POSITION BRIEF

NOVEMBER 2022

RECOMMENDATIONS FOR REVISING THE MODALITIES OF EUROPE'S HEAVY-DUTY VEHICLE CO_2 STANDARDS

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INTRODUCTION

The European Commission has imposed the binding requirement to achieve climate neutrality by 2050 through the European Climate Law.[1] To align the heavy-duty vehicle (HDV) sector with this commitment, the European Commission is required to revise the CO_2 standards by 31 December, 2022.[2] In its current form, the regulation fails to bring the needed reductions in CO_2 with annual HDV CO_2 emissions projected to increase by a total of 8% by 2050 relative to 2019 under the currently adopted policies.[3] The standards oblige a reduction in the average CO_2 emissions from most new trucks of 15% by 2025 and 30% by 2030, relative to a 2019/2020 baseline, but a projected 44% increase in freight activity over the period 2020–2050 greatly diminishes the CO_2 reduction benefit of the standards.[4]

The review clause must address a variety of points (otherwise known as modalities), within the current CO_2 standards:

- The appropriateness of the CO_2 target for 2030 and the introduction of CO_2 targets for 2035 and 2040
- Extending the standards to non-regulated vehicles
- Adjusting the incentive mechanism through the zero- and low-emission vehicle factor and accounting for zero-emission range in its calculation

1 European Commission, "Regulation (EU) 2021/1119 of the European Council and the Parliament of 30 June 2021 Establishing the Framework for Achieving Climate Neutrality and Amending Regulation (EC) No 401/2009 and (EU) 2018/1999 (European Climate Law)."

2 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 198/202 (July 25, 2019), http://data.europa.eu/eli/reg/2019/1242/oj/eng.

3 Eamonn Mulholland, Joshua Miller, Caleb Braun, Arijit Sen, Pierre-Louis Ragon, and Felipe Rodríguez, "The CO2 Standards Required for Trucks and Buses for Europe to Meet Its Climate Targets" (Berlin: ICCT, 2022), https://theicct.org/publication/hdv-co2standards-recs-mar22/.

4 A. De Vita et al., "EU Reference Scenario 2020: Energy, Transport and GHG Emissions: Trends to 2050," (LU: Publications Office of the European Union, 2021), https://data.europa.eu/doi/10.2833/35750.

Acknowledgments The authors would like to thank Pierre-Louis Ragon, Oscar Delgado, Chelsea Baldino, Jan Dornoff, Anuj Dhole, and Amy Smorodin (International Council on Clean Transportation) for their guidance and constructive comments in the preparation of this briefing.

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» Accounting for synthetic and advanced renewable fuels in the CO_2 standards

» Introducing an engine-based standard

» Assessing the appropriateness of the credit and debt system

» Introducing a mechanism to allow manufacturers to trade their emission credits

This brief details each of these modalities and provides recommendations for their amendment which would align the HDV sector with the European Climate Law which strives to achieve climate neutrality by 2050.[5] We first present an overview of the CO_2 standards in their current form, then discuss each of the modalities below.

A BRIEF OVERVIEW OF THE HDV CO_2 STANDARDS

The setting of the first HDV CO_2 standards in the EU was a long and complex process, which required the establishment of three separate regulations, with each building upon the last:

1. The Certification Regulation – (EU) 2017/2400: The CO_2 emissions from most HDVs must be determined using VECTO, a vehicle simulation tool.
2. The Reporting and Monitoring Regulation – (EU) 2018/956: Manufacturers must report the certified CO_2 emissions of their HDVs covered under (EU) 2017/2400 on an annual basis.[6]
3. CO_2 Standards for Trucks – (EU) 2019/1242: Manufacturers are required to reduce certified emissions from most new trucks by 15% by 2025 and 30% by 2030, relative to a 2019/2020 baseline. The CO_2 standards are based on the emissions monitored and reported in accordance with (EU) 2018/956.

Critically, all of these regulations do not apply to all vehicles. Approximately 72% of HDVs sold are required to determine and report their CO_2 emissions under the Certification Regulation, and 63% of new HDVs are required to reduce their emissions by 2025 and 2030 under the CO_2 standards.[7] Each year, the certified CO_2 emissions related to all new vehicles which fall under the scope of the Certification Regulation must be determined through the use of a simulation tool, VECTO. In VECTO, HDVs are split into groups based on their vehicle parameters, such as number of axles, gross vehicle weight, and body type. Vehicle groups which are covered in the CO_2 standards are further broken down into sub-groups based on their engine power and cab type.

Certified emissions determined by VECTO, in terms of gCO_2/tonne-kilometre (tkm), are averaged across all manufacturers for every sub-group over each period. The resulting emissions established for each sub-group over the period from July 2019 to June 2020 serve as the common baseline emissions for each manufacturer from which emissions will need to be reduced. However, each manufacturer's specific target is dependent on their fleet composition. A thorough analysis of these baseline data has been published in a previous ICCT report.[8]

5 European Commission, "Regulation (EU) 2021/1119 of the European Council and the Parliament of 30 June 2021 Establishing the Framework for Achieving Climate Neutrality and Amending Regulation (EC) No 401/2009 and (EU) 2018/1999 (European Climate Law)" (Brussels, June 30, 2021), https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32021R1119&from=EN.

6 In parallel, Member States must also report basic data on all new truck registrations at the national level on a yearly basis.

7 Based on annual sales data supplied by IHS Global SA; Copyright © IHS Global SA, 2022.

8 Pierre-Louis Ragon and Felipe Rodríguez, "CO_2 Emissions from Trucks in the EU: An Analysis of the Heavy-Duty CO_2 Standards Baseline Data" (Berlin: ICCT, 2021), https://theicct.org/publication/co2-emissions-from-trucks-in-the-eu-an-analysis-of-the-heavy-duty-co2-standards-baseline-data/.

Two key flexibilities also exist in determining each manufacturer's compliance with the standard, both of which will be evaluated by the European Commission in the upcoming revision. A zero- and low- emission vehicle (ZLEV) factor is applied to the manufacturer's reduction target and corresponds to a value between 1 and 0.97, depending on the manufacturer's share of zero- and low-emission vehicles. Manufacturers may also accumulate credits over the regulation period by overachieving what is required by the standard and use them to offset any debts accumulated (or vice-versa) in earlier or later periods to avoid penalties.

Vocational vehicles, broadly defined as any vehicle not intended for the delivery of goods (such as a dump truck, or a concrete mixer), are not required to comply with the CO_2 standards. Buses, coaches, trailers, and light and medium trucks are also outside of the scope of the CO_2 regulation, as they weren't covered by the certification regulation when the CO_2 standards were adopted. The upcoming revision offers the possibility to extend the scope of the CO_2 standards to cover these vehicles.

RECOMMENDATIONS FOR THE REVISION OF THE MODALITIES TO THE HDV CO_2 STANDARDS

THE APPROPRIATENESS OF THE CO_2 TARGET FOR 2030 AND THE INTRODUCTION OF CO_2 TARGETS FOR 2035 AND 2040

In their current form, the CO_2 standards oblige a reduction in the average CO_2 emissions (in terms of gCO_2/tkm) from the majority of new trucks of 15% in 2025 and 30% in 2030, relative to a 2019/2020 baseline. No targets are set for the period beyond 2030. The HDV sector will likely need to almost entirely decarbonize its annual fleet emissions by 2050 to comply with the European Climate Law.[9] The currently adopted HDV CO_2 standards fall far short of achieving such a target, with reductions in new fleet emissions largely offset by projected increases in freight activity. In the absence of more stringent CO_2 standards beyond 2030, total fleet emissions from HDVs are projected to increase by 8% in 2050 relative to 2019.[10] A major element of the review of these standards is the consideration of an update to the 2030 target and an introduction of targets for 2035 and 2040 to align the HDV sector with Europe's aim of achieving climate neutrality by mid-century.

Recommendation

The 2030 CO_2 reduction target should be increased to 60%, and targets of 90% and 100% should be introduced for 2035 and 2040, respectively.

A recent ICCT analysis provides an in-depth look into the reduction targets necessary in 2030, 2035, and 2040 for the EU-27 to align the HDV sector with the ambitions of the European Climate Law.[11] A brief synopsis is presented here.

The landscape for zero-emission trucks and buses has changed drastically since the inception of the CO_2 standards. Most major manufacturers of HDVs have pledged to significantly increase their production of zero-emission vehicles in the coming decades. Taking a sales-weighted average of all pledges, by 2030 zero-emission vehicles alone will reduce the average emissions of new HDVs by 41%, which is significantly beyond the currently established 30% target.

9 The European Green Deal laid out the ambition for transport to achieve a 90% reduction in annual emissions by 2050 to contribute towards climate neutrality. The share that road freight will play in this is dependent on the decarbonization efforts of other modes, particularly aviation and shipping. We analyze a fair contribution from road freight in Mulholland, Miller, Braun, Sen, Ragon, and Rodríguez, "The CO_2 Standards Required for Trucks and Buses for Europe to Meet Its Climate Targets."

10 "The CO_2 Standards Required for Trucks and Buses for Europe to Meet Its Climate Targets."

11 "The CO_2 Standards Required for Trucks and Buses for Europe to Meet Its Climate Targets."

More significant commitments have been made for the long-term; Daimler Truck has pledged to fully phase out sales of the internal combustion engine truck by 2039,[12] Scania by 2040,[13] and all remaining major manufacturers have pledged to end the sale of "fossil-free vehicles" by 2040.[14] If these manufacturers achieve 100% zero-emission vehicle sales by 2040 and implement consistent efficiency improvements in the internal combustion engine trucks produced up to this point, emission reductions would be closely in line with Europe's climate commitments, i.e., a 96% reduction in annual HDV emissions by 2050 relative to 2019. However, these goals are not certain to be followed without binding regulation, and as such, the manufacturer pledges should represent the minimum level of stringency to be considered in the review of the CO_2 standards.

