Truck CO2: Europe's chance to lead

Position paper on the CO2 standards for heavy-duty vehicles

April 2023

Summary

The European Commission's proposal to review the CO_2 emission standards for new heavy-duty vehicles (HDVs) is the most important legislative initiative to regulate climate emissions from trucks and buses in Europe. HDVs - or all road vehicles above 3.5 tonnes moving goods and passengers - are responsible for 28% of climate emissions from road transport in Europe, while accounting for only 2% of the vehicles on the road. If no action is taken, these emissions will continue to grow.

To reach climate neutrality by 2050, trucks and buses need to be entirely decarbonised. Zero-emission vehicles (ZEVs) - which include battery electric (BEVs) and fuel cell electric vehicles (FCEVs) as well as hydrogen combustion trucks - are the only available technology which can cut emissions from new sales quickly, fully decarbonise the heavy-duty sector in the long-term, and eliminate harmful air pollution. The Commission proposes to increase their sales through a -45% CO_2 reduction target for HDVs in 2030, a -65% target in 2035 and a -90% target in 2040.

The shortcomings of the Commission proposal

A CO_2 target of -90% might seem close enough to full decarbonisation at first sight. But due to a number of shortcomings, the proposal would only reduce emissions from HDVs by 56% until 2050 (against 1990 levels). This both fails the EU's climate ambitions and Europe's chance to retain its industrial leadership of the sector. While the Commission proposal brings a number of improvements compared to the current regulation, it is falling short in four key aspects.

1. It lacks a 100% zero-emission target

The Commission proposal fails to bring forward a 100% zero-emission target and instead stops at a -90% CO_2 reduction target in 2040. T&E analysis shows that the proposal would only reduce HDV emissions by 56% in 2050. In contrast, setting a 100% zero-emission target in 2035 for freight trucks, buses and coaches, and in 2040 for vocational and non-certified vehicles, would reduce the sector's GHG emissions by 94% by 2050.

Analysis by TNO (and commissioned by T&E) shows that this is feasible from a technological and cost perspective. By the 2030s, all new sales in the freight segments will have a lower total cost of ownership (TCO) compared to diesel while delivering the same capabilities in terms of range, payload and driving times (including for long-haul trucks, and across all European markets). Co-legislators should therefore:

- Increase the global CO_2 target from -65 to -100% in 2035 for trucks, buses and coaches

2. Its 2030 target is too low and lags behind industry plans

Although the Commission proposal increases the global CO_2 target for trucks, buses and coaches from the current -30% to -45% in 2030, this falls well short of what is needed to ramp up the supply of clean trucks and buses fast enough. T&E analysis shows that an increased global CO_2 target of -65% in 2030 would result in just 8% more zero-emission trucks on European roads than what truck makers have already publicly announced to produce until 2030. Co-legislators should therefore:

- Increase the global CO_2 target from -45 to -65% for trucks, buses and coaches in 2030

3. It leaves 20% of HDV sales unregulated

The proposal continues to exempt small trucks as well as the so-called 'vocational' and 'non-certified' vehicles. This means that climate emissions from vehicles that drive in our cities every day, including delivery, garbage and construction trucks, are not regulated at all. Together, these exempted vehicles make up almost 20% of HDV sales and 12% of fleet emissions.

Small trucks, vocational and non-certified vehicles should also be included in the regulation and contribute their fair share to decarbonising the sector. Vocational vehicles should be regulated by a CO_2 target. Non-certified vehicles, including small trucks, should be regulated by a ZEV target, which requires manufacturers to sell a certain share of ZEVs from a given year. Co-legislators should therefore:

- Introduce CO_2 targets for vocational trucks of -35% (2030), -85% (2035), and 100% (2040)
- Introduce ZEV targets for non-certified trucks of 30% (2030), 80% (2035), and 100% (2040)

4. It defines trucks running partially on diesel as zero-emission

Contrary to the CO_2 standards for cars and vans, the current definition of what counts as a zero-emission vehicle (ZEV) under the HDV CO_2 standards also includes internal combustion trucks which run exclusively on hydrogen. However, the Commission proposal is changing this definition to also allow for hydrogen dual-fuel engines running partially on diesel to qualify as zero-emission. While it is reasonable to define internal combustion trucks which are running exclusively on hydrogen as zero-emission, it is not acceptable to give the same label to trucks which still (partly) run on diesel. Co-legislators should therefore:

- Change the ZEV definition back to 1 gCO_2/kWh as set in the current regulation

Why the Commission is right not to include fuels

A crediting system or carbon correction factor for so-called 'renewable and low-carbon' fuels, including advanced biofuels and e-fuels, should not be included in the HDV CO_2 standards as these fuels will remain scarce and expensive, will not help reduce emissions due to sustainability issues and would risk creating regulatory loopholes.

