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The EU heavy-duty CO_2 standards: Impact of the COVID-19 crisis and market dynamics on baseline emissions

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Introduction

Regulatory and economic context

In February 2019, the European Union adopted its first-ever CO_2 emission performance standards for heavy-duty vehicles (HDVs).[1] The regulation mandates fleet-wide average emission reductions of 15% in 2025 and 30% in 2030 for new vehicles compared to the performance reported by manufacturers in the baselining period, which ran from July 1, 2019 to June 30, 2020.

In 2022, a review of the regulation will consider several policy elements necessary to align the standards with the EU's CO_2 emission mitigation strategy for the transportation sector. These include an evaluation of the appropriateness of the 2030 target, the introduction of new targets for 2035 and 2040, and validation of the baseline CO_2 emissions. The latter aims to ensure the integrity of the official CO_2 emissions reported by manufacturers; an inflated baseline would reduce the burden on manufacturers to meet the CO_2 emission standards.

Thus, it is crucial to understand how the baseline CO_2 emissions were affected by factors such as market composition and industry competition. During the baseline reporting period, the COVID-19 crisis has had a considerable impact on the economy. Freight activity declined significantly due to containment measures, a unique event that will strongly define baseline CO_2 emissions.

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1 European Commission, "Regulation (EU) 2019/1242 of the European Parliament and of the Council of 20 June 2019 Setting CO2 Emission Performance Standards for New Heavy-Duty Vehicles and Amending Regulations (EC) No 595/2009 and (EU) 2018/956 of the European Parliament and of the Council and Council Directive 96/53/EC," *Official Journal of the European Union* L 198 (July 25, 2019), https://eur-lex.europa.eu/eli/reg/2019/1242/oj#d1e1921-202-1.

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Scope

This paper presents an analysis of the truck market in the EU for 2020 in order to identify which factors influenced the baseline and how they affected it. This entails assessing the market composition during the baselining period in terms of vehicle segments and manufacturers, and comparing it with historical data. The analysis also estimates the effects of the COVID-19 crisis on the baseline, although this can only be done with a limited degree of certainty.

The analysis presented in this paper focuses on the 27 countries that currently make up the European Union, excluding the United-Kingdom (EU-27). Only trucks with gross vehicle weights (GVW) of 7.5 tonnes and above are considered, excluding light and medium lorries and buses, which follow different market dynamics.

The paper begins with a general overview of HDV market trends over the past years and provides a snapshot of the situation over the baselining period. Next, it estimates the impacts of the crisis linked to the COVID-19 pandemic, looking at the changes it introduced in the market dynamics. The third section provides an estimate of the baseline emissions for the largest truck makers, based on their sales segmentation, and discusses how it was influenced by the main findings from the previous sections.[2] Finally, we present conclusions and policy recommendations.

Market overview

The market composition across manufacturers and truck segments, as defined by the CO_2 emissions certification regulation, has important implications on the climate benefits of the CO_2 emission standards.[3] Given the weight that the baseline CO_2 emissions have on the latter, key market characteristics during the baselining period are identified below and compared against historical data.[4] This provides insight into the impact of the recent market downturn on the heavy-duty vehicle market, and the possible implications for the CO_2 emissions baseline. Historical data are taken from 2008 onwards, which marked a significant downturn in sales due to the global financial crisis.

General industry trends

Since the global financial crisis of 2008, sales of heavy-duty trucks above 7.5 tonnes have increased steadily, as shown in Figure 1. In particular, there was considerable growth between 2014 and 2018, with overall sales volumes increasing from about 200 thousand units to about 300 thousand units in 2019, representing a 50% growth in 4 years. Since 2016, sales volumes have fallen back to pre-2008 financial crisis levels. However, truck sales stagnated in 2019, and signs of a market decline were already apparent in the early months of 2020, prior to the COVID-19 containment measures. It is likely that the COVID-19 crisis will exacerbate this trend, leading to lower sales volumes for 2020, and potentially for the years to come. An analysis of the impact of the COVID-19 crisis is presented further in this paper.

2 The European Environment Agency will publish the official baseline values in April 2021.

3 European Commission, "Regulation (EU) 2017/2400 of 12 December 2017 Implementing Regulation (EC) No 595/2009 of the European Parliament and of the Council as Regards the Determination of the CO_2 Emissions and Fuel Consumption of Heavy-Duty Vehicles and Amending Directive 2007/46/EC of the European Parliament and of the Council and Commission Regulation (EU) No 582/2011," *Official Journal of the European Union* L 349 (December 29, 2017): 20, http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=OJ:L:2017:349:TOC.

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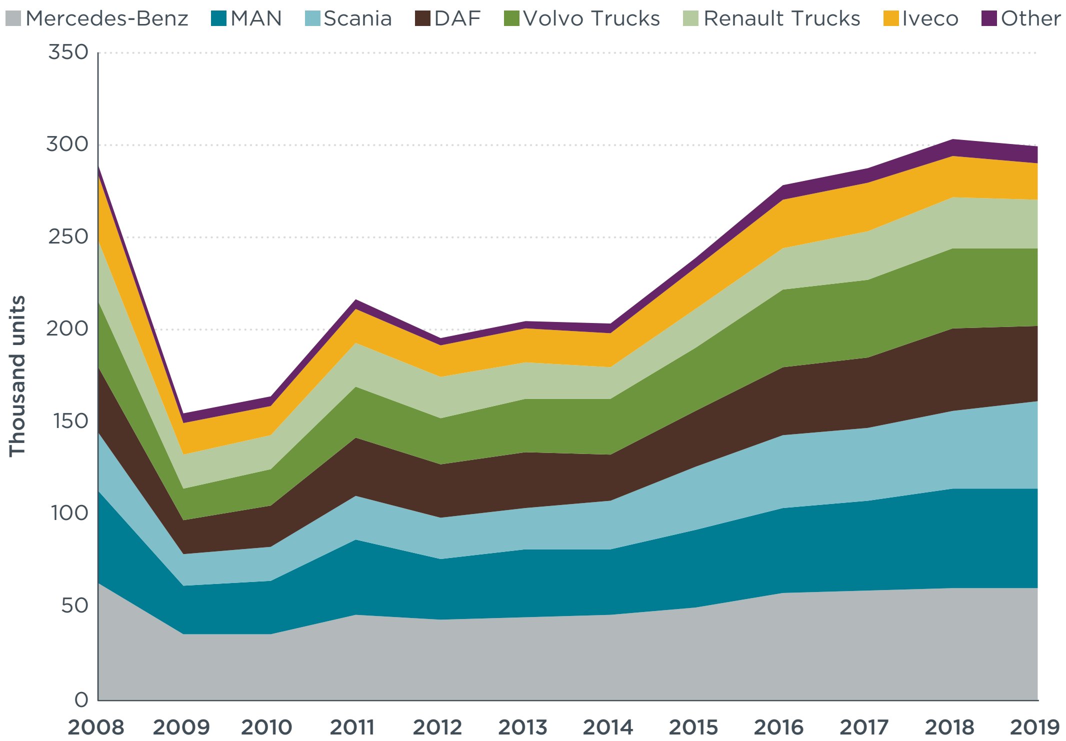

Figure 1. Sales of new trucks ≥ 7.5 tonnes in the EU, by manufacturer.

The European truck market is very consolidated overall, with 7 brands from 5 parent manufacturers accounting for almost the totality of the market shares. This is particularly the case within the regulated vehicle segments (see below), for which the top 5 manufacturers held around 99% of the market share in the baselining period, as shown in Figure 2. In non-regulated groups of heavy-duty trucks above 7.5 tonnes, however, this phenomenon is less pronounced and smaller manufacturers collectively held a 12% market share over the same period due to the presence of niche markets within these groups, such as for municipal utility and specialized construction trucks. Market shares among the top 5 manufacturers have been stable for more than 10 years and were not impacted by the 2008 financial crisis, as highlighted in Figure 1.

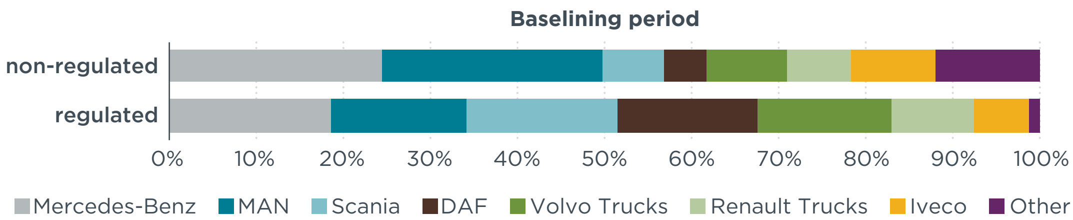

Figure 2. Market shares during the baselining period, by manufacturer, for both regulated and non-regulated vehicle segments.

During the baselining period, Volkswagen's subsidiary TRATON was the top-selling manufacturer, with its brands MAN and Scania together making up 33% of the market for all trucks. Mercedes-Benz (Daimler) was the top-selling brand with a 20% market share. Together, the top 2 manufacturers, TRATON and Volvo Group, with its brands Volvo Trucks and Renault Trucks, gathered a 56% market share. The top 3 parent manufacturers, including Daimler, accounted for 76%.