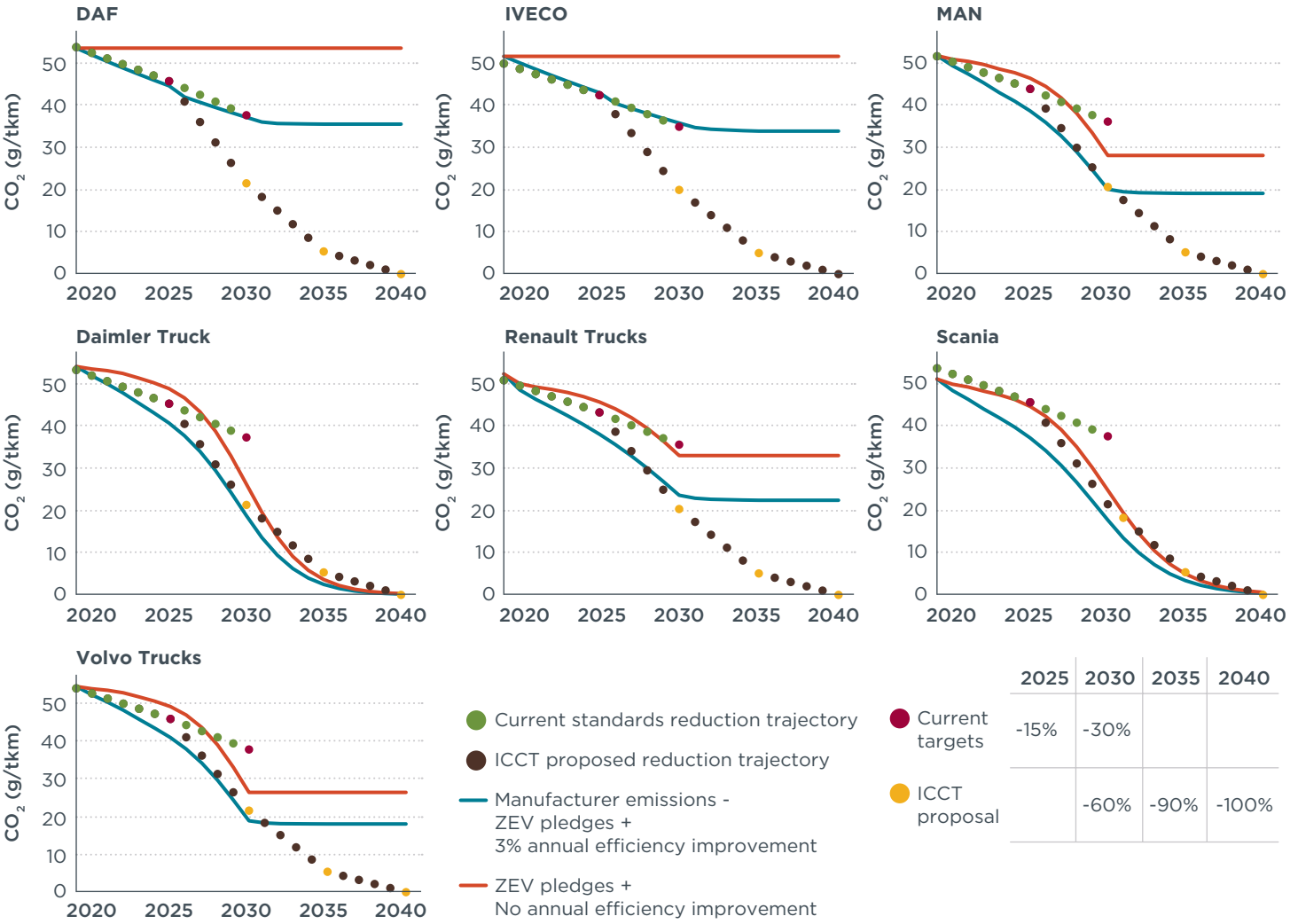
To make these manufacturer-led pledges a reality and, consequently, commit Europe's HDVs sector to a deep decarbonization pathway, the targets established in the HDV CO_2 standards should be increased from the current 30% reduction required by 2030 to at least 60% in 2030, and complemented with new reduction targets of at least 90% in 2035 and 100% in 2040.

Figure 1 shows how each major European truck manufacturer would perform compared to these targets, based on their announced zero-emission heavy-duty vehicle (ZE-HDV) deployment pledges, and if these pledges were supplemented with a 3% annual efficiency improvement until the technical potential of the internal combustion vehicle is met. The 3% annual efficiency improvement rate is considered technically feasible for manufacturers to achieve based on our own assessments.

12 Daimler AG, "Daimler Truck Strategy Day on May 20, 2021," May 20, 2021, https://www.daimler.com/investors/events/capital-market-days/2021-daimler-truck-strategy-day-may.html.

13 Scania, "Scania's Commitment to Battery Electric Vehicles," 2021, https://www.scania.com/group/en/home/newsroom/news/2021/Scanias-commitment-to-battery-electric-vehicles.html.

14 ACEA and PIK, "Joint Statement: The Transition to Zero-Emission Road Freight Transport," 2020, https://www.acea.auto/files/acea-pik-joint-statement-the-transition-to-zero-emission-road-freight-trans.pdf.



	2025	2030	2035	2040
Current targets	-15%	-30%		
ICCT proposal		-60%	-90%	-100%

Figure 1. Manufacturer CO_2 emission trajectories based on announced pledges towards zero-emission vehicles and assuming a 3% annual efficiency improvement. The ICCT proposed trajectory reflects emissions reductions of 60% in 2030, 90% in 2035, and 100% in 2040.

Four of these seven manufacturers (MAN, Daimler Truck, Scania, and Volvo) are on track to achieve a 60% reduction by 2030 if they meet their ZE-HDV deployment pledges, supplemented by consistent energy efficiency improvements. Two manufacturers are on track to achieve both a 90% reduction in 2035 and a 100% reduction in 2040 (Daimler Truck and Scania). Setting such targets would provide regulatory certainty to manufacturers who already have ambitious ZE-HDV deployment targets.

EXTENDING THE STANDARDS TO NON-REGULATED VEHICLES

The HDV CO_2 standards are currently only applicable to truck classes which accounted for 63% of total annual EU-27 HDV sales in 2021.[15] Significant additional emission reductions can be achieved by extending the standards to non-regulated classes.[16] A prerequisite for vehicles to be introduced into the HDV CO_2 standards is for them to have their CO_2 emissions certified under the Certification Regulation.

15 Based on annual sales data supplied by IHS Global SA; Copyright © IHS Global SA, 2022.

16 Pierre-Louis Ragon and Felipe Rodríguez, "Benefits of Extending the EU Heavy-Duty CO2 Emissions Standards to Other Truck Segments" (Berlin: ICCT, 2021), https://theicct.org/publication/benefits-of-extending-the-eu-heavy-duty-co2-emissions-standards-to-other-truck-segments/.

Currently, HDV models that make up 85% of annual vehicle sales have their CO_2 emissions certified, following a recent amendment to the original regulation.[17]

Trailers do not emit CO_2 but there exists a variety of alterations applicable to them which improves their efficiency when connected to a tractor, enabling the possibility for trailers to be covered by the CO_2 standards.[18] As with HDVs, CO_2 standards cannot be applied to trailers without them first being covered by the Certification Regulation. Trailers have recently been certified through their own separate regulation,[19] but have not yet been subject to CO_2 standards.

The review of the CO_2 standards will consider an extension of its scope to currently unregulated vehicles. This offers an opportunity for the CO_2 standards to be extended to vehicles which are currently covered by the Certification Regulation, but not by CO_2 standards, including trailers.

Recommendation

The CO_2 standards should be extended to cover all unregulated vehicles which are covered by the Certification Regulation. Separate CO_2 standards should be created for trailers, as well as for buses and coaches.

Significant fleetwide decarbonization from HDVs will only be possible if the emissions from all vehicles—including trucks, buses, coaches, and vocational vehicles—are regulated, as feasible. To achieve such levels of decarbonization, the scope of the CO_2 standards should be extended to include all vehicles covered by the Certification Regulation.

The share of HDVs which have their emissions certified under the Certification Regulation represent 95% of the annual CO_2 emissions from the HDV sector (see Figure 2), while just 70% of HDV emissions are covered under the CO_2 standards.[20] Extending the CO_2 standards to all vehicles covered under the Certification Regulation would regulate nearly all HDV-related CO_2 emissions in the EU-27.

17 European Commission, "Regulation (EU) 2022/1379 of the European Parliamant and of the Council of 5 July 2022 Amending Regulation (EU) 2017/2400 as Regards the Determination of the CO2 Emissions and Fuel Consumption of Medium and Heavy Lorries and Heavy Buses and to Introduce Electric Vehicles and Other New Technologies," *Official Journal of the European Union* L 212/1 (2022), https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32022R1379&qid=1664295468190&from=en. Currently, only 72% of HDV sales need to monitor and report their emissions, but the recent amendment has extended this to 85% of sales. These additional vehicles will not have to monitor and report their emissions until between 2024 and 2025.

18 Felipe Rodríguez, "Trailer CO_2 Certification in the European Union" (Berlin: ICCT, 2018), https://theicct.org/publication/trailer-co2-certification-in-the-european-union/.