Using e-fuels in the road freight sector is inefficient and unnecessary as cheaper zero-emission alternatives exist. E-fuels would be the most costly compliance option for vehicle makers, transport operators and society as a whole. T&E analysis shows that the TCO of diesel trucks running on e-fuels would be around 50% higher than the TCO of battery electric trucks, even when assuming that those e-fuels would be produced more cheaply in North Africa or other favourable regions and imported to Europe.

Industry headed for zero emissions, but certainty needed

While the EU as a block is just starting to negotiate the direction the regulation should take, 10 EU countries have already pledged to transition to 100% zero-emission HDV sales by 2040 (AT, BE, HR, DK, FI, IE, LT, LU, NL and PT). They have done so under a Global Memorandum of Understanding, which was also signed by the United Kingdom (UK), Norway, Switzerland and Turkey, as well as Canada and the United States. California, whose emission standards are commonly followed by other U.S. states, has recently proposed legislation for a 100% zero-emission sales target for trucks and buses already in 2036.

Today, Europe's truck manufacturers are world leaders in developing commercial vehicle technology. They have established a growing presence in global and emerging markets, including the U.S., China and India. Failing to set a target to reduce CO_2 emissions from new trucks and buses by 100% would put Europe's technological edge in the heavy-duty segment at risk just when the U.S. is joining China in the race for industrial leadership following the Inflation Reduction Act. In the worst case, it could lead to Europe's domestic automotive and supplier industry falling behind and losing its global leadership to the growing competition from overseas.

The HDV CO_2 standards are the key supply-side policy to mandate Europe's truck makers to invest, manufacture and sell clean trucks. If co-legislators in the European Parliament and Council do not agree on more ambitious CO_2 standards, they would fail to send the necessary signal and create investment certainty for Europe's industry.

Table of contents

1. The heavy-duty climate problem

In February, the European Commission published a proposal[1] to review the CO_2 emission standards for new heavy-duty vehicles (HDVs), which were first adopted in 2019.[2] The CO_2 standards are the most important legislation to regulate climate emissions from trucks and buses in Europe. They set the direction and speed at which vehicle manufacturers (also called original equipment manufacturers, or OEMs) have to produce and sell cleaner vehicles.

HDVs - or all road vehicles with a gross vehicle weight (GVW) above 3.5 tonnes moving goods and passengers - are responsible for 28% of greenhouse gas (GHG) emissions from road transport in Europe,[3] while accounting for only 2% of the vehicles on the road (see figure 1).[4] If no action is taken, these emissions will continue to grow. The European Commission[5] expects truck activity in the European Union (EU) to further increase by 40% between 2019 and 2050, while activity from buses and coaches would grow by 10% over the same period.

