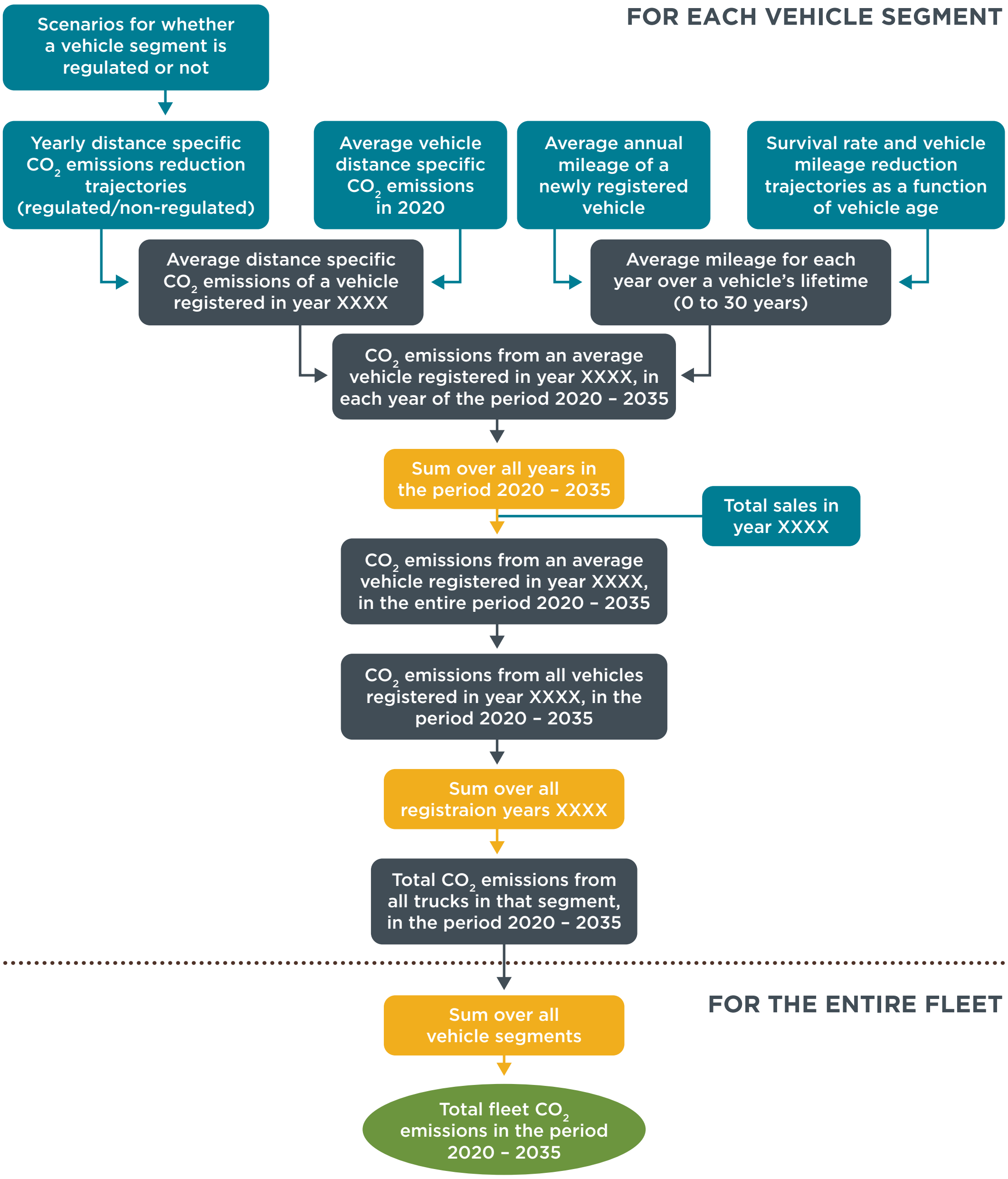

Figure 1. CO_2 emissions inventory method used in this study.

We applied the scenarios for the extension of the heavy-duty CO_2 standards described above. With this input, we estimated the additional CO_2 emissions savings achieved from extending the CO_2 standards to unregulated HDVs, on top of what is already achieved by the current state of the regulation. The following sections specify all data input to the model.

Sales data

For vehicle groups 1 to 17, as well as light and medium lorries in the N2 classification, total sales volumes were obtained using a combination of data sources. For the period 2005–2020, we used a detailed database recording the sale of every heavy-duty vehicle in the EU, together with technical specifications that allow us to classify them in the regulatory groups listed in Table 1.[1] For the 1990–2004 period, we used historical data from the IEA Mobility Model Database, adjusting it to match the overall sales volume from the former database for model year 2005 (International Energy Agency, 2021). Finally, for the period 2021–2035, we used projections from the ICCT's Roadmap model, adjusting them to match the data from the former database (International Council on Clean Transportation, 2021). Sales forecasts used 2019 registration data as the baseline to avoid factoring in the 2020 dip in sales linked with the COVID-19 pandemic, apparent in Figure 2, assuming that sales will rebound in 2021.