19 European Commission, "Commission Implementing Regulation (EU) 2022/1362 of 1 August 2022 Implementing Regulation (EC) No 595/2009 of the European Parliament and of the Council as Regards the Performance of Heavy-Duty Trailers with Regard to Their Influence on the CO_2 Emissions, Fuel Consumption, Energy Consumption and Zero Emission Driving Range of Motor Vehicles and Amending Implementing Regulation (EU) 2020/683," *Official Journal of the European Union* L 205/145 (August 1, 2022), https://eur-lex.europa.eu/eli/reg_impl/2022/1362/oj.

20 Emission values were calculated by using CO_2 emission factors generated from the monitoring and reporting data from the EEA and applying in-house estimates for vehicle classes which were not covered.

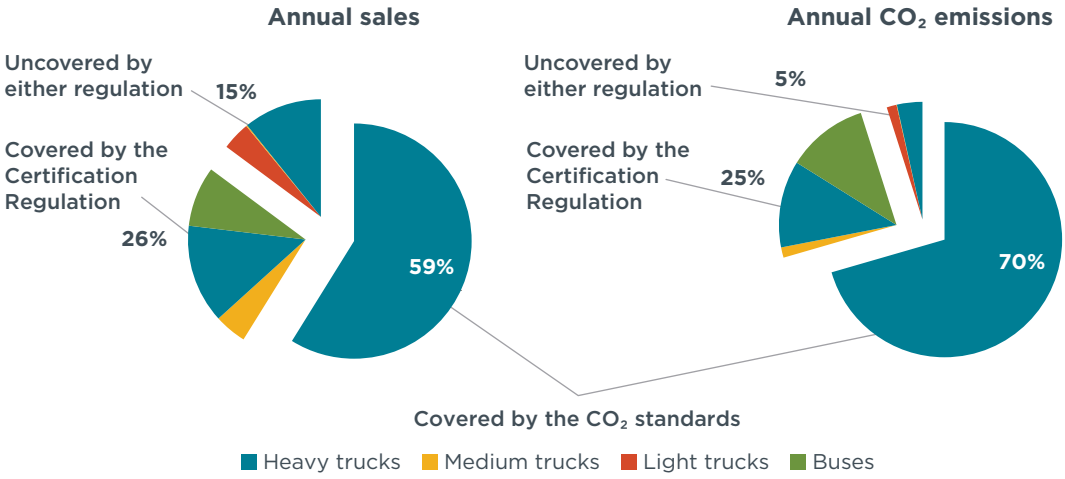


Figure 2. The share of annual sales and CO_2 emissions of HDVs by vehicle category and regulatory coverage in 2020. We calibrate HDV emissions to values reported annually to the United Nations Framework Convention on Climate Change, of which 2020 is the most recently available data set.

One challenge related to extending the scope of the regulation to currently unregulated vehicles is the establishment of a different baseline against which HDV emission reductions must be benchmarked. To rectify this, a new set of baselines will be required.

Setting a new baseline

For the vehicles currently regulated by the CO_2 standards, emissions reported over the period July 2019–June 2020 form the baseline emissions, and the targets of 15% and 30% for 2025 and 2030 are relative to the data collected over that period. Other HDVs covered by the Certification Regulation but not by the CO_2 standards did not report their emissions over this same period, but will have to do so in the near future (see Figure 3).

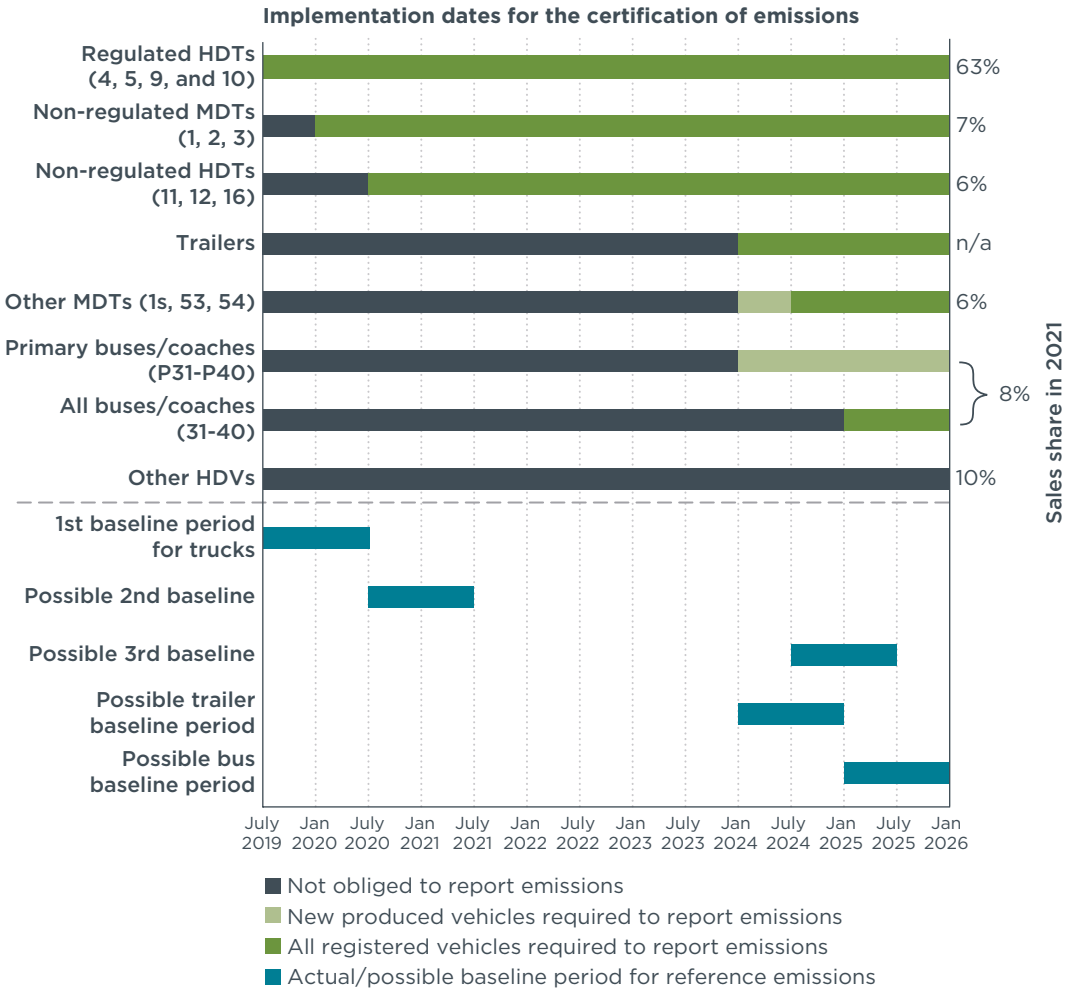


Figure 3. Various implementation dates of the Certification Regulation for HDVs in the EU-27. The blue bars represent potential dates for the setting of a new baseline for unregulated vehicles. The numbers below the HDV classes represent the specific VECTO groups.

The specific CO_2 emissions target for each manufacturer is based off a reference CO_2 value for each subgroup. Including additional vehicles into the CO_2 standards thus requires a definition of their CO_2 emission reference values, which is already defined for the regulated vehicle subgroups, but has yet to be defined for the certified but unregulated subgroups. To determine these values, a second baseline period needs to be introduced for VECTO groups which are covered by the current Certification Regulation but not by the CO_2 standards.[21] The reference value for these vehicles should be based on the earliest available reporting period, July 2020–June 2021 for vehicles covered under the original Certification Regulation (EU) 2017/2400. For the vehicles most recently added under the amendment to the Certification Regulation, a third baseline to determine their reference CO_2 values is required and should be set as soon as possible, i.e., over the reporting period July 2024–June 2025. The earliest baseline for trailers and buses will be over the reporting periods January–December 2024, and January–December 2025, respectively (see Figure 3).

Zero-emission vehicles should not be included in the calculation of the baseline emissions. Accounting for electric vehicles in the baseline unfairly penalizes manufacturers who have already made, or will make, significant progress in the electrification of their vehicles. For some HDV segments, most notably for buses, the

21 See Appendix for a complete list of the VECTO categorizations.

rate of adoption of zero-emission vehicles has been exceptionally high.[22] Setting a baseline based only on conventionally fueled vehicles enables a fairer reference for all manufacturers to benchmark their emission reductions.

Extending the CO_2 standards

For medium and heavy trucks, CO_2 certified vehicles that are currently unregulated should conform to the same targets applicable for regulated vehicles, as outlined in the previous section. For vocational trucks, engine standards should be set, which we describe in more detail in a subsequent section.

For trailers, separate CO_2 standards should be established. Semi-trailers do not produce CO_2 emissions, as they are non-motorized. However, a variety of modifications to the standard semi-trailer can be made to significantly improve the performance of the motorized tractor. The establishment of a trailer specific certification regulation has enabled a procedure for certifying the emissions attributable to a semi-trailer design.[23] Emissions can be reduced through introducing aerodynamic technologies, such as boat-tails, side skirts, or reducing the gap between the trailer and the tractor, rolling resistance technologies, such as low-rolling resistance tires, and light-weighting technologies, such as material substitution in the chassis frame and body structure. Previous ICCT research has shown that a combination of these technologies can achieve up to a 10% reduction in CO_2 emissions by 2030 in a long-haul cycle, and more than 7% in a regional cycle.[24]

For buses, including coaches, separate CO_2 standards should also be established. Buses are electrifying rapidly, even in the absence of regulatory requirements for manufacturers to produce lower emitting vehicles, driven by strong demand-side measures at both the Member State and the city level.[25] The European Commission established a non-binding goal for all buses in operation to be zero-emission by 2050.[26] Our previous analysis showed that to make this a reality, new targets should be established corresponding to a 90% reduction target in 2030, and 100% by 2035, relative a new baseline.[27] Manufacturers have already shown their willingness to comply with such a target. The largest bus manufacturer in the EU, Daimler Truck, has pledged to only sell zero-emissions city buses from 2030.[28] The second biggest manufacturer, MAN, plans for 50% of sales to be equipped with an electric drive by 2025.[29]

22 Eamonn Mulholland and Felipe Rodríguez, "The Rapid Deployment of Zero-Emission Buses in Europe," (Berlin: ICCT, 2022), https://theicct.org/publication/the-rapid-deployment-of-zero-emission-buses-in-europe/.