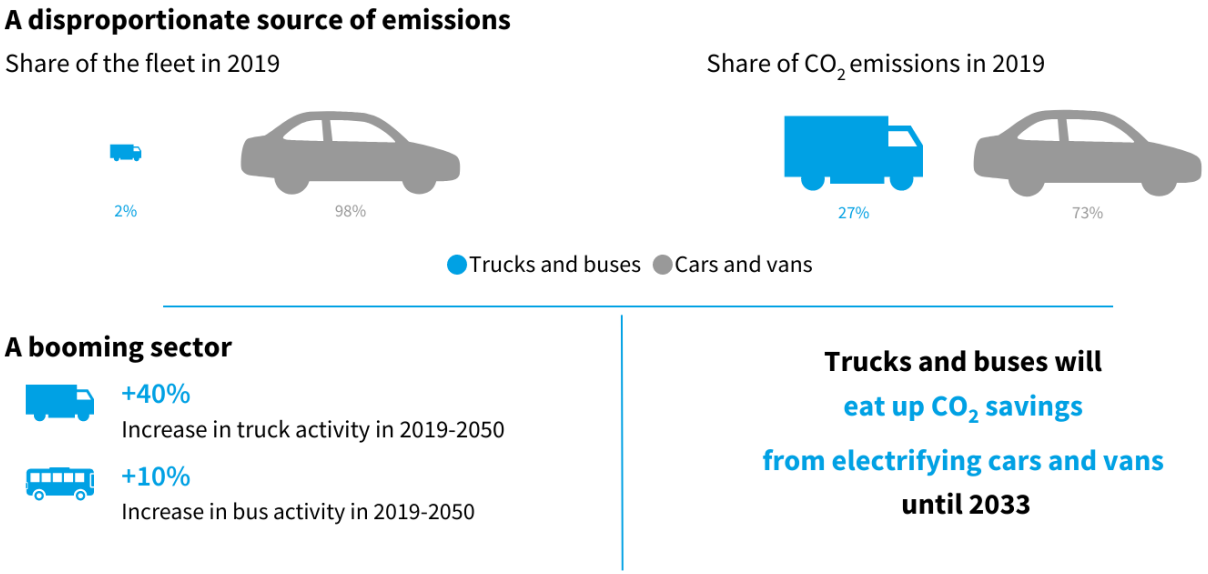


Figure 1. Fleet and emission shares of trucks and buses

To reach climate neutrality by 2050, trucks and buses need to be entirely decarbonised. Zero-emission vehicles (ZEVs) - which include battery electric (BEVs) and fuel cell electric vehicles (FCEVs) as well as hydrogen combustion trucks - are the only available technology which can cut emissions from new sales quickly, fully decarbonise the heavy-duty sector in the long-term, and eliminate harmful air pollution.

[1] European Commission (2023). Proposal for amending Regulation (EU) 2019/1242 as regards strengthening the CO_2 emission performance standards for new heavy-duty vehicles. Link.
[2] European Union (2019). Regulation (EU) 2019/1242 setting CO2 emission performance standards for new heavy-duty vehicles. Link.
[3] UNFCCC (2022). GHG data from UNFCCC. Link.
[4] ACEA (2022). Report – Vehicles in use, Europe 2022. Link.
[5] European Commission (2021). EU reference scenario 2020. Link.

2. Governments globally pledge 100% ZE-HDV sales

Governments around the world are recognising the growing momentum for zero-emission trucks. Regulators are realising that stringent and forward-looking regulation accelerates the market uptake of zero-emission technology and supports their domestic industries to thrive. Besides stimulating the demand for clean trucks and the roll-out of infrastructure, emission standards and sales targets requiring manufacturers to sell more ZEVs are effective policies to scale supply and bring down the cost per unit. The European CO_2 standards for cars and vans are the living proof of this: To comply with the targets set by the regulation, car manufacturers quintupled the sales of battery electric cars between 2019 and 2021.[6]

While the EU as a block is just starting to negotiate the direction the regulation should take, 10 EU countries have already pledged to transition to 100% zero-emission HDV sales by 2040. These include Austria, Belgium, Croatia, Denmark, Finland, Ireland, Lithuania, Luxembourg, the Netherlands and Portugal. They have done so under the so-called 'Global Memorandum of Understanding on Zero-Emission Medium- and Heavy-Duty Vehicles',[7] which was also signed by the United Kingdom (UK), Norway, Switzerland and Turkey, as well as Canada and the United States (U.S.).

California, whose emission standards are commonly followed by other U.S. states, has recently proposed legislation for a 100% zero-emission sales target for trucks and buses already in 2036.[8] This will have big implications also for the plans of European truck manufacturers, whose vehicle technology powers more than 50% of the heavy trucks on the U.S. market.[9]