A direct consequence of the degree of consolidation observed in the market is that a single manufacturer can have a large influence on the overall fleet CO_2 emissions performance. This is particularly the case within the vehicle segments targeted by the regulation, in which the market is even more consolidated.

To further understand the market dynamics, it is therefore important to study the fleet composition of the different manufacturers and how it evolved over time.

Fleet segmentation according to the regulatory vehicle groups

The CO_2 emissions certification regulation segments HDVs into 17 vehicle groups according to their Gross Vehicle Weight (GVW), chassis configuration (rigid or tractor-trailer), and axle type.

These technical considerations yield the so-called VECTO groups, listed in Table 1, VECTO being the simulation tool developed by the European Commission for the certification of the CO_2 emissions from newly registered trucks. This analysis only covers trucks with a GVW of 7.5 tonnes and above; that is VECTO groups 1 to 17.

Table 1. HDV classification for the purpose of CO_2 emissions certification.

Axle type	Chassis configuration	Gross vehicle weight (tonnes)	Vehicle groups	Date of certification requirement
4x2	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.
	Tractor	>16	5	
4x4	Rigid	7.5 – 16	6	Not considered by the certification regulation
	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.
	Tractor	all weights	10	
6x4	Rigid	all weights	11	July 1, 2020 for new registrations.
	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

Note: Only the vehicle groups highlighted in yellow form part of the scope of the CO_2 emission standards. The groups highlighted in orange form part of the scope of the certification regulation, but not that of the emission CO_2 standards. The groups in grey are not considered in either regulation.

In the current regulation, the targets for CO_2 emission reduction only apply to 4x2 and 6x2 rigid and tractor-trailers trucks with a GVW of 16 tonnes or above, corresponding to VECTO groups 4, 5, 9 and 10. Together these groups account for 77% of all the sales of trucks at or above 7.5 tonnes, as shown in Figure 3. Conversely, 23% of new truck sales, or approximately 65 thousand units in 2019, are not covered by CO_2 emission standards.

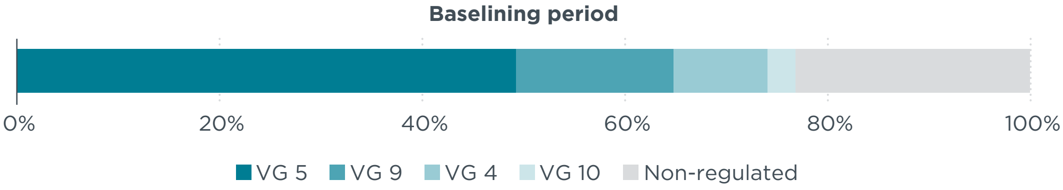

Figure 3. Shares of regulatory vehicle groups (VG) in the ≥ 7.5 tonnes trucks market in the baselining period.

Within the regulated vehicle groups, tractor-trailers are the most common type of heavy-duty trucks, representing 67% of sales. Tractor-trailers with a 4x2 axle configuration—that is, vehicle group 5—account for 95% of all new regulated tractor-trailers. Rigid trucks, also known as straight trucks, are less represented within the regulated groups with only 33% of the sales share. However, they represent over 90% of the sales in non-regulated groups, which are mainly comprised of urban delivery trucks—VECTO groups 1 to 3—as well as vocational trucks, such as construction trucks.

Looking at historical data, plotted on Figure 4, market shares from non-regulated vehicle groups have increased slightly over time to reach a significant 23% over the baselining period.[5] During this period, 54% of all truck sales—including both regulated and non-regulated vehicle groups—were tractor-trailers and 46% were rigid trucks. Overall, the fleet composition has seen little change over the past 12 years.

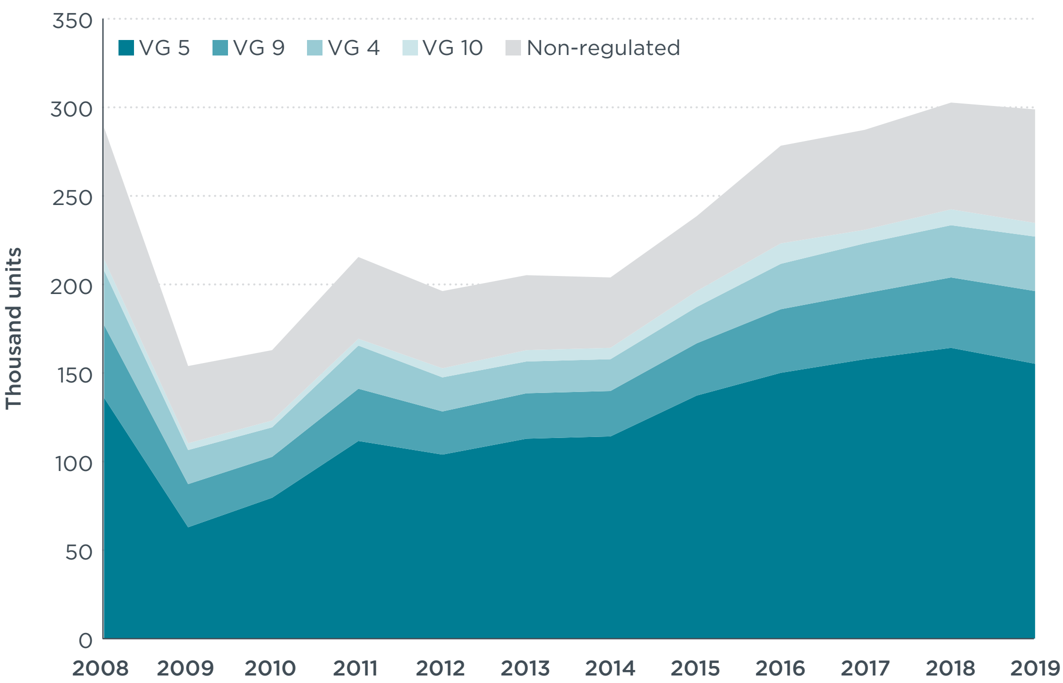

Figure 4. Historical data for the segmentation of the market of trucks ≥ 7.5 tonnes, according to regulatory vehicle groups (VG).

For the purpose of the HDV CO_2 emission standards, regulated vehicle groups are further divided into subgroups according to engine size and cabin type to account for their typical mission profiles: Urban Delivery (UD), Regional Delivery (RD), or Long Haul (LH). For each vehicle subgroup, the HDV CO_2 emission standards define a mileage and payload weighting factor (MPW) to account for the relative freight activity of each subgroup. Definitions of these subgroups, and the respective MPWs, can be found in Table 2.

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

Table 2. Vehicle subgroups for the purpose of the CO_2 emission standards.

Group description	Vehicle group	Vehicle subgroup[a]	Cabin type	Engine power	MPW[b]
Rigid, 4x2 axle, GVW > 16 t	4	4-UD	All	< 170 kW	0.099
		4-RD	Day cab	≥ 170 kW	0.154
			Sleeper cab	≥ 170 kW and < 265 kW	
		4-LH	Sleeper cab	≥ 265 kW	0.453
Tractor, 4x2 axle, GVW > 16 t	5	5-RD	Day cab	All	0.498
			Sleeper cab	< 265 kW	
		5-LH	Sleeper cab	≥ 265 kW	1.000
Rigid, 6x2 axle	9	9-RD	Day cab	All	0.286
		9-LH	Sleeper cab		0.901
Tractor, 6x2 axle	10	10-RD	Day cab	All	0.434
		10-LH	Sleeper cab		0.922

[a] UD: Urban Delivery. RD: Regional Delivery. LH: Long-haul
[b] MPW: Mileage and payload weighting factor.

The relative shares of these regulated subgroups as a total of all truck sales from the regulated groups are plotted in Figure 5. Based on the two data sets available for 2017 and 2019, the relative shares of the regulated subgroups appear to be steady over the past few years.[6]

Long-haul tractor-trailers account for the large majority of heavy-duty truck sales. Subgroup 5-LH alone represents almost two-thirds of the regulated truck sales and therefore has a considerable weight in the computation of the fleet-average baseline emissions. Overall, subgroups representing long-haul trucks make up 84% of the sales within regulated groups. Urban delivery trucks, which are represented by subgroup 4-UD only, account for less than 1% of sales and are therefore under-represented in the scope of the HDV CO_2 emission standards. Although vehicle groups 1 through 3, which are mainly used for urban delivery purposes, represent 10% of the total trucks sales, this significant segment is not covered by the standards.

6 Data for 2017 obtained from Alessandro Tansini et al., "Analysis of VECTO Data for Heavy-Duty Vehicles (HDV) CO2 Emission Targets," EUR - Scientific and Technical Research Reports (Publications Office of the European Union, 2018), JRC112015, https://doi.org/10.2760/819951. Data for 2019 obtained from ACEA, "CO2 Emissions from Heavy-duty Vehicles – Preliminary CO2 Baseline (Q3-Q4 2019)" (European Automobile Manufacturers Association, March 2020), https://www.acea.be/publications/article/paper-co2-emissions-from-heavyduty-vehicles-preliminary-co2-baseline.