23 European Commission, "Commission Implementing Regulation (EU) 2022/1362 of 1 August 2022 Implementing Regulation (EC) No 595/2009 of the European Parliament and of the Council as Regards the Performance of Heavy-Duty Trailers with Regard to Their Influence on the CO_2 Emissions, Fuel Consumption, Energy Consumption and Zero Emission Driving Range of Motor Vehicles and Amending Implementing Regulation (EU) 2020/683."

24 Ragon and Rodríguez, "Benefits of Extending the EU Heavy-Duty CO_2 Emissions Standards to Other Truck Segments." These values are based on a trailer driven by the most common HDV vehicle group, 5-LH, which is responsible for over half of Europe's HDV emissions.

25 Mulholland and Rodríguez, "The Rapid Deployment of Zero-Emission Buses in Europe."

26 European Commission, "EU Sustainable and Smart Mobility Strategy," 2020, https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12438-Sustainable-and-Smart-Mobility-Strategy.

27 "The CO_2 Standards Required for Trucks and Buses for Europe to Meet Its Climate Targets."

28 Daimler Truck, "Daimler Buses to Offer CO_2-Neutral Vehicles in Every Segment by 2030 – Dual-Track Strategy Based on Batteries and Hydrogen," 2022, https://media.daimlertruck.com/marsMediaSite/en/instance/ko/Daimler-Buses-to-offer-CO2-neutral-vehicles-in-every-segment-by-2030--dual-track-strategy-based-on-batteries-and-hydrogen.xhtml?oid=51925779.

29 Traton Group, "Traton Group Boosts Investment in Electric Mobility," March 22, 2021, https://traton.com/en/newsroom/press-releases/press-release-22032021.html.

ADJUSTING THE INCENTIVE MECHANISM THROUGH THE ZERO- AND LOW-EMISSION VEHICLE FACTOR AND ACCOUNTING FOR ZERO-EMISSION RANGE IN ITS CALCULATION

The HDV CO_2 standards include a bonus mechanism to promote the deployment of zero-emission heavy-duty vehicles in the form of a zero- and low-emission vehicle (ZLEV) factor. The ZLEV factor is applied to the manufacturer's fleet average specific CO_2 emissions and can, in effect, reduce a manufacturer's emission reduction target by up to 3%.

Manufacturers who increase their sales share of ZLEVs benefit from a reduced overall target during two phases; the super-credits phase which runs to 2025, and the benchmark phase which runs to 2030.

Under the super-credits phase, zero-emission vehicles are double counted toward the CO_2 emissions reduction target, and low-emission vehicles can be up to double counted, depending on their emissions. The super-credits phase will not be amended in the revision, and more information on this mechanism is described in a previous ICCT paper.[30]

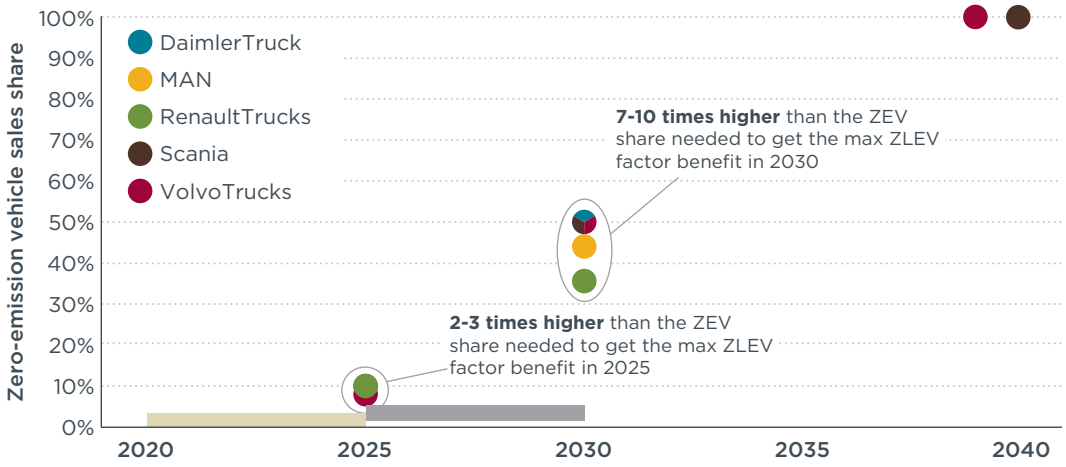
The benchmark phase, which runs from 2026 onward, may be amended in the upcoming revision. During this phase, manufacturers that have a ZLEV share of 2% or more are rewarded through a different ZLEV factor. Manufacturers are not faced with any penalties if they do not meet the 2% threshold. As in the super-credits phase, the ZLEV factor is also capped at a minimum of 0.97, meaning ZLEV shares greater than 5% relaxes the CO_2 targets by a maximum of 3%. Low emission vehicles are counted as between 0 and 1 vehicles, depending on their CO_2 emissions.

Recommendation

The ZLEV factor should be phased out after 2030. In the benchmark phase, a vehicle's contribution to the ZLEV factor should be dependent on its zero-emission range. Incentives should be weighted towards the higher emitting vehicle categories through the mileage and payload weighting factor.

In its current form, the ZLEV factor offers little positive benefit to the CO_2 standards. In the period 2026–2030, it sets a benchmark which is easily achievable, and most manufacturers are likely to surpass even in its absence. Five of the seven major truck manufacturers in Europe have committed to deploying between 35% and 60% zero-emission vehicles by 2030—over seven times what is needed to achieve the 5% benchmark cap (see Figure 4). As such, the ZLEV factor in its current form only serves to allow the remaining conventional vehicles to emit higher levels of CO_2 and hinder technological progress in internal combustion engine efficiency improvements, without serving its intended purpose of incentivising the increased deployment of ZLEVs.

30 Felipe Rodríguez, "CO_2 Standards for Heavy-Duty Vehicles in the European Union" (Berlin: ICCT, 2019), https://theicct.org/publication/co2-standards-for-heavy-duty-vehicles-in-the-european-union/.



	Min ZEV share needed to get ZLEV factor benefit	Max ZEV share needed to get ZLEV factor benefit
Super-creditsphase	None	2%
Benchmarkphase	2%	5%

Figure 4. Major HDV manufacturer zero-emission deployment targets, and the upper and lower bounds required for manufacturers to benefit from the ZLEV factor

Furthermore, in the current system, all zero-emission trucks contribute equally towards the ZLEV factor calculation, regardless of vehicle type or zero-emission range. Therefore, there is also no additional regulatory incentive to invest in Europe's most commonly used vehicles, such as the long-haul tractor trailer, compared to a less commonly used vehicle group, like the urban delivery truck.

The ZLEV factor for the super-credits phase should be amended to increase market competitiveness of electric trucks by ensuring that the deployment targets established by manufacturers are targeted at the highest emitting HDVs. The ZLEV factor should be redesigned to better incentivize investments into high-range zero-emission vehicle segments which are traditionally high-emitting vehicles. Such a redesign could be implemented through introducing two new mechanisms, described below.

Accounting for a vehicle's mileage and payload. The first mechanism would incentivize manufacturers to invest in zero-emission technologies for the highest-emitting vehicle types. This can be addressed by applying the mileage and payload weighting (MPW) factor to the ZLEV calculation, which is determined as the product of the vehicle's mileage and payload relative to the equivalent for the most common truck group in Europe, 5-LH. This would credit manufacturers for investing in the research, development, and manufacturing of ZE-HDVs with a higher average annual mileage and payload, which are traditionally higher-emitting vehicles.

Using such a mechanism, a zero-emission 5-LH vehicle and 9-LH vehicle, two of the highest polluting VECTO sub-groups responsible for 72% and 12% of regulated HDV emissions in 2020, respectively, would receive a counting of 1 and 0.9, respectively, towards the ZLEV factor, as shown in Table 1. In comparison, a regional delivery 9-RD vehicle, the sub-group which was responsible for 3% of the annual HDV emissions in 2020, would receive a counting of 0.15 towards the ZLEV factor.

Table 1. Regulated vehicles and their mileage, payload, and annual CO_2 emissions share parameters.

VECTO group	Annual mileage (km)	Average daily distance (km)	Payload (kg)	MPW	CO_2 emissions share in 2020
4-UD	60,000	175	2,650	0.1	0%
4-RD	78,000	250	3,180	0.15	4%
4-LH	98,000	300	7,420	0.45	4%
5-RD	78,000	250	10,258	0.5	0%
5-LH	116,000	375	13,842	1	72%
9-RD	73,000	225	6,280	0.29	3%
9-LH	108,000	350	13,400	0.9	12%
10-RD	68,000	225	10,258	0.43	0%
10-LH	107,000	350	13,842	0.92	4%

Note: Average daily distance is calculated through the annual mileage reference values, and our own assumptions on the daily utilization rate.

Accounting for zero-emission range. Under the current mechanism, a ZEV with a 200 km electric range receives the same benefits through the ZLEV factor as one with 1,000 km range. To disincentivize manufacturers from investing in low-range vehicles to avail of the ZLEV factor benefit, zero-emission vehicles should receive a graded contribution to the ZLEV factor based on their zero-emission range relative to its expected daily range requirement.