3. The shortcomings of the Commission proposal

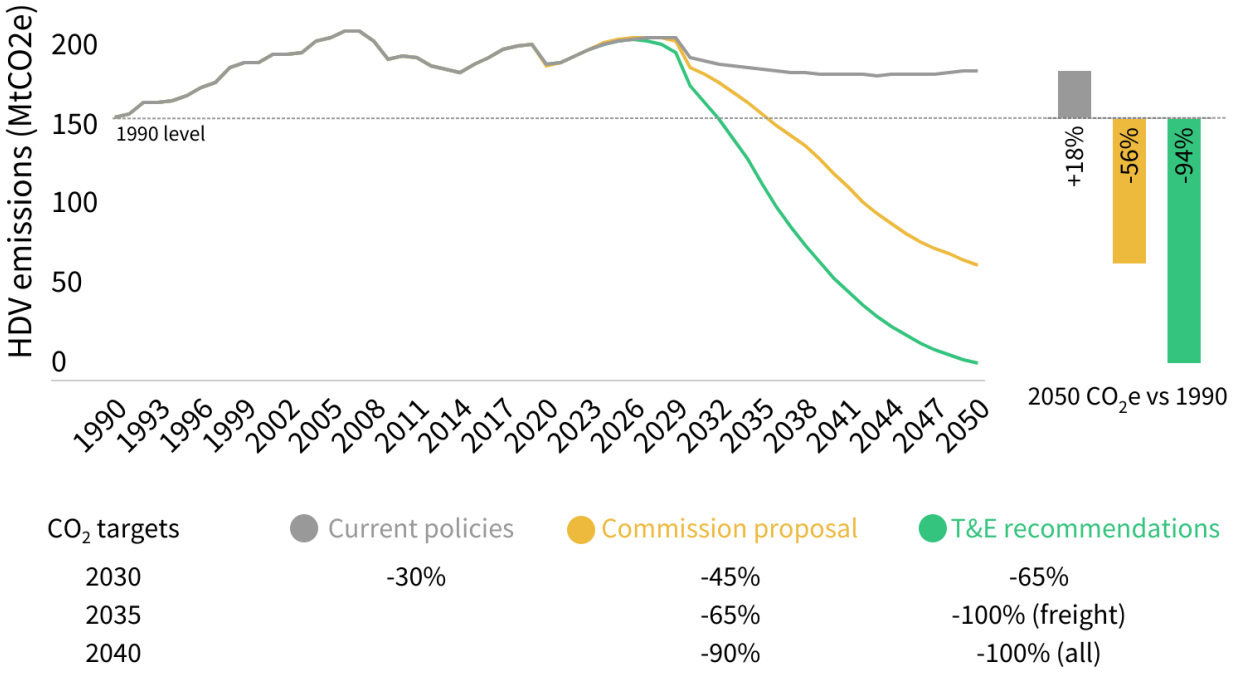
Considering this global momentum, the Commission proposal lacks the level of ambition which is needed to decarbonise the heavy-duty vehicle fleet in Europe in time and retain the EU's global leadership in the sector. While it brings a number of improvements compared to the current regulation, it is falling short in four key aspects:

- it fails to fully decarbonise the sector through a 100% zero-emission target;
- its 2030 target is too low and lags behind industry plans;
- It leaves 20% of HDV sales unregulated, including small urban delivery, garbage and construction trucks which are driving around in our cities every day; and
- It defines trucks running partially on diesel as zero-emission by weakening the ZEV definition.

[6] EEA (2022). Monitoring of CO2 emissions from new passenger cars. Link.
[7] Calstart (2023). Global Memorandum of Understanding on Zero-Emission Medium- and Heavy-Duty Vehicles. Link.
[8] CARB (2022). Proposed 15-day Changes to the Proposed Regulation Order Advanced Clean Fleets Regulation. 2036 100 Percent Medium- and Heavy-Duty-Zero Emissions Vehicle Sales Requirements. Link.
[9] ACEA (2022). Fact sheet: trucks. Link.

3.1. It lacks a 100% zero-emission target

The Commission proposal fails to bring forward a 100% zero-emission target and instead stops at a -90% CO_2 reduction target in 2040. T&E analysis[10] shows that this would only reduce HDV emissions by 56% in 2050 (against 1990 levels), thereby largely failing to meet the EU's 2050 climate neutrality target. In contrast, setting a 100% zero-emission target in 2035 for freight trucks, buses and coaches, and in 2040 for vocational and non-certified vehicles, would align the regulation with the EU's climate objectives and reduce the sector's GHG emissions by 94% by 2050 (see figure 2).