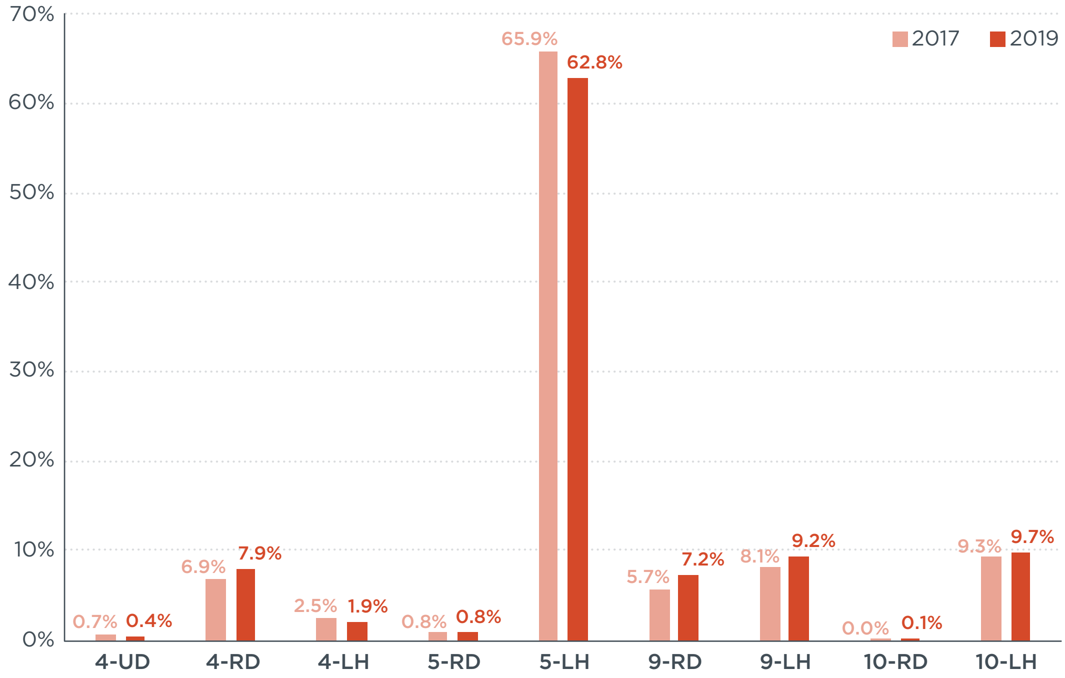

Figure 5. Regulated subgroups relative market penetration, as a share of total sales from regulated groups.

Although the market-wide fleet composition has been mostly stable over time, there are large discrepancies in the fleet composition of the different leading manufacturers. To evaluate the exact composition of the new vehicles fleet during the baselining period, data for the second half of 2019 is estimated from the available 2019 yearly registration data.[7] Sales of trucks are not constant throughout the year and vary monthly, with sales being higher in certain periods of the year. To obtain the composition of the new vehicle fleet for the entire baselining period, we apply distribution statistics from ACEA to the overall 2019 sales volumes and the available data for the first half of 2020 to obtain the composition of the new vehicles fleet for the entire baselining period.[8]

Figure 6 presents the composition of the fleet of new vehicles for the best-selling brands, together with their overall sales volumes and market shares during the baselining period. The two best-selling brands, Mercedes-Benz and MAN, which respectively gathered 20% and 18% of the market shares over the baselining period, have very similar fleet compositions, with large shares of non-regulated groups and below-average shares of tractor-trailers, that is groups 5 and 10.

On the other hand, tractor-trailers, which are regulated by the CO_2 emissions standards, represent about three quarters of DAF's truck fleet and only 8% of the fleet are from non-regulated segments. Scania and Volvo Trucks, which have similar fleets compositions and sales shares, have intermediate shares of long-haul tractors and relatively low shares of non-regulated groups. Renault Trucks has a higher share of rigid trucks in the regulated segments, with groups 4 and 9 together accounting for a third of their fleet. Finally, Iveco has a similar fleet composition to that of Mercedes-Benz, but with approximately one-third of the sales volume.

7 Content supplied by IHS Global SA; Copyright © IHS Global SA, 2019.

8 Distribution data from ACEA - European Automobile Manufacturers' Association, "Commercial Vehicle Registrations: -33.7% First Half of 2020; -20.3% in June | ACEA - European Automobile Manufacturers' Association," July 23, 2020, https://www.acea.be/press-releases/article/commercial-vehicle-registrations-33.7-first-half-of-2020-20.3-in-june. For sales data, content supplied by IHS Global SA; Copyright © IHS Global SA, 2020.

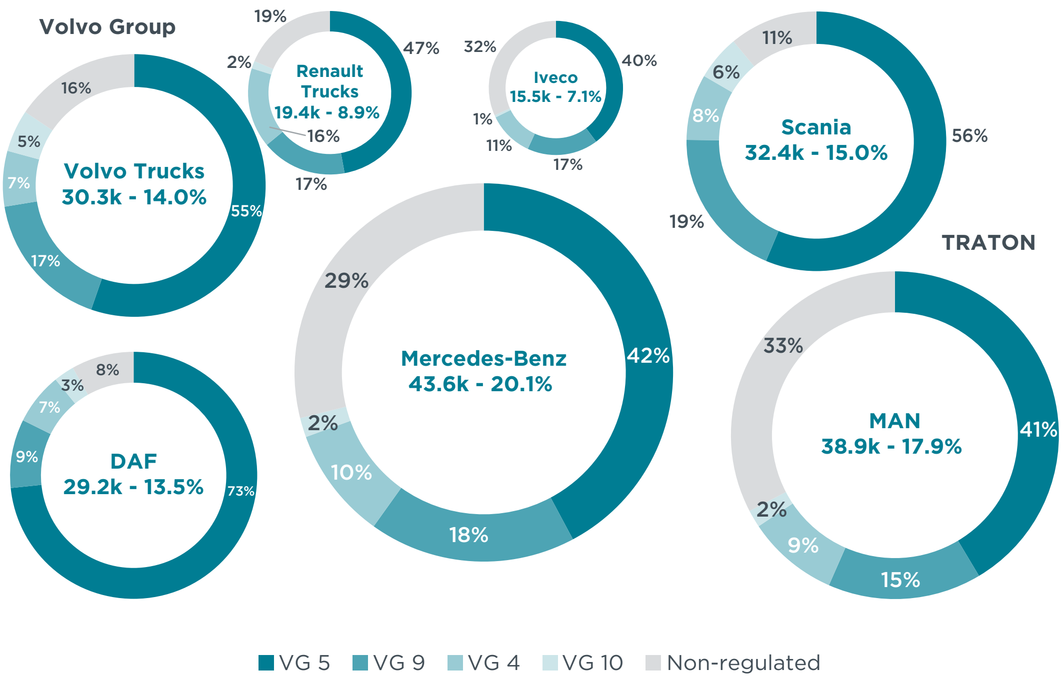

Figure 6. Market shares and composition of new vehicles fleet, in terms of vehicle groups (VG), of the best-selling brands in the EU over the baselining period. The area of the rings is proportional to the market shares. Market shares and fleet compositions for the second half of 2019 were assumed to be the same as for the entire year.

Status quo of the adoption of alternative powertrains

To meet their respective CO_2 emission targets, truck manufacturers will have to significantly improve the performance of their fleet by adopting emission reduction technologies. While diesel trucks still account for about 98% of the market, the adoption of zero- and low-emission HDVs (ZLEV) is set to become an important compliance pathway for manufacturers to reduce their fleet-wide CO_2 emissions to the required levels. Zero-emission technologies include battery electric and fuel cell electric trucks, which have no tailpipe CO_2 emissions. A truck is considered low emission if its CO_2 emissions are less than half of the baseline CO_2 emissions of the respective subgroup. Low-emission trucks typically consist of hybrid technologies. The CO_2 standards contain incentives for manufacturer to adopt ZLEV technologies by providing more lenient CO_2 emission targets to manufacturers that will exceed a given ZLEV sales share benchmark, currently defined as 2% of their new truck fleets, and by allowing them to accumulate early credits in the 2019-2024 period.

Figure 7 shows the number of new hybrid-electric, battery electric, and natural gas truck registrations in the EU between 2008 and 2019. As shown, the sales of electrified trucks are still unsignificant and limited to a few units. Moreover, among the 810 electrified trucks sold in the entire period, of which about a half were hybrids and the other half purely electric trucks, only 142—or 18%—were in the regulated vehicle groups. Fuel cell trucks, which are another promising zero-emission technology, have not yet achieved any market penetration, although a few prototypes are currently being tested.