Modifications to the ZLEV factor

The current mechanism for ZLEVs may be better aimed at longer ranged and higher mileage vehicles by multiplying the contribution of each ZLEV with two scalars. The first would be through simply introducing the MPW into the calculation. The second would set a value between 0 and 1 based on a vehicle's zero-emission range relative to its reference mileage.

As an illustrative example, Table 2 shows the calculated zero-emission range factor and the overall ZLEV contribution from a variety electric truck models currently available for sale. Such a system would reward high-range vehicles such as the Daimler Truck eActros LongHaul, which has an electric range 33% greater than the daily range for the sub-group, while it would penalize low range trucks such as Scania's P Series 4x2 which only delivers 70% of the desired range of the sub-group.

Table 2. ZLEV contribution of various zero-emission trucks

Manufacturer	Zero-emission model	Sub-group	Zero-emission range (km)	Sub-group daily range (km)	ZERange Factor	MPW	Proposed ZLEV contribution
Daimler Truck	eActros 300 4x2	4-RD	300	250	1.00	0.15	0.15
	eActros 300 6x2	9-RD	300	225	1.00	0.29	0.29
	eActros LongHaul	5-LH	500	375	1.00	1	1.00
	GenH2	5-LH	1000	375	1.00	1	1.00
Volvo Trucks	Volvo FH Electric 4x2	5-LH	300	375	0.80	1	0.80
	Volvo FL Electric 4x2	4-RD	300	250	1.00	0.15	0.15
	Volvo FL Electric 4x2	4-LH	300	300	1.00	0.45	0.45
MAN	eTGM 6x2	9-RD	190	225	0.84	0.29	0.24
Scania	P Series 4x2	5-LH	250	375	0.67	1	0.67
	P Series 6x2	9-LH	250	350	0.71	0.9	0.60
	FCEV 6x2	9-LH	400	350	1.00	0.9	0.90
DAF	FT 4x2	5-LH	280	375	0.75	1	0.75
	FAN 6x2	9-LH	220	350	0.63	0.9	0.63
Renault	T electric	5-LH	300	375	0.80	1	0.80
	C electric	9-LH	300	350	0.86	0.9	0.77

Sources: MAN Truck & Bus, "MAN ETGM," 2020, https://www.man.eu/de/en/truck/all-models/the-man-etgm/etgm.html.; Scania, "Battery Electric Truck," Scania Group, https://www.scania.com/group/en/home/products-and-services/trucks/battery-electric-truck.html.; Scania, "Norwegian Wholesaler ASKO Puts Hydrogen Powered Fuel Cell Electric Scania Trucks on the Road," Scania Group, 2020, https://www.scania.com/group/en/home/newsroom/news/2020/norwegian-wholesaler-asko-puts-hydrogen-powered-fuel-cell-electric-scania-trucks-on-the-road.html.; DAF, "Jumbo Takes Delivery of First DAF CF Electric," 2018, https://www.daf.com/en/news-and-media/news-articles/global/2018/q4/18-12-2018-jumbo-takes-delivery-of-first-daf-cf-electric., Renault Trucks, "Renault Trucks T and C Electric T trucks in the E-Tech Range", https://www.renault-trucks.com/en/newsroom/press-releases/renault-trucks-t-and-c-electric-trucks-e-tech-range.

ACCOUNTING FOR SYNTHETIC AND ADVANCED RENEWABLE FUELS IN THE CO_2 STANDARDS

Some consideration is being given to a fuels crediting mechanism, whereby manufacturers contribute to their CO_2 emission reduction targets by purchasing credits from renewable synthetic and advanced alternative fuel suppliers.

Fuel producers are already required to blend a quantity of renewable fuel in accordance with the mandates established by the recast of the Renewable Energy Directive (RED II).[31] Due to this pre-existing requirement for fuel producers, for a fuels crediting system to viably contribute towards greenhouse gas (GHG) emission reductions, significant efforts are required to prevent fuels that are already counted towards the RED II transport target to count towards the CO_2 standards.

Although fuels crediting was considered but not included in the final CO_2 standards for light-duty vehicles, the topic of fuels crediting is again generating interest for HDVs, with some manufactures expecting renewable fuels to be used in their combustion engines.[32]

Recommendation

Fuels crediting should not be allowed in the CO_2 standards.

Fuels crediting would promote the supply of synthetic e-fuels, which face high production costs, and biofuels, which are in limited supply and susceptible to

31 European Parliament and Council of the European Union, "Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the Promotion of the Use of Energy from Renewable Sources" (European Union, 2018), http://data.europa.eu/eli/dir/2018/2001/oj.

32 Volvo Group, "Reducing carbon emissions," 2022, https://www.volvogroup.com/en/sustainability/climate-goals-strategy/reducing-carbon-emissions.html

sustainability risks. Further, fuels crediting may risk the integrity of the standards due to the potential of double counting with the RED II and distract manufacturers from focusing their innovation efforts toward the deployment of technologies capable of reducing vehicle CO_2 emissions.[33] We highlight three of the biggest concerns with a fuels crediting mechanism below.

The production of e-fuels is inefficient and prohibitively expensive

E-fuels are produced over several stages which require renewable electricity as a direct input if they are to be considered as fully sustainable. The combined costs of these stages makes e-diesel expensive to produce. A recent ICCT analysis puts the cost of domestic production in the range of €1.96–€3.81 per litre in 2020,[34] dropping to a range of €0.86-€2.10 per litre by 2050.[35] Using these projections, Figure 5 shows the range of the marginal cost of compliance for HDV manufacturers to reduce their fleet emissions by 1 gCO_2/tkm per vehicle in 2025 and 2030 through fuels crediting of e-fuels.[36] Assumptions for the annual mileage and survival of each sub-group used to calculate these values is described in a recent ICCT report.[37]

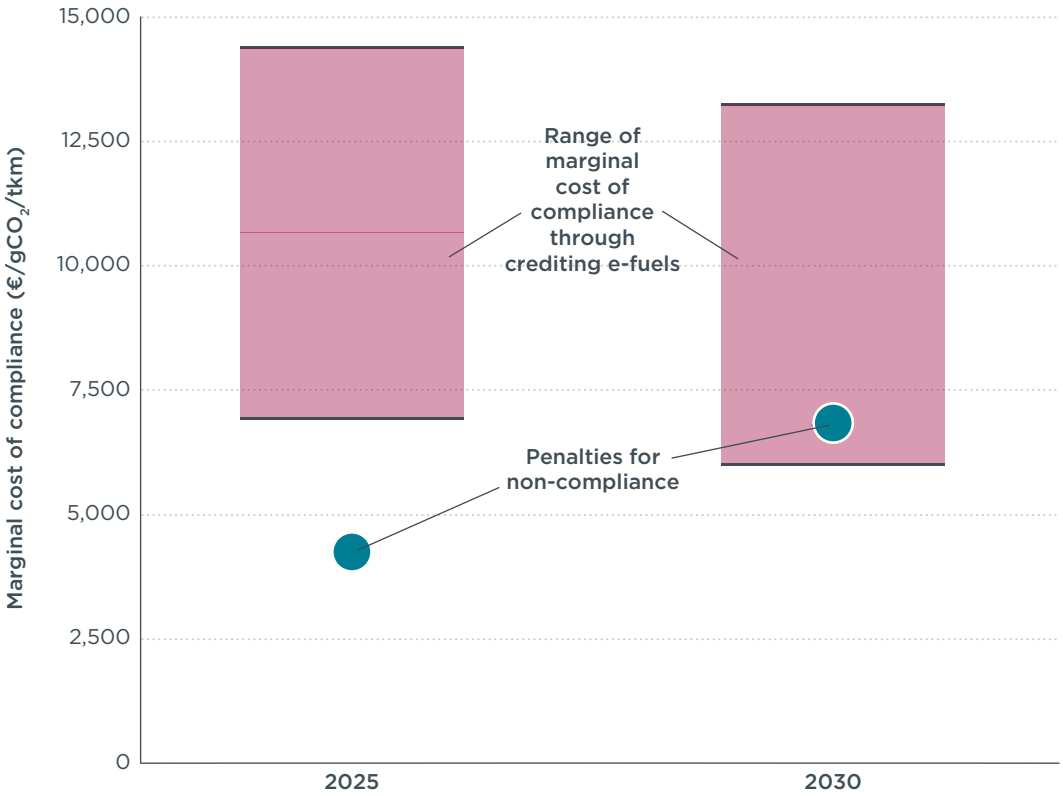


Figure 5. The cost of compliance for manufacturers to meet the 2025 and 2030 targets through e-fuels (red bars) benchmarked against the cost of penalties if manufacturers did not invest in any efficiency improvements from the baseline.

The cost of compliance penalties in 2025 is lower than the marginal cost of fuels crediting through e-fuels. In 2030, the cost of penalties is akin to our optimistic estimate for e-fuels. Thus, it would likely be cheaper for manufacturers to do nothing than to comply with their targets through purchased e-fuels credits. It would also

33 Chelsea Baldino, "How Is Alternative Fuels Crediting in the EU Vehicle Standards a Bad Idea? Let Me Count the Ways...," *ICCT Staff Blog* (blog), May 7, 2021, https://theicct.org/how-is-alternative-fuels-crediting-in-the-eu-vehicle-standards-a-bad-idea-let-me-count-the-ways/.

34 Excluding tariffs, taxes, and distribution costs

35 Zhou, Searle, and Pavlenko, "Current and Future Cost of E-Kerosene in the United States and Europe."

36 As only the production cost is considered, and assuming the fuel supplier does not profit from the sale of the credits, these assumptions may be viewed as conservatively low.