CO_2 targets	Current policies	Commission proposal	T&E recommendations
2030	-30%	-45%	-65%
2035		-65%	-100% (freight)
2040		-90%	-100% (all)

Figure 2. Projected emission reductions

Analysis by TNO[11] (and commissioned by T&E) shows that such a 100% CO_2 reduction target for all freight trucks is feasible from a technological and cost perspective (including for long-haul trucks, and across all European markets). By the 2030s, all new sales in the freight segments will have a lower total cost of ownership (TCO) compared to diesel while delivering the same capabilities in terms of range, payload and driving times (see section 7.3.).

[10] Transport & Environment (forthcoming). Addendum: addressing the heavy-duty climate problem. *The previous publication can be found here*.
[11] TNO (2022). Techno-economic uptake potential of zero-emission trucks in Europe. Link.

Key recommendation

- Increase the global CO_2 target from -65 to -100% in 2035 for trucks, buses and coaches

3.2. Its 2030 target is too low and lags behind industry plans

Although the Commission proposal increases the global CO_2 target for trucks, buses and coaches from the current -30% to -45% in 2030, this falls well short of what is needed to ramp up the supply of clean trucks and buses fast enough. The proposed -45% target would result in 243,000 fewer zero-emission trucks on the road than what truck makers have already publicly announced to produce until the end of the decade (see figure 3). Without regulation, these voluntary plans will not materialise. T&E analysis shows that an increased global CO_2 target of -65% in 2030[12] would result in just 8% more zero-emission trucks on European roads compared to the truck makers' announcements (see section 7.2.).

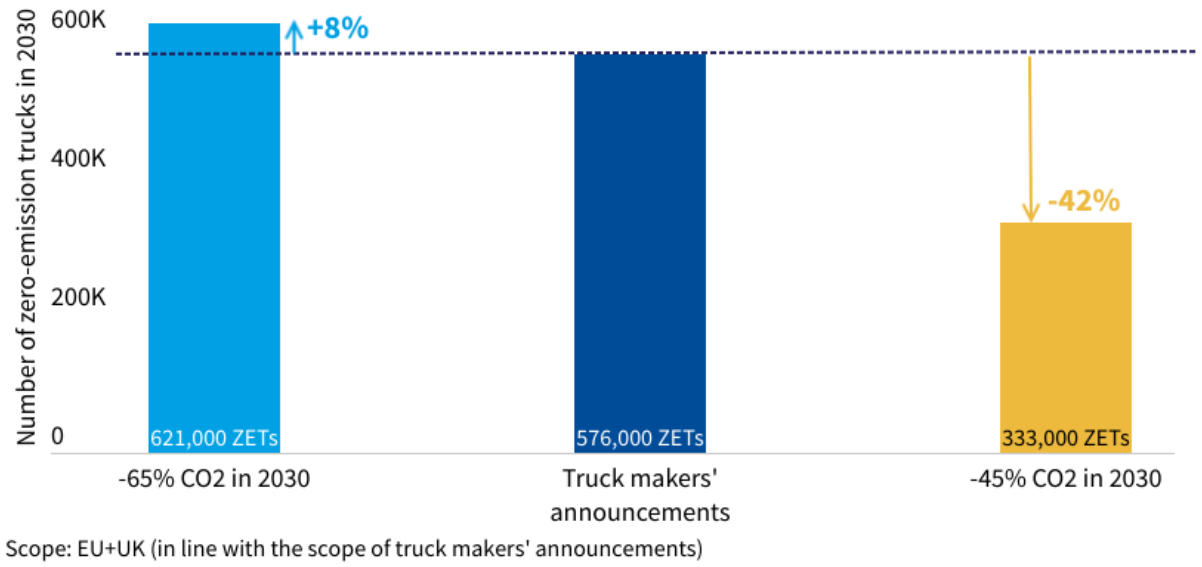


Figure 3. Zero-emission truck fleet in 2030 in the EU+UK

[12] This also includes the introduction of separate targets for vocational and non-certified trucks aligned with the scope of the truck makers' announcements (see section 4.2.).

Key recommendation

- Increase the global CO_2 target from -45 to -65% for trucks, buses and coaches in 2030

3.3. It leaves 20% of HDV sales unregulated

The current CO_2 standards are only regulating the heavier trucks (above 16 tonnes) which make up about 62% of total HDV sales and 65% of fleet emissions according to T&E analysis (see figure 4). The Commission now proposed to extend the regulation to cover a little over 80% of sales and 88% of emissions. The newly covered categories include the remainder of the heavy trucks (7.4 - 16 tonnes), all medium trucks (5 - 7.4 tonnes) as well as urban buses and coaches.