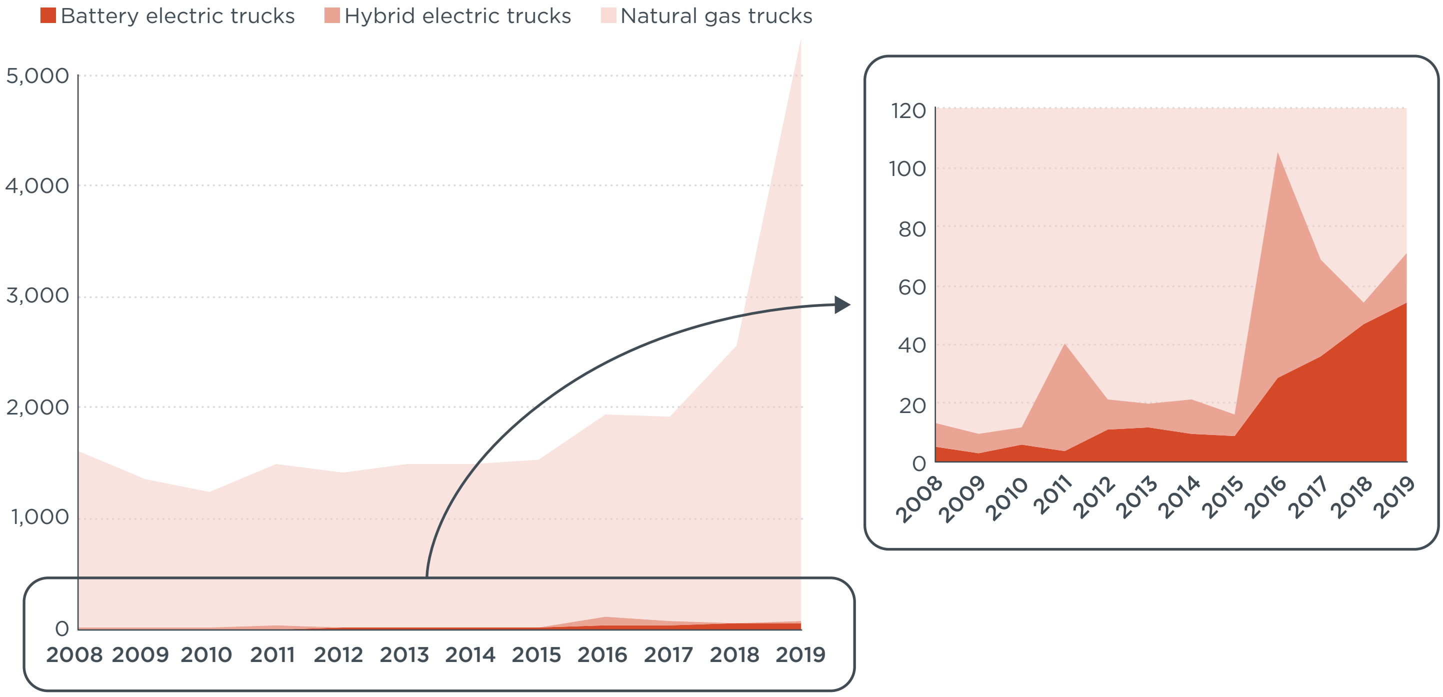

Figure 7. Registration of new hybrid-electric, battery electric and natural gas trucks in the EU between 2008 and 2019.

Uptake of Liquified Natural Gas (LNG) in tractor-trailer trucks

Despite the mounting scientific evidence to the contrary,[9] some industry stakeholders are making the case that natural gas trucks are a promising technology to reduce the tailpipe CO_2 emissions from long-haul freight transportation, due to the low carbon content per MJ of natural gas compared to diesel.[10] Manufacturers are able to comply with the CO_2 emission targets by investing in natural gas trucks, and this is encouraged by several regulatory and fiscal incentives.[11] Figure 7 shows that natural gas trucks have been much more widely adopted than ZLEV trucks over the past decade. Moreover, sales have rapidly increased in the past few years, from under 1,844 units in 2017 to 5,262 units in 2019—almost a threefold increase in two years. In 2019, 94% of the natural gas truck sales were in the regulated groups, of which 62% were in group 5. For these long-haul tractor-trailers, liquified natural gas (LNG) is the main gas technology being considered.

To further evaluate the adoption natural gas trucks, the market penetration of LNG tractor-trailers was assessed for the main manufacturers, as this was identified as the main application of natural gas technologies in the industry. Figure 8 presents the evolution of the relative shares of LNG trucks in the manufacturers' fleets for vehicle group 5 only.

9 Moritz Mottschall, Peter Kasten, and Felipe Rodríguez, "Decarbonization of On-Road Freight Transport and the Role of LNG from a German Perspective" (Washington, D.C.: Institute for Applied Ecology (Öko-Institut e.V.), May 12, 2020), https://theicct.org/publications/on-road-freight-lgn-germany.

10 Matteo PRUSSI et al., *JEC Well-to-Tank Report V5* (LU: Publications Office, 2020), https://data.europa.eu/doi/10.2760/959137.

11 Mottschall, Kasten, and Rodríguez, "Decarbonization of On-Road Freight Transport and the Role of LNG from a German Perspective."

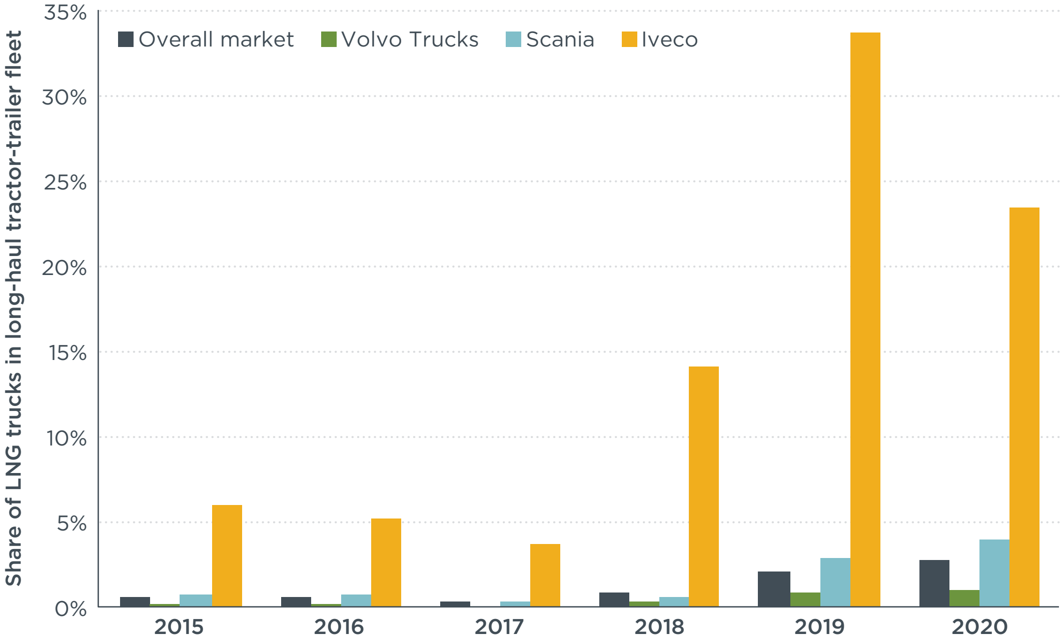

Figure 8. Evolution of the shares of LNG trucks in new long-haul tractor-trailer registrations for the main manufacturers.

Overall, there has been considerable growth in the adoption of LNG trucks over the past five years for three of the main manufacturers—Iveco, Scania, and Volvo Trucks—whereas the remaining manufacturers have not yet adopted this technology. While LNG trucks still represent low shares of the long-haul tractor-trailers for Volvo Trucks and Scania—1% and 4%, respectively—they are now a considerable portion of Iveco's new vehicle fleet, representing 34% and 24% of the manufacturer's group 5 truck sales in 2019 and 2020, respectively. Figure 9 shows the market shares in the LNG market during the baselining period. Iveco accounts for over two-thirds, or 69.9%, of the LNG truck sales in this period despite being the smallest manufacturer. Scania and Volvo, which have similar fleet sizes, share the rest with 24% and 6%, respectively.

Given the overall market shares of Iveco, and the investments that they have made in adopting LNG technologies in the past years, it is most likely that LNG trucks will be the main compliance pathway for this manufacturer. Yet, the two leading manufacturers overall, Mercedes-Benz and MAN, have not endorsed this strategy, and LNG trucks remain negligible proportions of their fleet.[12] This shows the differing opinions in the industry about this technology, which, despite its tailpipe CO_2 emissions reduction potential, does not necessarily have a climate benefit when looking at total well-to-wheel (WTW) greenhouse gas (GHG) emissions. In fact, especially due to methane leakage during the

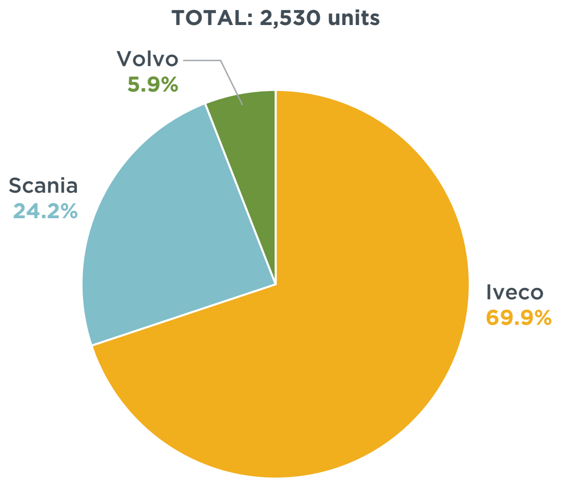

Figure 9. Market shares in the LNG long-haul tractor-trailer truck market in the baselining period.