37 "The CO_2 Standards Required for Trucks and Buses for Europe to Meet Its Climate Targets."

be substantially more expensive than the estimated costs required to meet the CO_2 standards through efficiency improvement measures, calculated by the Impact Assessment of the CO_2 Standards to be €390/gCO_2/tkm in 2025 and €1,216/gCO_2/tkm per vehicle in 2030.[38] This analysis and the underlying assumptions are detailed further in the Appendix.

Biofuels are in low supply and are exposed to sustainability risks

Biofuels have much lower costs compared to e-fuels. However, most biofuels used in transport today are produced from food and feed materials, which are associated with significant land use change emissions.[39] While wastes and residues can be used to produce low-GHG alternative fuels, their potential to decarbonize the road sector is limited due to competing uses with other transport sectors.[40] Biofuels made from wastes and residues are in low supply,[41] and may indirectly increase emissions due to undesired land use change if strict sustainability criteria are not followed.

The RED has been amended to reduce these sustainability risks, but these risks are not reflected in the GHG savings assigned to the feedstocks in the RED II. For example, some land use change emissions are not included, thus simply referencing the GHG savings of a fuel in a fuels crediting system could have undesirable effects for the climate. In addition, feedstocks such as food and waste oils might not be capped or excluded from the alternative fuels crediting scheme as in the RED II. Using food or feed-based feedstocks would not achieve significant carbon savings.[42]

Even if adhering to strict sustainability guidelines that would allow only advanced biofuels additional to the RED II to count towards the CO_2 standards, their combustion would still be associated with air pollutant emissions of nitrogen oxides at levels similar to conventional fuels and with particulate matter emissions, albeit at a comparatively lower level, which increase the risk of morbidity associated diseases.[43] Investments into zero-emission vehicles provide guaranteed improvements into air quality.

Fuel credits may be double counted towards fuel supplier existing obligations

Fuel suppliers already have a variety of emission reduction obligations. Under the RED II, fuel suppliers are required to provide a minimum of 14% renewable energy of the total amount consumed in road and rail transport by 2030.[44] This target is under review and could increase as a part of the Fit for 55 package.

A manufacturer should only be eligible to use fuel credits towards its CO_2 targets if they are supplemental to a fuel producer's quota under the RED II. Under the Directive, the European Commission must establish a database to enable the tracing of fuels eligible towards compliance. Such a database could help ensure that fuels

38 EU Commission, "Proposal for a Regulation of the European Parliament and of the Council Setting CO2 Emission Performance Standards for New Heavy Duty Vehicles Part1/2" (Hart Publishing, 2018), https://doi.org/10.5040/9781782258674.

39 European Commission, "The Land Use Change Impact of Biofuels Consumed in the EU," August 27, 2015, https://ec.europa.eu/energy/sites/ener/files/documents/Final%20Report_GLOBIOM_publication.pdf.

40 Camilla Carraro, Stephanie Searle, and Chelsea Baldino, "Waste and Residue Availability for Advanced Biofuel Production in the European Union and the United Kingdom" (Washington, DC: ICCT, 2021), https://theicct.org/publication/waste-and-residue-availability-for-advanced-biofuel-production-in-the-european-union-and-the-united-kingdom/.

41 Tenny Kristiana, Chelsea Baldino, and Stephanie Searle, "Estimating the Potential for Used Cooking Oil from Major Asian Exporting Countries [Fact sheet}," (ICCT, February 2022), https://theicct.org/wp-content/uploads/2022/02/Europe-Fact-Sheet-%E2%80%93-UCO-potential.pdf.

42 Kristiana, Baldino, and Searle.

43 Magín Lapuerta et al., "Potential for Reducing Emissions in a Diesel Engine by Fuelling with Conventional Biodiesel and Fischer-Tropsch Diesel," *Fuel* 89, no. 10 (October 1, 2010): 3106–13, https://doi.org/10.1016/j.fuel.2010.05.013; Eamonn Mulholland, Josh Miller, Caleb Braun, Lingzhi Jin, and Felipe Rodríguez, "Quantifying the Long-Term Air Quality and Health Benefits from Euro 7/VII Standards in Europe" (Berlin: ICCT, 2021), https://theicct.org/publication/quantifying-the-long-term-air-quality-and-health-benefits-from-euro-7-vii-standards-in-europe/.

44 European Parliament and Council of the European Union, "Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the Promotion of the Use of Energy from Renewable Sources."

credits are not double counted towards both a manufacturer's CO_2 reduction target and the fuel producer's obligation under the RED II. However, it would need to be capable of tracking every single liter of alternative fuel produced to enable cross-checking across policy targets and between Member States. Since the RED II is a directive, tracking how fuels are counted towards either the RED or the CO_2 standards could be left to the individual Member States, each of which has its own system for determining RED II compliance.

INTRODUCING AN ENGINE-BASED STANDARD

The CO_2 standards in their current form apply to the full vehicle, allowing manufacturers to comply with their emissions reduction requirement through the adoption of multiple measures. These technologies include vehicle road load technology such as aerodynamic improvements and low rolling resistance tires, and engine technology such as engine friction reduction, combustion optimization, or zero-emission adoption.

As part of the revision, the European Commission plans to evaluate the impact of introducing a separate engine standard for vehicles, as is in place in the United States and Canada. Such a system offers a viable opportunity for certain vehicles, particularly vocational vehicles such as refuse and dump trucks, to contribute to emission reductions. Vocational vehicles benefit proportionately less from efficiency improvements through road load technologies, particularly aerodynamic improvements, but can still avail of emission reductions through engine standards.

Vocational vehicles are not covered under the scope of the CO_2 standards due to their comparatively low mileage with respect to the regulated vehicle groups. They make up 1% of the annual vehicles sold in the regulated VECTO categories according to the baseline monitoring and reporting data covering the period July 2019–June 2020.

Recommendation

The scope of the CO_2 standards should be extended to vocational vehicles through the implementation of engine standards which require an emissions reduction through engine specific technologies.

Technologies capable of reducing CO_2 emissions for engines exist, and there is no viable reason for why such technologies cannot be employed in vocational vehicles. The main arguments for why the introduction of an engine standard is worthwhile are detailed below.

A vocational engine standard encourages CO_2 emission reductions in parallel with Euro VII emission standards compliance

The European Commission's proposal for Euro VII emission standards establishes stricter limits for emissions of nitrogen oxides (NOx). Some technologies aimed at reducing NOx emissions come at the expense of higher fuel consumption, and thus higher CO_2 emissions, while others can improve both concurrently. Setting a complementary standard for CO_2 reduction on the engine would ensure manufacturers optimize engine improvements around both CO_2 and NOx reductions, rather than focusing on technologies which reduce NOx at the expense of fuel consumption. A previous ICCT analysis has identified a list of engine technologies compatible with both NOx and CO_2 reductions.[45]

45 Francisco Posada, Aaron Isenstadt, and Huzeifa Badshah, "Estimated Cost of Diesel Emissions-Control Technology to Meet the Future California Low NO_x Standards in 2024 and 2027" (Washington, DC: ICCT, 2020), https://theicct.org/publication/estimated-cost-of-diesel-emissions-control-technology-to-meet-the-future-california-low-nox-standards-in-2024-and-2027/.

Engine improvements for vocational vehicle may also be adopted by other regulated HDV segments

Engines used in vocational vehicles are not always exclusive to these vehicles. Table 3 shows the percentage of non-vocational vehicles which use the same engine as a vocational vehicle, based on the monitoring and reporting data.[46] Vocational vehicles only represented 1% of vehicle sales, but 31% of non-vocational vehicles shared a common engine with a vocational vehicle. Introducing a requirement for vocational vehicles to lower their emissions through engine improvements will filter these technological advances into these other vehicle types, including vehicles not covered by the Certification Regulation.

Table 3. Illustration of non-vocational vehicles which use the same engine as a vocational vehicle.

Manufacturer	Non-vocational vehicle sales	Vocational vehicle sales	Sales of non-vocational vehicles using the same engine as a vocational vehicle	Percentage of non-vocational vehicle sales using the same engine as a vocational vehicle
Daimler Truck	101,917	2,528	7,634	7%
DAF	35,974	1,683	34,790	97%
Renault Trucks	25,205	-	17,315	69%
IVECO	21,707	-	-	0%
Volvo Trucks	43,945	134	38,723	88%
Scania	51,400	-	-	0%
MAN	32,463	-	-	0%
Total	**312,611**	**4,345**	**98,462**	**31%**

Notes: Data is based on the engine certification number provided in the EEA monitoring and reporting database. In the case of Renault Trucks, while they have no registered vocational vehicles, some vehicles use the same engine as a Volvo Trucks vocational vehicle, as both fall under the umbrella of Volvo Group.

Measuring compliance would not present a significant additional burden

Manufacturers are already required to monitor and report engine-related CO_2 emissions for their vehicles on an annual basis to the European Environment Agency.[47] Cumulative cycle CO_2 emissions for new HDVs are determined annually through the World Harmonized Transient Cycle (WHTC) and the World Harmonized Stationary Cycle (WHSC) test, which is used to determine compliance with the Euro pollutant emissions standards.[48] Determining compliance of an engine standard can be based off this pre-existing framework.

ASSESSING THE APPROPRIATENESS OF THE CREDIT AND DEBT SYSTEM

The CO_2 standards include flexibilities for manufacturers to comply with their CO_2 emission targets through a credit and debt system. Manufacturers can accumulate credits over the reporting periods for the years 2019–2029 and can accumulate debts over the reporting periods for the years 2025–2029.[49] The points at which a manufacturer accumulates credits or debts is summarized in Figure 6.