However, the proposal continues to exempt the small trucks (3.5 - 5 tonnes) as well as the so-called 'vocational' and 'non-certified' vehicles. This means that climate emissions from vehicles that drive in our cities every day, including delivery, garbage and construction trucks, are not regulated at all. Together, these exempted vehicles make up almost 20% of HDV sales and 12% of fleet emissions.[13]

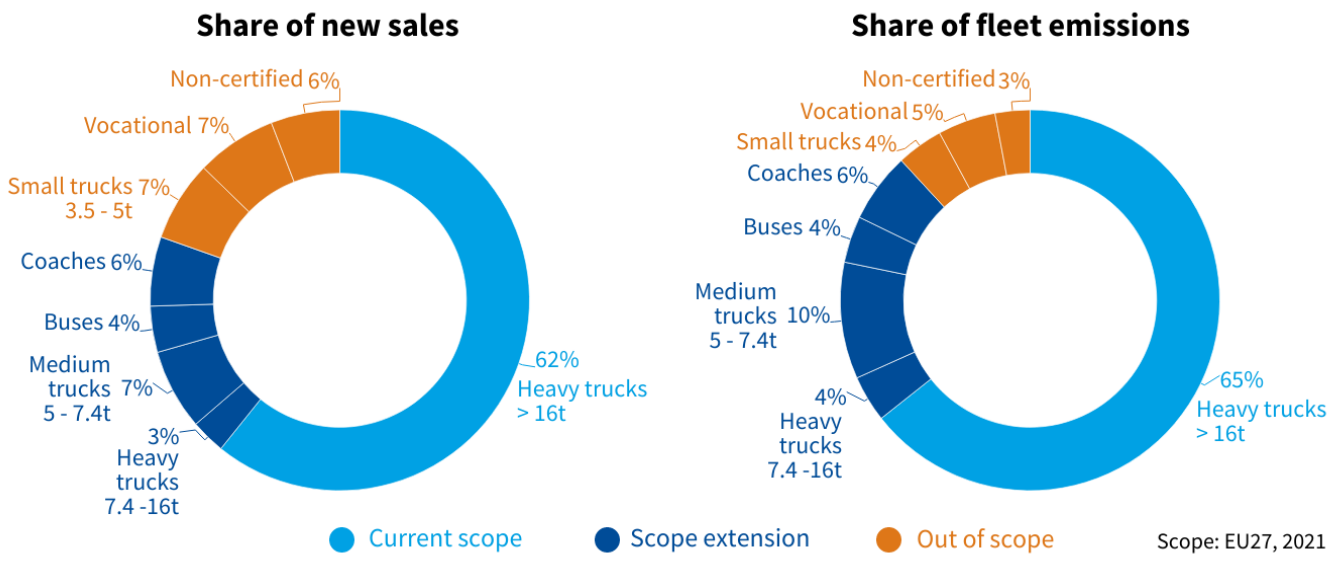


Figure 4. Sales and emissions split of HDVs

[13] T&E analysis is comparable to estimates in the impact assessment which assesses the share of emissions from new sales, but not the share of new sales by itself. The impact assessment estimates that vocational vehicles (including those in vehicle groups 11, 12 and 16) make up 7.4%, while non-certified vehicles account for 1.7% of emissions from new sales. See also European Commission (2023). Impact Assessment accompanying the Proposal for amending Regulation (EU) 2019/1242 as regards strengthening the CO_2 emission performance standards for new heavy-duty vehicles. Link.

The decision to not regulate these vehicles is not acceptable. Small trucks, vocational and non-certified vehicles should also be included in the regulation and contribute their fair share to decarbonising the sector. Vocational vehicles should be regulated by a CO_2 target (see section 4.2.1.). Non-certified vehicles, including small trucks, should be regulated by a ZEV target, which requires manufacturers to sell a certain share of ZEVs from a given year (see section 4.2.2.).