12 Daimler Trucks' CEO, Martin Daum, states: "... natural gas drives also emit CO_2 and would only be an expensive transition technology on the road to CO_2-neutral transport. Therefore, it's not worth pursuing natural gas further." Daimler, "The road to CO_2-neutral transport," accessed November 23, 2020, https://www.daimler-truck.com/innovation-sustainability/efficient-emission-free/co2-neutral-transport.html.

production, transport, and combustion of natural gas, LNG trucks were even found to perform worse than diesel trucks when assessing WTW GHG emissions for these two technologies in the medium term.[13]

The adoption of alternative CO_2 and GHG emission reduction technologies by truck manufacturers will have to ramp up in the coming years for the CO_2 standards to achieve the EU's overall CO_2 mitigation strategy. While this trend appears to be already underway when looking at the evolution of sales in the past few years, the COVID-19 crisis might lead to difficulties for manufacturers in introducing these technologies to the market. The following section of the paper assesses qualitatively and quantitatively—as much as the available data allows—the main implications of the pandemic on market dynamics.

Impact of the COVID-19 crisis

To assess the impact of the COVID-19 crisis, market data for the first half of 2020 are compared to the same period in the previous two years. Part of the changes observed are linked with the COVID-19 crisis, and part are linked to the deceleration in sales that was already identifiable in the early months of 2020, prior to any containment measures. The estimated contribution of the pandemic to these trends is based on best available data, however it should be noted that high levels of uncertainty remain in this estimation.

Impact on sales volumes

The statistics from ACEA on the monthly variations in sales have been combined with the available annual registration data to assess the impact of the pandemic on overall sales volumes.[14] Table 3 shows the total sales volume of new trucks per half-year (H1 for the first half of the year, H2 for the second half) for 2018, 2019, and 2020. Overall, there was a large decline in truck sales in 2020. New truck registrations were down by 46% in the first half of 2020 compared to the same period in 2019. Specifically, there were major losses in sales in the lockdown period (March-June), which in 2019 accounted for as much as 42% of the annual sales. While it is hard to anticipate the market behavior in the last months of 2020, truck registrations in 2020 will likely be well below 2019 values.

Table 3. Total sales volumes of new trucks per half year for 2018, 2019, and 2020.

Year	2018	2019	2020
H1 sales (thousand units)	156	179	97
H2 sales (thousand units)	147	121	-
Total Sales (thousand units)	**303**	**300**	-

There are some caveats that need to be considered when comparing H1 data for 2019 and 2020. The sales in 2018, in which total sales volumes were very similar to 2019, were evenly distributed across the year, as shown in Table 3. On the contrary, the sales in 2019 were particularly concentrated in H1. In fact, 60% of all sales in 2019 occurred in the first half of the year and only 40% occurred in the second half. Figure 10 shows the monthly variations in the EU-27 sales of heavy commercial vehicles with GVW at or above 16 tonnes for 2019 and 2020, normalized to the sales in the corresponding month in 2018. In the years prior to 2018, sales were also more evenly distributed across the year, pointing out the singularity of 2019. This phenomenon emphasizes the sales losses observed in 2020 H1, which are being compared to a value for 2019 that was higher than

13 Mottschall, Kasten, and Rodríguez, "Decarbonization of On-Road Freight Transport and the Role of LNG from a German Perspective."

14 Monthly sales from ACEA - European Automobile Manufacturers' Association, "Commercial Vehicle Registrations." Annual registration data supplied by IHS Global SA; Copyright © IHS Global SA, 2020.

usual. On the contrary, when compared to 2019 H2, for which the sales were already down compared to the first half of the year, the sales from 2020 H1 were only down 20%.

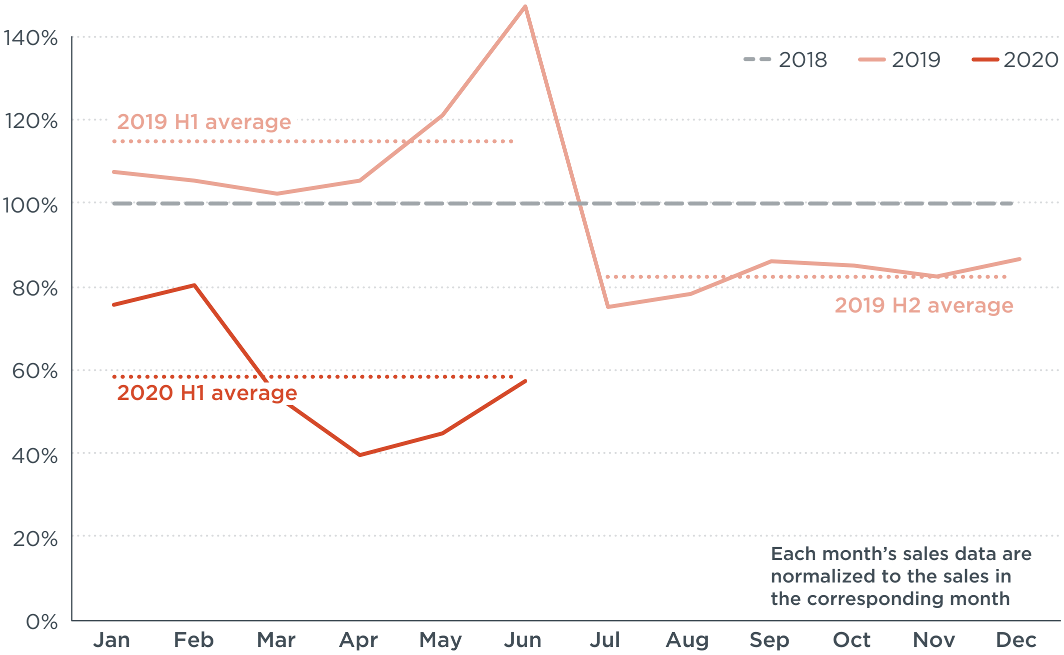

Figure 10. Monthly variations in sales of HDVs with GVW ≥ 16 tonnes, normalized to the sales in the corresponding month in 2018.

To account for this trend, the monthly sales data for 2020 are compared to the corresponding month in 2018, for which the sales were more evenly distributed throughout the year than in 2019. Additionally, 2018 had the highest sales in the past decade, as shown in Figure 1, which, when compared to 2020 data, will result in a worse-case estimate when assessing the impact of the pandemic on sales losses. Overall, 2018 historical data are deemed to be the most suited to assess the impact of the COVID-19 crisis on the sales of new trucks in the EU.

Table 4 shows the losses in new truck sales in the first half of the year, which corresponds to the second half of the baselining period, for the main domestic markets in the EU: Germany, France, Italy, Spain, Poland, and the Netherlands. The smaller markets are grouped together and referred to as *Rest of EU-27* in the table. Overall, sales volumes were down between 29% and 57% in the first half of 2020 compared to the same period in 2018. The smaller markets experienced the biggest losses in 2020 H1 overall with an almost 60% sales deficit compared to 2018, followed by Poland with a 48% loss and the Netherlands with a 38% loss.

Table 4. Sales losses in the first half of 2020 for the main domestic truck markets in the EU-27, compared to the same period in 2018.

Member State	Germany	France	Italy	Spain	Poland	The Netherlands	Rest of EU-27
Losses relative to 2018	-30%	-29%	-34%	-33%	-48%	-38%	-57%

To estimate the sales losses attributed to the pandemic, it is necessary to analyze the market downturn experienced in the pre-COVID-19 months. Figure 11 shows the monthly sales losses in the main domestic markets from January to August 2020. As shown, sales were already down between 5% and 50% in the different European domestic markets in January, before any containment measures were taken to prevent the spread of the pandemic. It is therefore assumed that the impact of the pandemic can be assessed by looking at the trends from February onwards.

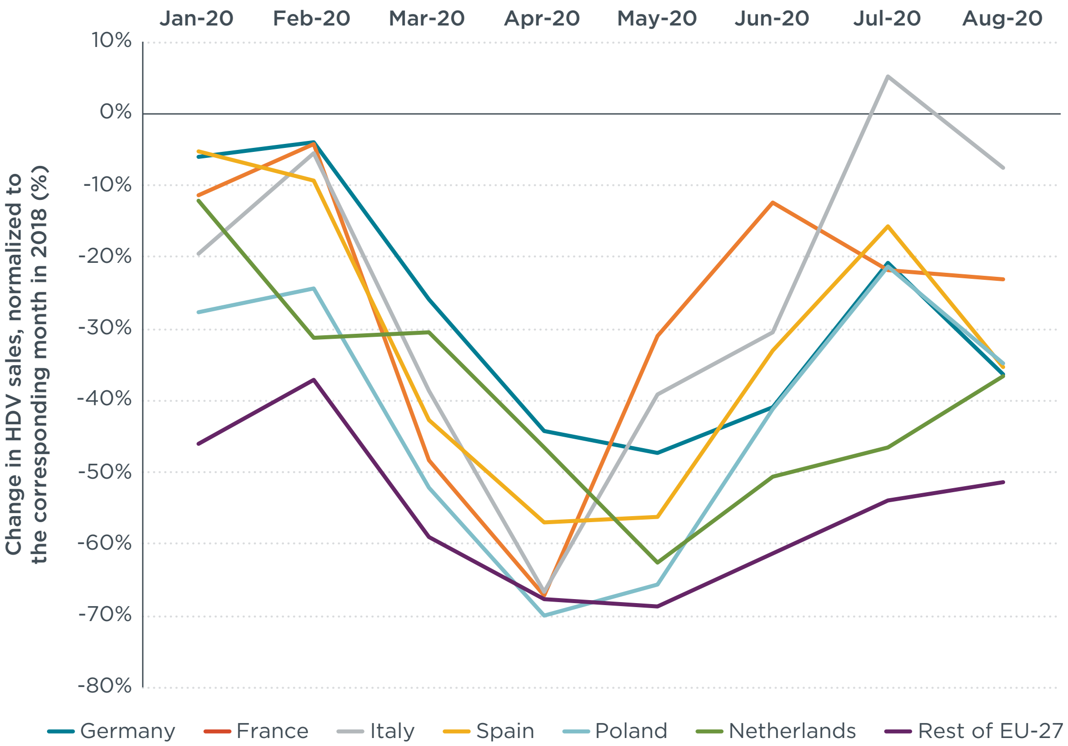

Figure 11. Monthly sales losses for HDVs with GVW ≥ 16 tonnes in the main domestic markets, normalized to the corresponding month in 2018. Source: ACEA - European Automobile Manufacturers' Association, "Commercial Vehicle Registrations."