46 European Environment Agency, "Monitoring of CO_2 Emissions from Heavy-Duty Vehicles," January 6, 2021, https://www.eea.europa.eu/data-and-maps/data/co2-emission-hdv.

47 "Monitoring of CO_2 Emissions from Heavy-Duty Vehicles."

48 European Commission, "Regulation (EC) No 595/2009 of the European Parliament and of the Council of 18 June 2009 on Type-Approval of Motor Vehicles and Engines with Respect to Emissions from Heavy Duty Vehicles (Euro VI) and on Access to Vehicle Repair and Maintenance Information and Amending Regulation (EC) No 715/2007 and Directive 2007/46/EC and Repealing Directives 80/1269/EEC, 2005/55/EC and 2005/78/EC (Text with EEA Relevance)," *Official Journal of the European Union* L 188/1 (July 18, 2009), http://data.europa.eu/eli/reg/2009/595/oj/eng.

49 The reporting period for a year, for example 2025, is defined as the period 1st of July 2025–30th June 2026.

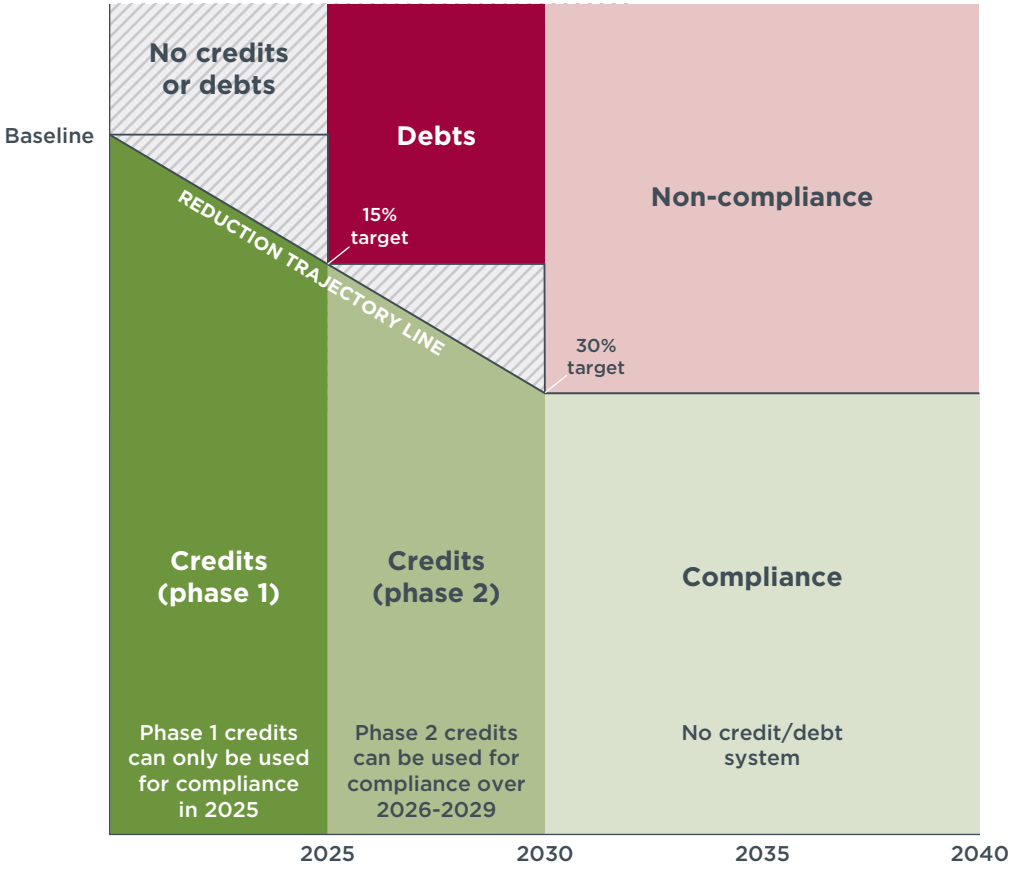


Figure 6. HDV CO_2 standards credit and debt mechanism. Hatched area represent where nether credits nor debts are accumulated.

For the year 2025, if a manufacturer accumulates any debts (measured in gCO_2/tkm), it can use any credits accumulated from 2019 through 2024 to offset them. The credits accumulated between 2019 and 2024 can only be used in 2025. If the manufacturer still has any remaining debts after using up all their credits, and this exceeds 5% of the target times the number of vehicles sold, they must pay a fine of €4,250/gCO_2/tkm per vehicle.

The same process applies in the second phase, between 2026 and 2029. If at any point in these years, a manufacturer accumulates debts beyond 5% of the target that it cannot offset with credits earned since 2025, they must pay a fine of €4,250/gCO_2/tkm per vehicle.

The credit and debt system ends in 2030. From then onwards, manufacturers must pay a penalty of €6,800 per vehicle for each gCO_2/tkm they are above the 2030 target.

Recommendation

The credit and debt mechanism should only be extended past 2030 if the stringency of the 2030 target is significantly increased.

A credit and debt system provides manufacturers flexibility in managing their transition to a lower emission fleet. Early action is incentivized, allowing ambitious manufacturers to bank credits to offset any future debts. In effect, this averages out a manufacturer's fleet emissions over the compliance period, allowing for their target to be met in a more cost-effective way.

However, caution should be exercised if the credit and debt system is to be continued forward, particularly if the CO_2 reduction targets for 2030 are not significantly

increased. Most manufacturers have pledged to sell shares of zero-emission vehicles by 2030 that go far beyond the currently imposed 30% target (see Figure 4). As a result, they're on track to accumulate a significant number of credits. For example, if Scania, Volvo Trucks and Daimler Truck achieve their 50% zero-emission sales targets, they will generate cumulative credits worth €4.4 billion euro in 2030 alone.

If these manufacturers are allowed to use the credits generated over the period 2025–2029 to comply with their 2030 target, it opens the possibility of these high-achieving manufactures significantly increasing their fleet emissions for this compliance year. For the same reason, it's critical that the lifetime of credits is held exclusive to the compliance period (e.g., credits earned in the period 2026–2030 cannot be carried over to beyond 2031). This would prevent manufacturers who achieve a high share of zero-emission vehicles early on from over-relying on these credits to meet their reduction targets in the later years and divesting from emission reduction technologies. A continuation of the credit and debt system should only be allowed if the 2030 target is set in accordance with manufacturer pledges (i.e., 60%).

INTRODUCING A MECHANISM TO ALLOW MANUFACTURERS TO TRADE THEIR EMISSION CREDITS

Emission credits are non-transferrable across manufacturers. A credit trading mechanism would allow manufacturers to combine their emissions reduction efforts to comply with their targets. This would effectively mean under-performing manufacturers could purchase credits from their over-performing counterparts.

The light-duty vehicle CO_2 standards allows for a similar mechanism through pooling, and this is under consideration for the revision of the HDV CO_2 standards. In the original HDV CO_2 standards, the Impact Assessment advised against the inclusion of a pooling system under claims that, despite reducing compliance costs, it risks reducing competitiveness in a market which only has a limited number of individual manufacturers, and thus would reduce the number of technologies available for sale.[50]

Recommendation

Allow manufacturers to trade their credits to other manufacturers, but only if the stringency of the 2030 target is significantly increased.

The HDV market is more consolidated than the light vehicle market, with the top seven truck manufacturers comprising 98% of the total sales in 2021.[51] The concern with a credit mechanism raised by the Impact Assessment is that it may disincentivize a manufacturer from producing zero- or low-emitting vehicles (ZLEVs) by allowing them to trade with another who has over complied with their reduction target by producing a higher volume of ZLEVs. The Impact Assessment claims that this would result in reducing both the competitiveness and diversity of ZLEVs available in the market. Contrary to this reasoning, we argue that a credit trading mechanism may actually increase diversity in the HDV market.

While the market for conventional HDVs is segregated, the market for zero-emission HDVs is growing in diversity. Whereas the top seven truck manufacturers were responsible for 98% of the sales of conventional vehicles, this reduces to 86% when only considering zero-emission trucks (see Figure 7). There is also an increasing number of smaller HDV manufacturers entering the market who are focusing only on zero-emission vehicle production. For trucks, these include Emoss, Volta Trucks,

50 EU Commission, "Proposal for a Regulation of the European Parliament and of the Council Setting CO_2 Emission Performance Standards for New Heavy Duty Vehicles Part1/2."

51 Based on annual sales data supplied by IHS Global SA; Copyright © IHS Global SA, 2022.

Einride, Tevva, and E-Trucks Europe, and for buses it includes BYD, Ebusco, Karsan, Golden Dragon, and Caetano Bus. Zero-emission manufacturers will naturally generate emission credits for every ZE-HDV built. Allowing a trading mechanism would offer a new source of capital for these smaller manufacturers to gain a better foothold in the market.