Key recommendation

- Introduce CO_2 targets for vocational trucks: -35% (2030), -85% (2035), and 100% (2040)
- Introduce ZEV targets for non-certified trucks: 30% (2030), 80% (2035), and 100% (2040)

3.4. It defines trucks running partially on diesel as zero-emission

Under the CO_2 standards for cars and vans, only vehicles without an internal combustion engine are defined as zero-emission. This means battery electric (BEVs) and hydrogen fuel cell (FCEVs) vehicles. The CO_2 standards for trucks and buses have always included a broader definition: internal combustion vehicles which emit less than 1 gCO_2/kWh[14] are also counted as a ZEV.

The current definition allows for spark-ignited internal combustion trucks which are exclusively powered by hydrogen to qualify as zero-emission. The reason why these hydrogen combustion trucks still emit small amounts of CO_2 emissions is due to the exhaust aftertreatment system which is needed to reduce their nitrogen oxide (NOx) emissions.[15] In addition, the combustion of lubricants (oils used to lubricate the internal parts of engines) also causes some marginal CO_2. In total, these trace emissions are expected to be below the current regulatory threshold of 1 gCO_2/kWh.

However, the Commission proposal is now opening up this definition to allow for hydrogen dual-fuel engines running partially on diesel to qualify as zero-emission. These trucks require diesel as pilot fuel to ignite the fuel-air mix. The emissions threshold was increased to 5 gCO_2/tkm, which would allow a 40-tonne tractor trailer to consume up to 10% fossil diesel while still being counted as a ZEV under the newly proposed ZEV definition.[16] An earlier draft of the proposal (which was leaked one week before its publication) had first increased it to 1gCO_2/tkm.

While it is reasonable to define internal combustion trucks which are running exclusively on hydrogen as zero-emission, it is not acceptable to give the same label to trucks which still (partly) run on diesel. It is also questionable whether dual-fuel hydrogen-diesel engines would actually need such a high threshold of 5 gCO_2/tkm. Westport Fuel Systems, a leading company commercialising

[14] Or 1 gCO_2/km if type-approved as a light-duty vehicle under WLTP.
[15] The chemical 'hydrolysis' reaction of urea (also known as 'AdBlue') with water emits ammonia and CO_2 as a by-product.
[16] Based on the current specific CO_2 emissions of a vehicle in sub-group 5-LH.

this technology, is claiming that they will be able to comply with the current 1 gCO_2/kWh.[17] The increased threshold could also potentially open the door to even larger shares of diesel fuel being used in the real world, for example through engine modifications on the aftersales market.

Key recommendation

- Change the ZEV definition back to 1 gCO_2/kWh as set in the current regulation

4. Detailed recommendations for the targets

There are two types of CO_2 reduction targets in the Commission proposal. The new Article 3a sets so-called 'global CO_2 targets' for 2030, 2035 and 2040 that apply across all HDV categories which are covered by the new regulation. Annex I of the regulation includes specific targets for each vehicle sub-group that set out how each of them have to contribute to the global target. Together, the sub-group targets for trucks, buses and coaches add up to the global CO_2 targets of -45% in 2030, -65% in 2035, and -90% in 2040. This means that the 100% ZEV target for urban buses from 2030, which is set out in Article 3b, does not come on top but is also aggregated under the global CO_2 targets. The CO_2 targets for trailers are set separately and come on top of the targets for vehicles.

There are two separate compliance pathways: one for all trucks (and trailers) as well as one for urban buses and coaches. Vehicle manufacturers have to achieve compliance for each pathway separately, but within each they are allowed to overperform on one vehicle sub-group and underperform on another one, as long as, on average and across all their new sales, they achieve the global CO_2 targets as set out in article 3a. This approach is reasonable as it provides vehicle manufacturers with the flexibility to comply with the regulation across the widest possible range of vehicle types and segments. To account for the difference in their emissions intensity, new vehicle sales have to contribute to the targets based on a weighting for their respective vehicle type, duty cycle, mileage and payload.

4.1. Increase the global CO_2 targets for trucks, buses and coaches

The existing regulation already includes CO_2 targets for 2025 and 2030, but these only apply to some of the heavier trucks above 16 tonnes. The Commission proposal leaves the 2025 target unchanged, both in terms of emission reduction (-15% CO_2 reduction) and scope (certain heavy trucks above 16 tonnes). The existing 2030 target is increased from -30% to -45% and proposed to also apply to medium trucks and more heavy trucks as well as buses and coaches. New CO_2 targets are introduced in 2035 (-65%) and 2040 (-90%) respectively.