Additionally, about 50,000 N1 vans (under 3.5 tonnes) were type-approved as heavy-duty vehicles in 2019, given the overlap in scope of the type-approval regulations for light- and heavy-duty vehicles (ACEA 2019b). Conversely, we assumed that 46% of N2 vans were type-approved as light-duty vehicles, and we removed these from the overall sales data (ACEA 2019a). For all other model years in the considered period, we assumed a constant ratio of N1 vans type-approved as HDVs to the total of light and medium lorries. The resulting volumes for both light and medium lorries, and heavy-duty trucks are shown in Figure 2.

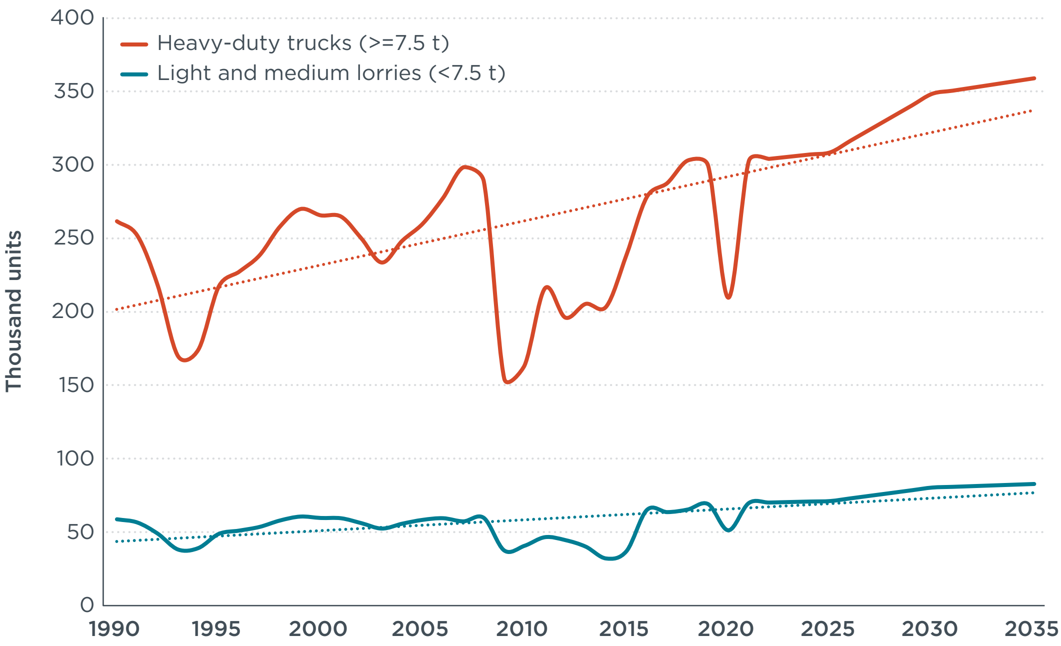

Figure 2. Historical sales data and projections out to 2035 for both heavy-duty as well as light and medium lorries.

The fleet segmentation data in terms of vehicle groups was not available for the historical data in the period 1990–2004. Therefore, for this period, as well as for the

1 Historical data supplied by IHS Global SA; Copyright © IHS Global SA, 2019

2021–2035 projections, we used the average fleet composition over the 2005–2020 period to determine the relative market shares of the different vehicle groups in Table 1. For the period 2005–2020, we used the actual yearly composition data. For the regulated subgroups, we obtained sales shares for the second half of 2019 from the European automobile manufacturers association (ACEA, 2020), and assumed a constant composition throughout the modelling period. A previous ICCT study showed that the fleet composition has remained stable over the past decade, suggesting the validity of these assumptions (Ragon & Rodríguez, 2020). Additionally, the resulting light and medium lorries fleet, after consideration of the flexibilities in the type-approval regulation, was comprised of 72% N1 vans, 18% N2 vans at an assumed GVW of 5 tonnes, and 10% of N2 medium (box) trucks at an assumed GVW just below 7.5 tonnes. The same composition was assumed over the entire modelling period, based on historical sales data. The fleet segmentation for both light and medium lorries, and heavy-duty trucks is shown in Figure 3.