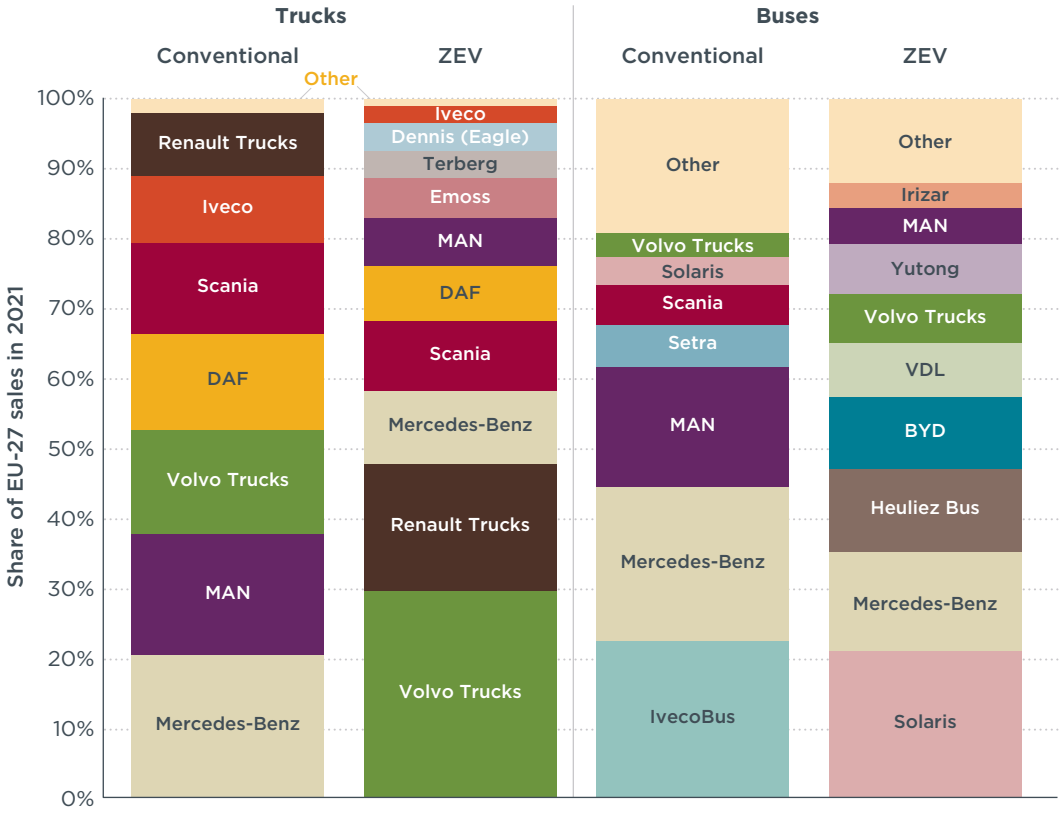


Figure 7. Manufacturer sales share of conventional and zero-emission trucks and buses in 2021

However, a credit trading system should only be considered if the stringency of the CO_2 standards are increased in accordance with manufacturer pledges (i.e., 60%). As previously discussed, some major manufacturers are on track to generate a significant number of credits. Without increasing the stringency of the standards, these manufacturers would dominate the credit trading market, risking a reduction to the overall competitiveness for zero-emission vehicles.

SUMMARY OF POLICY RECOMMENDATIONS

The HDV CO_2 standards in their current form offer little climate benefit, with the limited scope of the standards failing to achieve any significant emission reductions by 2050. The revision of the CO_2 standards offers the opportunity to rectify this. This brief highlights the most significant elements to be considered under the revision and provides recommendations on how to align the HDV sector with Europe's long-term climate commitments. We summarize these points below and further summarize in Figure 8.

The 2030 CO_2 reduction target should be increased to 60%, and targets of 90% and 100% should be introduced for 2035 and 2040, respectively. These targets align with the latest pledges of the major HDV manufacturers in Europe and would deliver a 96% reduction in annual HDV CO_2 emissions by 2050.

The CO_2 standards should be extended to include all unregulated vehicles which are covered by the certification regulation. Regulating the emissions of all HDVs

which must certify their emissions would regulate 95% of annual HDV CO_2 emissions. Separate CO_2 standards should be created for trailers, as well as for buses and coaches.

The ZLEV factor should be phased out after 2030. In its current form, the ZLEV factor provides little incentive for manufacturers to invest in zero-emission technology, as the majority of them have already pledged to exceed the benchmark by up to ten-fold by 2030. The mechanism can be improved in the short term by weighting the incentives base on the vehicle's zero-emission range and mileage and payload weighting factor.

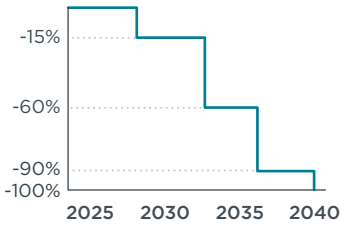
Fuels crediting should not be allowed in the CO_2 standards. Sustainable e-fuels are prohibitively expensive, and biofuels are linked to issues of sustainability and availability. Fuel credits are also at risk of being double counted with fuel suppliers pre-existing obligations under the Renewable Energy Directive.

The scope of the CO_2 standards should be extended to vocational vehicles through the implementation of engine standards which require an emissions reduction through engine specific technologies.

The credit and debt mechanism should be extended past 2030, but only if the stringency of the 2030 target is significantly increased. This would offer additional flexibility in compliance while preventing manufacturers from over-relying on credits to meet later reduction targets and divesting from emissions reduction technologies.

Manufacturers should be allowed to trade their credits to other manufacturers, but only if the stringency of the 2030 target is significantly increased. Doing so would open a source of revenue for smaller manufacturers who focus solely on zero-emission deployment, thus increasing competitiveness in the market.

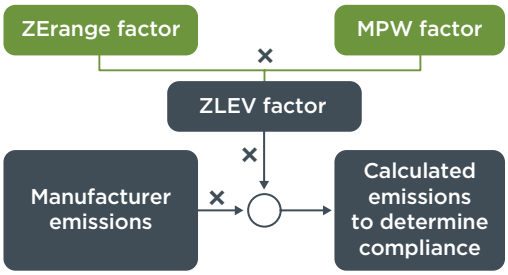
Increase the 2030 target to 60%, introduce targets of 90% for 2035 and 100% for 2040



Regulate all certified vehicles

Reduction targets relative to baseline	2030	2035	2040
	60%	90%	100%
	90%	100%	
	7-10%		

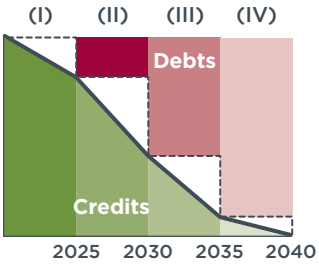
Differentiate the ZLEV factor based on a vehicle's MPW and zero-emission range



Do not introduce a fuels crediting system

Introduce engine standards for vocational vehicles

Extend the banking and borrowing system past 2030, but only if the stringency of the standards is increased



Allow for manufacturers to trade their credits

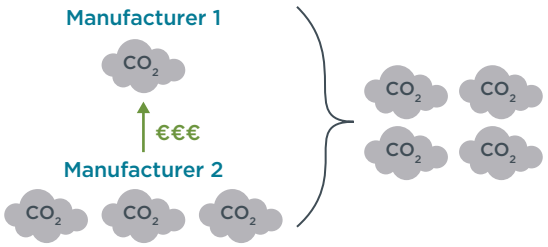


Figure 8. Summary of recommendations for the HDV CO_2 standards review

APPENDIX: CALCULATION OF E-FUELS MARGINAL COMPLIANCE COSTS

This paper presented the marginal cost of a manufacturer reducing their fleet average specific CO_2 emissions by 1 gCO_2/tkm through the use of e-fuels. This appendix outlines the assumption behind these calculations.

For every regulated VECTO vehicle, we calculated the total cost of e-fuel production that would be required if these vehicles were run only on e-diesel, using the following equation:

$$Lifetime\ efuel\ production\ cost_{SG} = \sum_{Y}^{Y+30} Mileage_{SG,Y\text{-}Y_0} \times Survival_{SG,Y\text{-}Y_0} \times efuel\ cost_{Y}$$

Where *SG* is the VECTO sub-group, *Y* is the year, Y_0 is the first year of the analysis (i.e., 2025 or 2030), *Mileage* is the annual mileage of a vehicle of age Y-Y_0, *Survival* is the probability of a vehicle surviving to age Y-Y_0, and *e-fuel cost* is the production cost of e-diesel.

Our assumptions behind the survival and annual mileages of each VECTO group and projections on the production cost of e-diesel are detailed in the Appendix of a previous ICCT paper.[52] The resulting lifetime mileage, given through the product of annual mileage and vehicle survival, is shown below in Table A1.

Table A1. Characteristics of the regulated VECTO subgroups

VECTO category	Sales (2021)	Lifetime Mileage (vkm)	gCO_2/tkm
4-UD	89	513,706	307.2
4-RD	18,166	675,294	198.8
4-LH	15,613	791,286	106.8
5-RD	835	583,331	85.8
5-LH	121,547	977,660	57.2
9-RD	10,861	603,511	112.0
9-LH	25,569	888,553	65.8
10-RD	48	721,016	84.5
10-LH	7,462	861,553	59.1

After quantifying the production cost for e-fuels to cover a vehicle's total life, we took the share which would be required to reduce a manufacturer's fleet average specific CO_2 emissions by 1 gCO_2/tkm. The weighted average of all manufacturer's fleet average specific CO_2 emissions in the baseline reporting period amounted to 52.8 gCO_2/tkm. To reduce this value by 1 gCO_2/tkm would require 1.9% of the total fuel from every manufacturer's truck to be covered by e-fuels. We applied this 1.9% share to the lifetime e-fuel production cost for every vehicle, and multiplied it by the vehicle's sales share in 2021 as follows:

$$Marginal\ cost\ of\ efuel\ compliance = 1.9\% \times \sum_{SG} Lifetime\ efuel\ production\ cost_{SG} \times SalesShare_{SG}$$

Where *SalesShare* is calculated using the total sales of HDVs in 2021.

We compared this marginal cost to the current penalties which have only be set for 2025 (€4,250 for every excess gCO_2/tkm), and 2030 (€6,800 for every excess gCO_2/tkm).

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