The main domestic markets in the EU all experienced a V-shaped dip in sales corresponding to the lockdown period, with sales dropping significantly at the start of the lockdown period and recovering as the containment measures were progressively relaxed. The markets were, however, affected with different levels of severity and within different time scales by the COVID-19 crisis.

Sales were the most impacted in France, Italy, Spain, and Poland in the first 2-months of the crisis, as losses compared to the corresponding months in 2018 amounted to up to 65% during this period. This is not surprising when considering that the former three countries were also the most affected countries by the pandemic in its early stages. In other countries, such as Germany and the Netherlands, the impact of the pandemic was delayed slightly as the peak in losses occurred in May rather than April. Signs of recovery were observed starting in May for France and Italy, whereas a similar trend was initiated in June for the other main markets. These identified signs of recovery carried on into July. Although the data for August seem to suggest that an interruption in the recovery for the main markets, this can be attributed to the sales during the reference value, August 2018, being particularly high. In smaller markets (*Rest of EU-27* in the figure), sales were already down 40% in February compared to 2018 levels. Although a similar V-shaped recovery was initiated in June, sales were still down more than 50% in August compares to 2018 levels.

Important elements to consider when looking at the results presented in this subsection are the purchasing cycles and the typical delays between order and registration in the HDV market. A decrease in truck registrations from March might result from a drop in truck orders from a few weeks earlier in January or February. The trends identified from these data seem to suggest that the market was already slowing down from the end of 2019 even before the COVID-19 appeared in Europe, as can be seen in Table 3 and Figure 10 when comparing 2019 H2 to both 2018 H2 and 2019 H1 data. Another element to consider is that the early emergence of the pandemic in China might have led to supply chain issues and impacted the production from January onwards, potentially contributing to the reduction in truck registrations already observed in Figure 11 for the first two months of 2020.

Impact on market shares

Looking at the evolution of manufacturer market shares for 2019 and 2020 (H1), an estimate can be made regarding the impact of the COVID-19 crisis on the market distribution among truck makers. The resulting comparison is plotted in Figure 12. Overall, market shares were not significantly impacted by the pandemic or by the market downturn already underway before the COVID-19 crisis. The only notable change being that Iveco has gained a 2% additional market share in 2020 compared to its performance in 2019. This is an expected result, given that all production lines were impacted in similar ways, as the timescales for plant closures and the social distancing measures adopted when the plants reopen were relatively common across manufacturers.

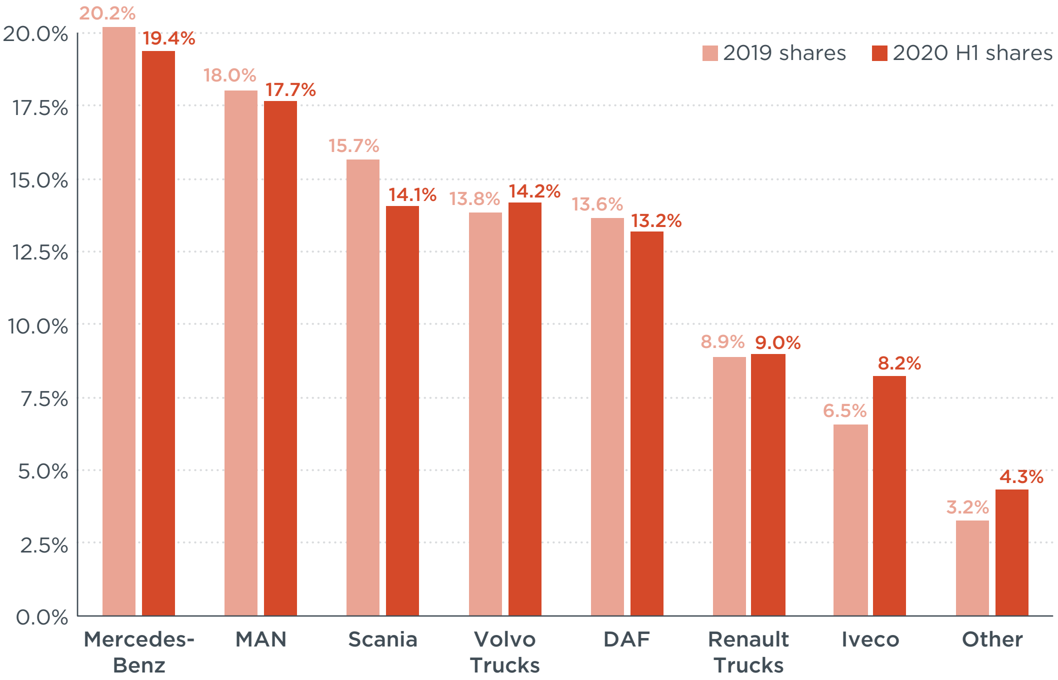

Figure 12. Change in market shares among the main truck manufacturers between 2019 and 2020.

Given that truck production is directly pulled by demand—that is, they do not accumulate stock—production cuts resulting from the containment measures taken to mitigate the spread of the pandemic are not expected to have been a driver for sales losses. However, plant closures could be the cause of the apparent V-shaped recovery in the months following plant closures, as backlogged orders were then produced. A closer examination of the registration data of the second half of 2020 will be needed to confirm or refute any recovery trends.

Additionally, the appearance of a second wave of the pandemic in October and the associated containment measures taken by Member States might change these dynamics. Although the new containment measures are less strict than original ones, which should ensure that the freight activity can continue to recover, smaller original part providers are now facing business difficulties as a result of the prolonged crisis. This has left truck manufacturers worried about their ability to ensure continued production.[15] Thus, any further drop in truck registrations that might be observed in the

15 Henirk Henriksson, remarks from "Putting the EU auto industry back on track post-COVID" (ACEA online conference, October 23, 2020). https://www.acea.be/news/article/video-how-to-ensure-a-strong-and-green-recovery-of-the-eu-auto-industry.

last months of 2020 and beginning of 2021 could be caused by supply issues rather than by a drop in demand.

Impact on fleet composition

Unlike manufacturers' market shares, which remained relatively unchanged, market segmentation changed significantly between the second half of 2019 and the first half of 2020, with tractor-trailers from group 5 loosing 6% in market share to rigid trucks from group 9—up 4%—as well as to non-regulated groups—up 4%. The changes in the composition of the market-wide new vehicle fleet between 2019 and 2020 are highlighted in Figure 13.

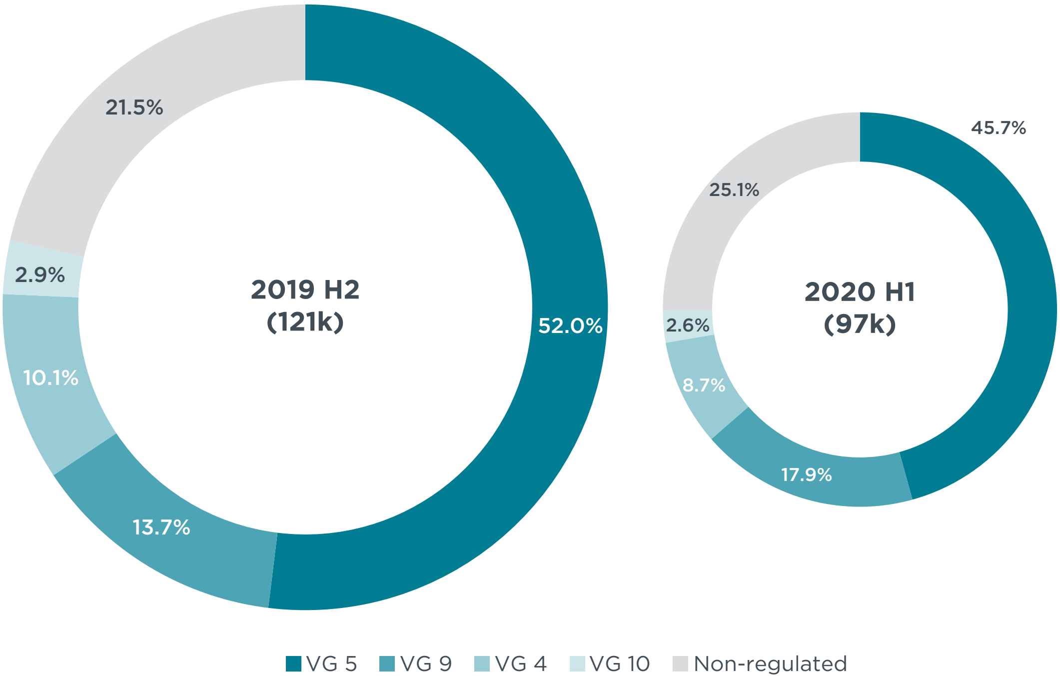

Figure 13. Changes in the composition of the market-wide new vehicle fleet between 2019 and 2020, in terms of regulatory vehicle groups (VG).