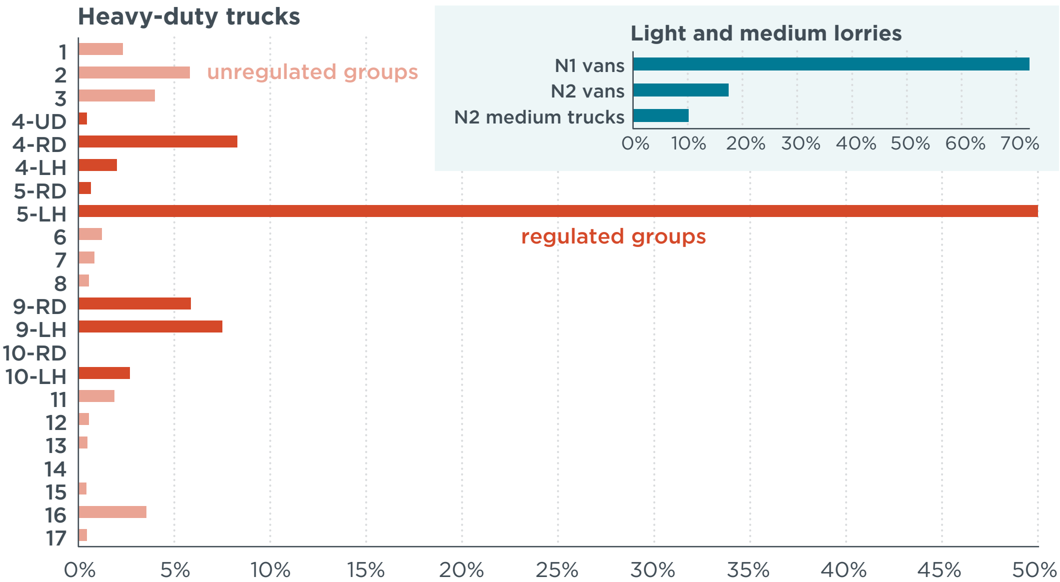

Figure 3. Sales shares of heavy-duty trucks and of light and medium lorries, according to the segmentation of Table 1 and Table 2. The “N1 vans” shares only account for those vans that are type-approved as heavy-duty.

Vehicle kilometers travelled

The truck segments described above are used for different applications and, therefore, differ in annual distance driven. For instance, long-haul tractor-trailers travel significantly more distance every year than urban delivery trucks, resulting in higher CO_2 emissions. The vehicle kilometers travelled (VKT) of a truck is also known to decrease with vehicle age (Meszler, Delgado, Rodríguez, & Muncrief, 2018). In this study, the reference usage data for newly registered trucks from the regulated vehicle groups—4, 5, 9 and, 10—was obtained from the heavy-duty CO_2 standards regulation (European Commission, 2019). For all other truck segments, data were obtained from a study contracted by the European Commission (Graz University of Technology 2012). Finally, for vans, we obtained data from the European Commission financed TRACCS project (Emisia et al. 2013). The reference VKT for each truck segment is shown in Table A1 in the Appendix.

Data for the degradation of VKT with vehicle age were also obtained from the TRACCS project. Degradation curves were obtained for the different truck segments and are shown in the top-left panel of Figure 4. Although the data segmentation did not correspond to the vehicle groups in Table 1, we matched each vehicle group with the closest dataset from TRACCS, as shown in Table A1 in the Appendix.

Finally, we accounted for the renewal of the heavy-duty vehicle fleet via the survival curve of a typical truck, shown in the bottom-left panel of Figure 4, which was obtained from ICCT's roadmap model. The VKT degradation curves (top-left panel of Figure 4) were weighted by the survival rate (bottom-left panel of Figure 4) to obtain a vehicle usage factor, as a function of vehicle age, for each truck segment. This usage factor, shown in the right panel of Figure 4, was then used to scale the reference VKT discussed above.

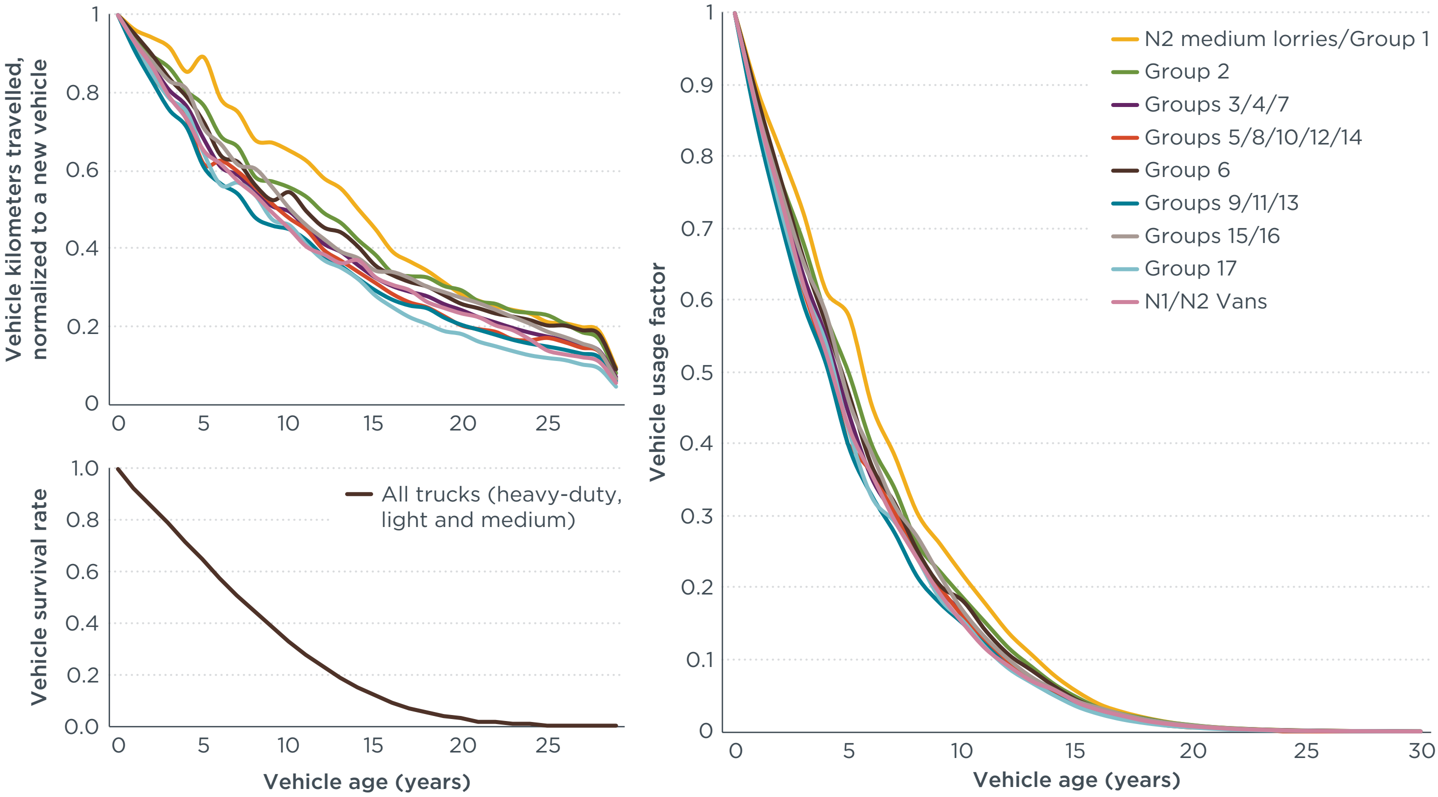

Figure 4. Vehicle kilometers travelled (VKT) degradation and survival rate as a function of vehicle age.

Specific CO_2 emissions and reduction trajectories

Under the scope of the monitoring and reporting regulation, (EU)2018/956, manufacturers are required to report the CO_2 emissions of every truck they register, which are certified via the regulatory tool known as VECTO. As shown in Table 1, this currently applies to the regulated groups 4, 5, 9, and 10, as well as vehicle groups 1, 2, 3, 11, 12, and 16. The European Environment Agency, responsible for monitoring the data on behalf of the European Commission, recently published the data for the first monitoring period (European Environment Agency, 2021). We therefore used market average values of the officially reported specific CO_2 emissions for each truck segment mentioned above. For the truck segments in Table 1 that are not yet covered by the monitoring and reporting regulation, we used the specific CO_2 emissions from the closest group for which we have data, based on technical specifications. Finally, for vans, we use emissions data from ICCT's latest market monitor (Mock et al. 2021), representative of the largest van segments that are relevant to this study. The specific CO_2 emissions used for each truck segment are summarized in Table A1 in the appendix.

The average distance-specific CO_2 emissions (in g/km) reduction trajectory for each vehicle group is dependent on whether the group was regulated or not, as shown in Figure 5, according to the scenarios described above. For non-regulated vehicle groups, we assumed a 0.5% yearly reduction in emissions following the trends for the fuel consumption of the best performing tractor-trailers identified in a previous ICCT study (Dallmann & Jin, 2020), assuming no significant change in fuel properties. For regulated vehicle groups, we assumed a linear reduction curve in the period 2020–2030 that yields the 15% and 30% reduction targets in 2025 and 2030, respectively, in line with what is currently mandated by the HDV CO_2 standards. Outside of this period, we also assumed a 0.5% yearly reduction in distance-specific CO_2 emissions. That is, we obtained reduction trajectories assuming that truck manufacturers did not invest in CO_2 emissions reduction technologies further than what is strictly required to comply with the standards, providing a worst-case scenario.