For reference, tractor-trailers were also the segment most impacted by the 2008 financial crisis. However, they also recovered the fastest and ended gaining market shares of rigid trucks.[16] Although every crisis is different, it could prove to be the likely recovery pathway in the aftermath of the COVID-19 crisis. In any case, the changes in fleet composition observed in Figure 13 should not be taken as the basis for the evolution of the market in the coming years, but they are useful to assess how the segmentation was impacted during the baselining period.

The changes in the composition of new vehicles fleets observed in this section cannot be attributed, with a high level of certainty, to the sole effect COVID-19 pandemic. However, these changes appear to be extraordinary when compared to the stable market composition observed in Figure 4 for the past decade. Moreover, the pandemic was the primary event that effected the economy, including the transportation sector, in this period. It is therefore likely that the pandemic was the main driver for these identified changes.

16 Felipe Rodríguez, *Commercial Fleet Renewal Programs as a Response to the COVID-19 Crisis in the European Union*, (ICCT: Washington, DC, 2020), https://theicct.org/publications/eu-commercial-fleet-renewal-response-covid-aug2020.

Baseline CO_2 emissions

The reduction targets set by the CO_2 emission standards are defined relative to a fixed baseline obtained from the official reported data from July 1, 2019 to June 30, 2020. The official baseline CO_2 emissions will be published by the European Environment Agency in April 2021.

The baseline is formed by nine separate values, one for each regulated subgroup. The baseline CO_2 emissions of each subgroup, in grams of CO_2 per tonne-km, are determined by simple averaging across all vehicles in each subgroup from all manufacturers registered in the baselining period. For each new truck being sold, the VECTO certified CO_2 emissions are monitored according to the reporting and monitoring regulation, allowing for the simple averaging process over all new truck registrations.[17] However, compliance with the CO_2 emission standards is not assessed for each individual subgroup, but it is evaluated at the manufacturer's fleet level, through a metric dubbed average specific CO_2 emissions, also in gCO_2/t-km.

A manufacturer's average specific CO_2 emissions strongly depend on the composition of its new fleet. Similarly, the CO_2 emissions target used to evaluate compliance, or for the accumulation of credits and debts, is also dependent on the manufacturer's fleet composition (see Figure 14).

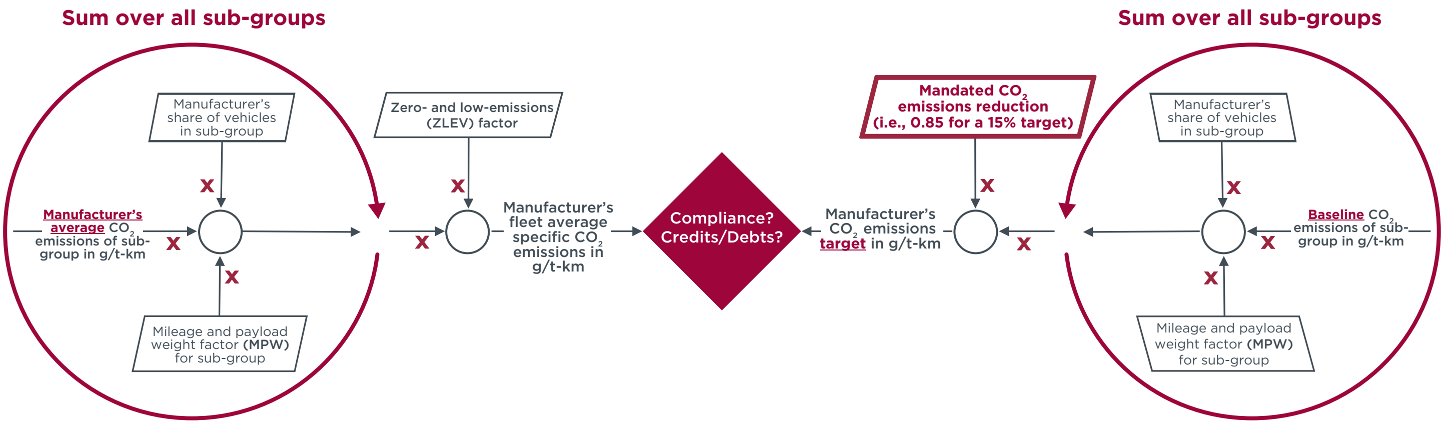

Figure 14. Calculation of the average specific CO_2 emissions of a manufacturer in a given year.

This section evaluates the effect of the fleet composition of each manufacturer on the average specific CO_2 emissions and assess the impact of the market dynamics identified in the previous sections on compliance to the baseline for the leading manufacturers.

Baseline determination, compliance, and early-credits

For each manufacturer, compliance to the baseline is determined by computing the fleet-wide average specific emissions obtained via the methodology illustrated in Figure 14. These average specific emissions are calculated based on the manufacturer's performance in each vehicle subgroup and adjusted to account for the large disparity in freight activity—that is, the differences in payload and annual distance traveled—between vehicle subgroups. This is done through the Mileage and Payload Weighting (MPW) factor. The CO_2 emissions for each subgroup are combined into a single fleet-average value by weighting them by the manufacturer's share of vehicles in the given subgroup and the respective MPW factor (see Table 5).

17 European Union, "Regulation (EU) 2018/956 of the European Parliament and of the Council of 28 June 2018 on the Monitoring and Reporting of CO_2 Emissions from and Fuel Consumption of New Heavy-Duty Vehicles," *Official Journal of the European Union* L 173 (July 9, 2018): 956, https://eur-lex.europa.eu/eli/reg/2018/956/oj.

This policy design gives manufacturers compliance flexibility by allowing them to focus on their core vehicle segments to comply with the fleet-wide emission reduction targets. The CO_2 standards also introduce an early-credit scheme to incentivize manufacturers to reduce their CO_2 emissions as early as possible before the implementation date of the first mandated reduction in 2025, providing additional compliance flexibility. A CO_2 emissions reduction trajectory is determined for each manufacturer, which is defined as a linear function between the baseline and the 2025 emissions target. Early-credits can therefore be obtained for each reporting period if a manufacturer performs better than its emissions reduction trajectory. These earned credits can then be used to comply to the 2025 target. Further details on the credits scheme can be found in ICCT's policy update.[18]

The baseline CO_2 emissions reported by manufacturers over the baseline period have not yet been published. However, ACEA provided an initial assessment of the baselining CO_2 emissions for each subgroup during the second half of 2019.[19] The estimated values are presented in Table 5, together with the mileage and payload data and MPW factors defined by the regulation. These data, together with the fleet composition of each manufacturer, are used to evaluate the impact of the fleet composition on the average specific emissions of each manufacturer. It is assumed that the relative shares of regulated subgroups did not change between the second half of 2019, for which the data in Figure 5 was obtained, and the first half of 2020.

Table 5. Preliminary assessment of the average specific CO_2 emissions (g/t.km) and MPW factors for each subgroup.

Regulated subgroup	Average specific CO_2 emissions [g/t.km]	Average payload [t]	Annual mileage [km]	MPW factor
4-UD	199.0 (ICCT estimate)	2.65	60,000	0.099
4-RD	198.1	3.18	78,000	0.154
4-LH	102.9	7.42	98,000	0.453
5-RD	84.0	10.26	78,000	0.498
5-LH	56.5	13.84	116,000	1.000
9-RD	110.9	6.28	73,000	0.286
9-LH	64.7	13.40	108,000	0.901
10-RD	84.0	10.26	68,000	0.434
10-LH	58.6	13.84	107,000	0.922

The results, which are shown in Table 6, do not capture any differences in performance between manufacturers—as the same subgroup average emissions were used for all manufacturers—but only measure the impact of fleet composition on the computation of the average specific CO_2 emissions.

Table 6. Impact of fleet composition on the computation of the average specific CO_2 emissions using ACEA's preliminary baseline emissions. The subgroup CO_2 emission values used are common for all manufacturers.

Manufacturer	DAF	Iveco	MAN	Mercedes-Benz	Renault Trucks	Scania	Volvo Trucks
Average specific CO_2 emissions (g/t.km)*	53.58	50.17	50.96	50.76	49.75	51.97	52.32

Note: Differences between manufacturers do not reflect their relative performance but only differences in fleet composition.