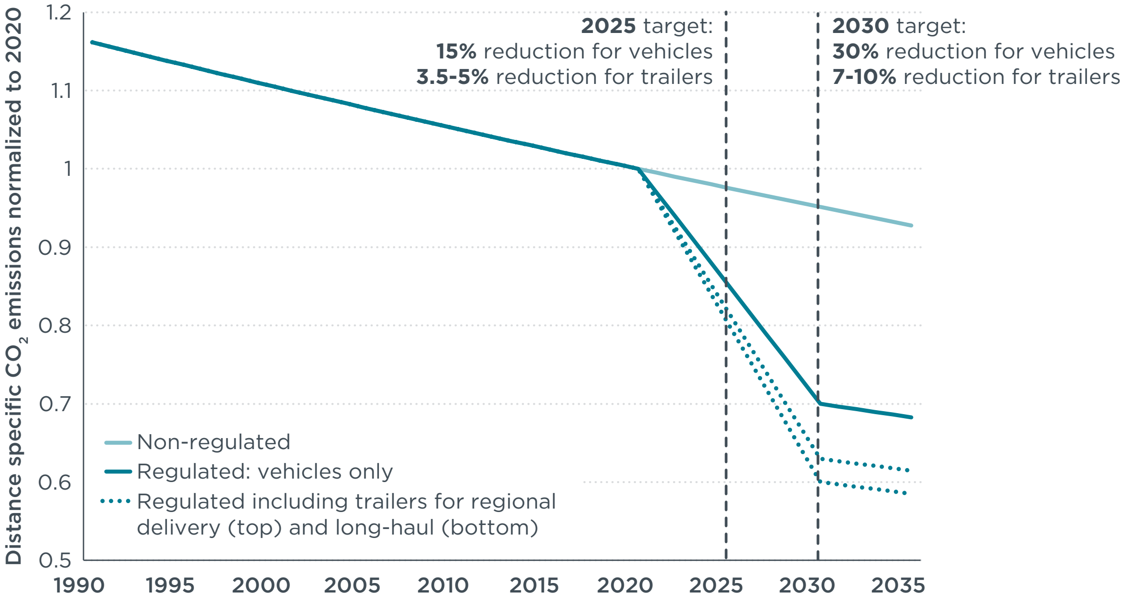

Figure 5. Distance-specific CO_2 emissions reduction trajectories for regulated and non-regulated vehicle groups.

Several technology pathways are available for manufacturers to meet their respective targets, including the deployment of the remaining technology potential for internal combustion engines and the adoption of alternative and zero-emission powertrain technologies such as natural gas, battery electric or fuel cell electric trucks. However, the role of these different technologies pathways for compliance was not considered in this study. Instead, we used the fleet-average CO_2 emissions reductions that would enable manufacturers to comply to their targets for each regulated vehicle group, as this is how compliance is determined (Rodríguez, 2019).

Finally, we considered the impact of extending the heavy-duty CO_2 standards to semi-trailers on the average CO_2 emissions from vehicle groups 5 and 10. On top of the vehicle reduction targets of 15% and 30%, respectively, for 2025 and 2030, we assumed that additional, specific targets were applied to trailers, yielding the corresponding reduction trajectories in Figure 5. By 2025, we assumed that CO_2 performance standards for trailers would translate to additional reductions of 5% and 3.5% for tractor-trailers from the LH and RD subgroups, respectively. By 2030, we assumed the trailer standards would deliver 10% and 7% additional reductions, respectively. The numerical values for these targets, as well as the ratio of the LH to RD targets, were informed by the technology potential for improved aerodynamics, light-weighting, and rolling resistance reduction for trailers identified in a previous ICCT study (Sharpe & Rodríguez, 2018). As the aerodynamics technology potential is only relevant to semi-trailers with a box-type configuration, we only applied the trailer targets to the 69% of tractor-trailers from groups 5 and 10 that are assumed to operate with such trailers. The remainder of the trucks in these groups were assumed to follow the “regulated” curve of Figure 5. We acknowledge that there is available technology potential for CO_2 improvements from non-box semi-trailers, drawbar trailers, and rigid truck bodyworks that are not captured in the present modeling. So, our estimates on the CO_2 benefits of semi-trailers CO_2 performance standards scenario can be considered conservative.

Validation of the model

Given all the assumptions listed in the previous sections, our model yields an estimate of the CO_2 emissions savings from the current regulation in the period 2020–2035 that is 44.2% higher than that of the European Commission's impact assessment (European Commission, 2018), which is based on cost curves obtained by the Joint Research Center for the different available CO_2 emissions reduction technologies (Krause & Donati, 2018). However, under their "base cost" assumption, the European Commission assumes a yearly improvement of 1.15% in CO_2 emissions from trucks that are not subject to CO_2 emissions reduction targets. Adjusting our assumptions in Figure 5 to obtain a similar rate, the gap between the two studies reduced to only 2.6 megatonnes of CO_2, or 1.9%, as shown in Figure 6. The remaining gap between the two studies is assumed to result from different methodologies and assumptions.

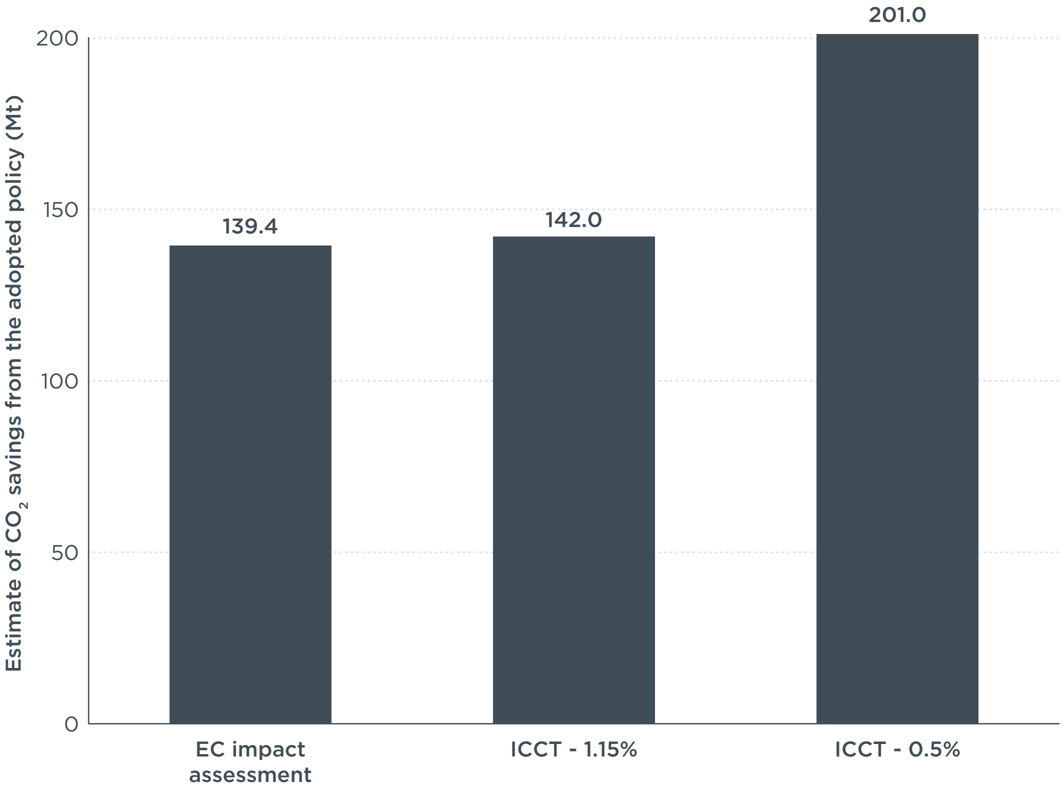

Figure 6. Validation of our CO_2 inventory model against the European Commission's regulatory impact assessment of the CO_2 standards. The "ICCT – 1.15%" and "ICCT – 0.5%" cases correspond to the assumed business-as-usual yearly improvement in CO_2 emissions from unregulated trucks.

Sources of uncertainty remain in our model. First, the best available data for the reference annual kilometers travelled of the unregulated vehicle groups are outdated and may not reflect current conditions. This parameter has a significant influence on the overall CO_2 emissions calculation, and we expect that the uncertainty in the data might impact our results. Second, we used a single survival profile to account for the fleet turnover of all truck segments although different segments would typically follow different trends. However, we have good confidence in the data from the largest segments by market shares, which have the largest influence on total emissions. Overall, we therefore expect the model to have good accuracy, as indicated by the good agreement with the European Commission's impact assessment.

Results and analysis

With our inventory model, we estimated the total CO_2 emissions resulting from each vehicle segment over the entire 2020–2035 period for each scenario. Results are shown in Table 4 together with the estimated savings from extending the heavy-duty CO_2 standards to each vehicle group.

Table 4. Estimated total cumulative CO_2 emissions from each vehicle segment in the period 2020–2035, provided it is regulated or not.

Vehicle group	Cumulative CO_2 emissions, 2020–2035: unregulated (Mt CO_2)	Cumulative CO_2 emissions, 2020–2035: regulated (Mt CO_2)	CO_2 emissions savings from regulating vehicle group, 2020–2035 (Mt CO_2)
Light and medium lorries (<7.5 t)			
N1 vans	43.24	38.76	4.48
N2 vans	10.42	9.34	1.08
N2 medium trucks	38.99	35.22	3.77
Heavy-duty trucks (>=7.5 t)			
1	37.15	33.43	3.72
2	89.63	80.48	9.16
3	71.37	64.21	7.16
4 - UD	4.76	4.19	0.58
4 - RD	94.02	82.62	11.40
4 - LH	35.58	31.27	4.31
5 - RD	15.66	13.78	1.87
5 - LH	1659.77	1474.64	185.13
6	15.78	14.23	1.55
7	14.55	13.28	1.27
8	13.72	12.44	1.27
9 - RD	104.08	93.40	10.68
9 - LH	246.42	221.14	25.29
10 - RD	0.60	0.53	0.07
10 - LH	85.49	74.69	10.80
11	46.65	41.81	4.83
12	20.14	18.07	2.07
13	9.49	8.51	0.97
14	0.73	0.54	0.06
15	8.40	6.56	0.67
16	87.98	64.00	7.21
17	8.92	6.85	0.82

Note: Vehicle groups 5 and 10 include the savings from including trailers in the HDV CO_2 standards.