18 Felipe Rodríguez, *CO_2 Standards for Heavy-Duty Vehicles in the European Union*, (ICCT: Washington, DC, 2019), https://theicct.org/publications/co2-stds-hdv-eu-20190416.

19 ACEA, "CO_2 Emissions from Heavy-duty Vehicles – Preliminary CO_2 Baseline (Q3-Q4 2019)."

Impact of fleet composition on compliance to the baseline

In the previous section of this paper, it was identified that the COVID-19 crisis, beyond impacting truck sales volumes drastically, could have also introduced changes in the fleet composition, which had previously been stable for over a decade. It is important to note that these observed impacts of the pandemic on sales cannot, by definition, impact the baseline values that are determined per regulated vehicle subgroup. The only way the pandemic might have impacted the baseline is if it prevented manufacturers from introducing new CO_2-reduction technologies to the market during the baselining period. However, there is not enough evidence that the main manufacturers were impacted in such a way in the first half of 2020.

Instead, the changes in fleet composition observed between 2019 and 2020 are expected to have a significant impact on compliance with the CO_2 emission reduction targets for manufacturers, as the latter is heavily dependent on fleet composition. The values obtained in Table 6, which give an idea of how fleet composition will impact the compliance target of each manufacturer based on a fixed baseline, vary significantly from one manufacturer to another. Variations of up to 8% between the highest and lowest values are obtained while using the same subgroup CO_2 baseline estimate for all manufacturers. Comparing these results with the manufacturers respective fleet compositions in Figure 6, there is a direct correlation between the share of long-haul tractor trailers (subgroup 5-LH) in a manufacturer's fleet and its average specific CO_2 emissions. This is illustrated in Figure 15 with the example of DAF and Renault Trucks, which have the highest and lowest shares of 5-LH vehicles of 72% and 47% respectively.

The fleet average specific CO_2 emissions cannot be compared across manufacturers to assess the relative performance of different truck makers, as the deviations only reflect the different vehicle segments in which each manufacturer specializes.

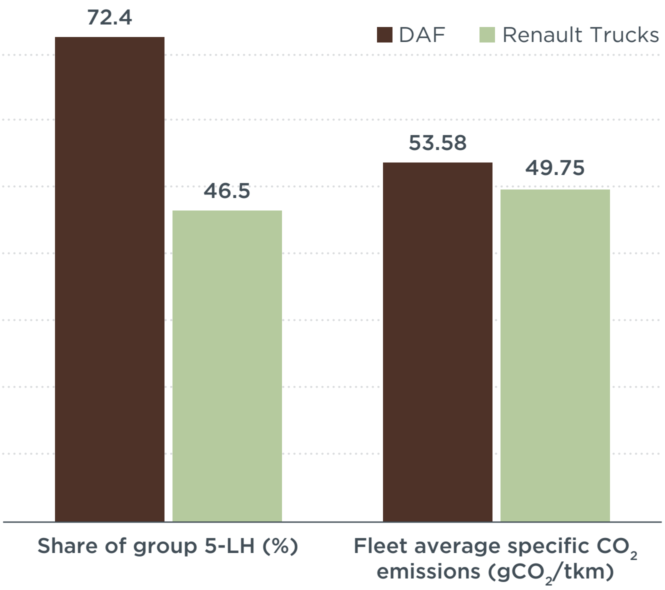

Figure 15. Share of subgroup 5-LH and average specific CO_2 emissions for DAF and Renault Trucks.

Long-haul tractor-trailers, which represent the bulk of the trucks regulated by the CO_2 emission standards, are also the vehicle segment with the highest cost-effective CO_2 emissions reduction potential.[20] This includes improved engine efficiency technologies, as well as road load technologies for improved aerodynamic and rolling resistance

20 Dan Meszler Oscar Delgado, Felipe Rodríguez, and Rachel Muncrief, *EU HDVs: Cost effectiveness of fuel efficiency technologies for long-haul tractor-trailers in the 2025-2030 timeframe*, (ICCT: Washington, DC, 2018), https://theicct.org/publications/cost-effectiveness-of-fuel-efficiency-tech-tractor-trailers.

performance. Such technologies are easier to optimize for long-haul trucks, which operate in a relatively narrow range of operating conditions, and for which the investment costs are scaled across a large number of vehicles. Furthermore, due to the long distances traveled by long-haul trucks and the associated high fuel cost, over their lifetimes efficiency technologies with high upfront cost can still be cost-effective. As a result, manufacturers can deploy fuel efficiency technologies in an easier manner in subgroup 5-LH vehicles. On the other hand, rigid trucks are used across a wider range of applications, which translates in a reduced cost-effectiveness of efficiency technologies compared to long-haul tractor trailers to achieve the same CO_2 reduction. Hence, manufacturers with lower shares of long-haul tractor-trailers might face additional challenges to comply with the set targets, or to accumulate early credits.

This is illustrated by the following example. Suppose that DAF, which has the highest share of long-haul tractor-trailers vehicles, were to reduce their emissions of subgroup 5-LH vehicles to 20% below the baseline while achieving no improvements in any other segment. This would lead to a 16.6% improvement in the manufacturer's fleet-wide average specific CO_2 emissions. However, Renault Trucks, which has the lowest share of long-haul tractor-trailer vehicles, would only achieve a 13.0% reduction in its fleet-wide average specific CO_2 emissions with the same improvement.

Using the same rationale, the reduction in shares of group 5-LH trucks that was observed between 2019 and 2020 in Figure 13 might require additional efforts for the industry as a whole to comply with the CO_2 emissions reduction target of 2025 and for the accumulation of early-credits.

Key findings and policy recommendations

The EU truck market is dominated by a few large manufacturers which have the potential to largely influence the baseline CO_2 emissions via the performance of their fleet. The financial penalties set by the CO_2 emission standards are a strong incentive for large manufacturers to unduly increase the baseline, effectively reducing the burden to meet the relative targets set by the regulation. Irrelevant of what the final values will be for the baseline, which is defined for each regulated vehicle subgroup, the fleet average specific CO_2 emissions of a manufacturer, which are the basis for the determination of compliance, will strongly depend on its fleet composition. Due to the policy design and to the large proportion of group 5-LH long-haul tractor-trailers in the overall fleet, it is anticipated that manufacturers such as DAF, with higher shares of this subgroup, will require less effort to comply with their CO_2 emissions reduction targets than those that, like Renault Trucks, have higher shares of rigid trucks in their fleets.

As the value of the baseline for each subgroup is determined from the average market performance, consumer purchasing decisions and the introduction of new purchasing technologies to the market during the baselining period could have impacted the baseline. This period was marked by the COVID-19 pandemic, which had a detrimental impact on the market. The continuous growth in truck sales observed in the previous five years was already slowing down in the first months of 2020, dropping between 5% and 50% compared to the same period in 2018. The COVID-19 crisis added to this trend by introducing further losses in sales in the following months, leading to overall losses between 29% and 57% in the first half of 2020 compared to 2018. The number of new truck registrations seem to have been rising since June, although a second wave of the pandemic could further threaten the industry.

Although the COVID-19 pandemic did not affect market shares among the largest truck makers, there were significant changes to the fleet composition between the second half of 2019 and 2020, which can be mostly attributed to the crisis. Regulated vehicle groups have been primarily dominated by long-haul tractor-trailers in the past decade. While this was still the case in the baselining period, the share of this vehicle segment seems to have decreased in 2020 with potential impacts on the baseline. Conversely, the number of vehicles in the non-regulated categories have increased in recent years, gaining 4% market shares in the first half of 2020 compared to 2019. An increasingly high share of the fleet—23% during the baselining period—is therefore not covered by CO_2 emission standards. As long-haul tractor-trailers have the highest cost-effective CO_2 emissions reduction potential, this trend could also make compliance and the accumulation of early credits harder for manufacturers overall.

2022 Review

The review of the regulation that will take place in 2022 will, among other tasks, assess the validity of the baseline emissions. However, the baseline coherence with historical data cannot be assessed, as HDV CO_2 emissions were not monitored nor reported prior to 2019. The poor sales performance in the baselining period compared to previous years does not necessarily compromise the representativeness of the baseline values for each subgroup unless the pandemic prevented manufacturers from introducing new CO_2 emission reduction technologies to their fleets.

Another aim of the review is to consider the application of CO_2 emission targets to other vehicle groups. The tendency for increasing market shares of non-regulated groups, identified in Figure 4 and Figure 13, warrants the inclusion of those vehicle groups into the scope of the CO_2 emission standards. The climate benefits of this policy intervention will be explored in an upcoming related publication.

Finally, the market penetration of zero- and low-emissions trucks (ZLEV) as a compliance pathway is still very low. While truck manufacturers seem eager to support such technologies, the economic recession brought by the COVID-19 pandemic might present a barrier to market penetration. Further incentives and recovery programs would help manufacturers to introduce larger shares of these technologies in their fleet. Some manufacturers have also started adopting LNG truck technologies for their long-haul fleets, as they represent a promising pathway for the reduction of tailpipe CO_2 emissions and, therefore, for compliance to the baseline. However, when looking at well-to-wheel GHG emissions, LNG trucks do not seem to present climate benefits compared to diesel trucks. The 2022 review is therefore an opportunity to also assess the impact of non-CO_2 GHG emissions and consider the extension of the targets to these as well.