Based on our estimates, the current regulation will avoid 201 Mt of cumulative CO_2 emissions in the period 2020–2035. Such a large number is expected, as the European Commission selected several of the most important vehicle groups to be regulated first. However, extending the standards to cover other vehicle groups could substantially increase the overall benefits of the regulation: the *Currently certified* scenario could increase the benefits by 18%, the *Trailer* scenario by another 24%, and finally the *All heavy trucks* and *Light and medium lorries* scenarios by an additional 3% and 5%, respectively, as shown in Figure 7.

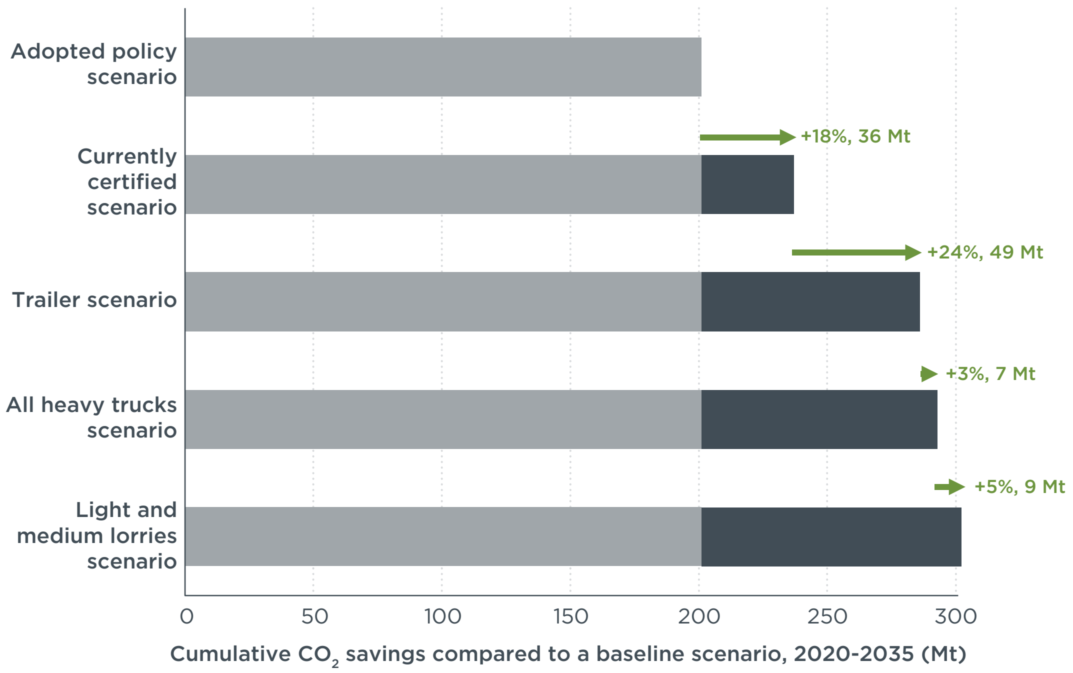

Figure 7. Additional cumulative CO_2 savings from extending the heavy-duty CO_2 standards to additional vehicle groups compared to the Adopted policy scenario, for the period 2020–2035. The green arrows show the relative increase in CO_2 savings relative to the previous scenario, and the green data labels show the relative increase in CO_2 savings compared to the Adopted policy scenario.

The largest additional savings would result from applying CO_2 targets to trailers—that is, an additional 24%, or 49 megatonnes, reduction in total CO_2 emissions from heavy-duty vehicles in the 2020–2035 period. As the extension of the CO_2 determination regulation to trailers is already under discussion, also including these in the heavy-duty CO_2 standards would be facilitated. The second largest savings would come from extending the standards to vehicle groups 1, 2, 3, 11, 12, and 16, which are already covered by the certification regulation, providing an additional 18%, or 36 megatonnes, reduction in overall CO_2 emissions from heavy-duty vehicles. Together, these two scenarios would increase the savings currently expected from the regulation by 42%, or 85 megatonnes CO_2 in the next 15 years.

Additional savings could be achieved by extending the standards to light and medium lorries. Although sales volumes are significant in these segments, the low distance-specific CO_2 emissions from these lighter trucks would result in smaller savings in the order of 5%, or 9 megatonnes CO_2. Finally, an extension to vehicle groups 6, 7, 8, 13, 14, 15, and 17 would result in an additional reduction of 3%, or 7 megatonnes CO_2. The latter groups are not yet part of the CO_2 determination regulation, and the relatively low market shares of trucks in these segments—3.9% of heavy-duty trucks altogether—explain these relatively small additional benefits.

Altogether, extending the current regulation to cover all vehicle groups and trailers could increase the CO_2 emission savings by 50.3%. Although this analysis does not cover buses, extending the regulation to this vehicle group would result in even larger additional savings.

Conclusions

Under the current state of the regulation, the heavy-duty CO_2 standards introduce emissions reduction targets for the four largest truck segments in terms of market shares—vehicle groups 4, 5, 9, and 10—which together would account for 81% of cumulative CO_2 emissions in the period 2020–2035 in the absence of the currently adopted CO_2 standards. Our study found that this would lead to significant CO_2 emissions savings of around 200 megatonnes in the period 2020–2035, ignoring any loss in benefits due to flexibilities in the regulation, such as the ZLEV incentives.

However, a significant proportion of the CO_2 emissions from the sector remain unaffected by the regulation. Our study shows that significant additional savings could be obtained by extending the heavy-duty CO_2 standard to other truck segments as well as semi-trailers. As the extension of the scope of the heavy-duty standards will be considered in the 2022 review of the regulation, our findings show that the benefits of the current regulation could be increased by up to 50% by extending the standards to cover all currently unregulated vehicle groups and trailers. In particular:

» Extending the current CO_2 emissions reduction targets of 15% and 30% by 2025 and 2030, respectively, to vehicle groups 1, 2, 3, 11, 12, and 16, which are already covered by the CO_2 certification regulation, would lead to additional savings of 18%, or 36 megatonnes of CO_2, compared to the adopted policy scenario.

» Applying specific CO_2 performance targets to semi-trailers with a box body would drive the adoption of emissions reduction technologies, such as boat-tails, side skirts, lightweighting, and low rolling resistance tires, that considerably reduce CO_2 emissions from long-haul tractor-trailers. According to our model, additional savings of up to 24%, or 49 megatonnes of CO_2, could be obtained by setting standards that would mandate a 10% improvement in the CO_2 performance of semi-trailers by 2030. The European Commission is in the process of extending the CO_2 certification regulation to trailers, enabling the development and adoption of ambitious CO_2 performance standards that exploit the large technology potential available to improve semi-trailers, trailers, and bodyworks.

» Including light and medium lorries into the scope of the CO_2 standards —the CO_2 certification procedure for medium lorries is under development—would lead to additional savings of 5%, or 9 megatonnes of CO_2, compared to the adopted policy scenario. Additionally, extending the targets to buses—which will also be covered by the upcoming amendments of the CO_2 certification procedure—would lead to further CO_2 benefits. However, the latter were not quantified, as buses were outside of the scope of this analysis.

» Applying targets to the remaining heavy truck segments would lead to less benefits. These vehicle categories are not yet covered by the CO_2 certification regulation, and it is unclear whether they will become part of the scope of the upcoming amendments.

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Appendix: Summary of the CO_2 inventory model input data

Table A1. Summary of the input data for the inventory of the total heavy-duty tailpipe CO_2 emissions in the period 2020–2035.

Vehicle group	2020 distance specific CO_2 emissions (g/km)	Reference annual VKT (km)	TRACCS equivalent vehicle type (Emisia et al. 2013) for VKT degradation[a]	2019 sales[b]
Light and medium lorries (<7.5 t)				
N1 vans	218	33,385	N1 Light Commercial Vehicle	50,000[c]
N2 vans	218	33,385	N1 Light Commercial Vehicle	11,739
N2 medium trucks	626	62,000	Rigid (<= 7.5t) HDT	11,739
Heavy-duty trucks (>=7.5 t)				
1	626	62,000	Rigid (<= 7.5t) HDT	4,861
2	651	62,000	Rigid (7.5 – 12t) HDT	12,424
3	782	62,000	Rigid (14 – 20t) HDT	12,582
4 – UD	814	60,000	Rigid (14 – 20t) HDT	1,182
4 – RD	626	78,000	Rigid (14 – 20t) HDT	23,329
4 – LH	784	98,000	Rigid (14 – 20t) HDT	5,611
5 – RD	862	78,000	Articulated (34 – 40t) HDT	1,959
5 – LH	783	116,000	Articulated (34 – 40t) HDT	153,734
6	626	53,000	Rigid (12 – 14t) HDT	3,619
7	782	53,000	Rigid (14 – 20t) HDT	3,041
8	1095	60,000	Articulated (34 – 40t) HDT	2,532
9 – RD	697	73,000	Rigid (20 – 26t) HDT	18,019
9 – LH	873	108,000	Rigid (20 – 26t) HDT	23,024
10 – RD	854	68,000	Articulated (34 – 40t) HDT	88
10 – LH	806	107,000	Articulated (34 – 40t) HDT	8,457
11	961	75,000	Rigid (20 – 26t) HDT	5,758
12	990	105,000	Articulated (34 – 40t) HDT	1,729
13	990	60,000	Rigid (20 – 26t) HDT	1,556
14	1095	60,000	Articulated (34 – 40t) HDT	83
15	990	51,250	Rigid (28 – 32t) HDT	1,746
16	1095	60,000	Rigid (28 – 32t) HDT	11,475
17	990	60,000	Rigid (> 32t) HDT	1,261

[a] Data from Emisia et al. (2013)

[b] Historical data supplied by IHS Global SA; Copyright © IHS Global SA, 2019.

[c] Data from ACEA (2019b)