[17] Westport Fuel Systems and AVL (2021). Total Cost of Ownership (TCO) Analysis for Heavy Duty Hydrogen Fueled Powertrains. Link.

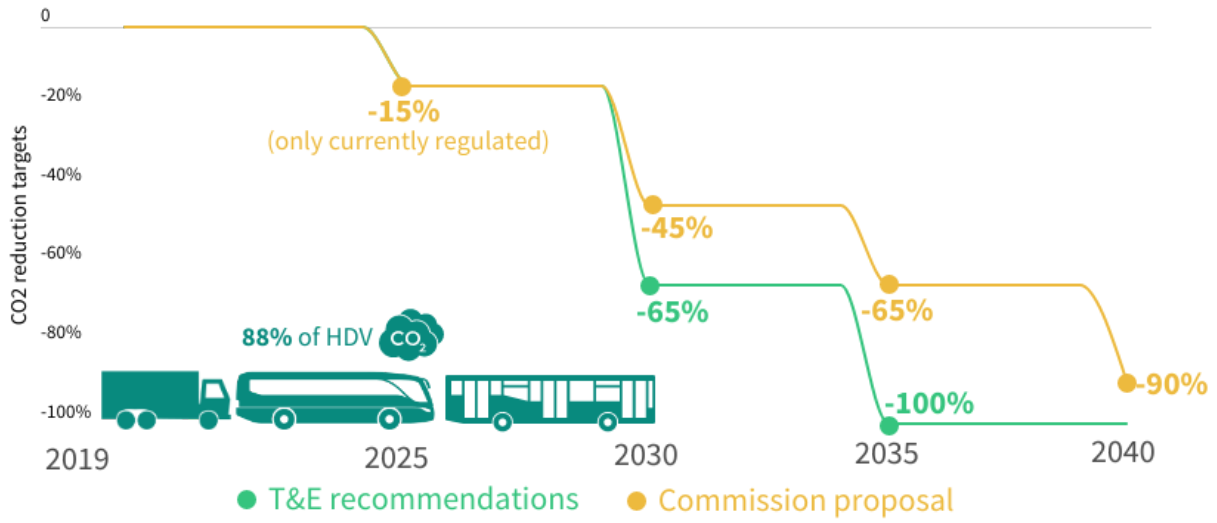


Figure 5. Global CO_2 targets for trucks, buses and coaches

However, these targets are by far not enough to reach Europe's climate targets. T&E analysis shows that they reduce HDV emissions by only 56% until 2050 (see section 3.1.). A range of industry stakeholders[18] as well as environmental organisations[19] have called for significantly higher targets in 2030 and a 100% zero-emission target already in 2035. While the infrastructure will be rolled out from 2025 (see section 7.4.), transport companies who want to go zero emissions today are struggling with a lack of supply of zero-emission vehicles and high costs due to the lack of scale.[20]

The global CO_2 targets for trucks, buses and coaches as set in Article 3a of the regulation should therefore be increased to -65% in 2030 and -100% in 2035. The 100% ZEV target for urban buses as set out in Article 3b should be brought forward to 2027.

4.1.1. Increase the sub-group CO_2 targets for trucks and coaches

The Commission gave medium trucks, heavy trucks and coaches each the same sub-group CO_2 target of -43% in 2030, -64% in 2035 and -90% in 2040. These targets are slightly lower than the global CO_2 targets described above because those also include the emissions reduction impact of the 100% ZEV target for urban buses.

The targets for these sub-groups should be increased from -43% to -64% in 2030 and -100% in 2035 (see table 2.). Aggregating this with the urban buses then results in T&E's proposed global CO_2 target

[18] Climate Group, EV100+ (2022). We're calling for a 2035 deadline for zero emission trucks in the EU. Link.
[19] Transport & Environment (2022). European environmental, health and consumer groups urge Commission to make all new trucks zero emission by 2035. Link.
[20] European Clean Trucking Alliance (2020). Position paper. Make zero-emission trucks an offer you can't refuse. Link.

of -65% in 2030. Coaches can follow a similar trajectory as heavy trucks due to their similarities with the long-haul segment in regard to the operational needs and expected TCO parity.

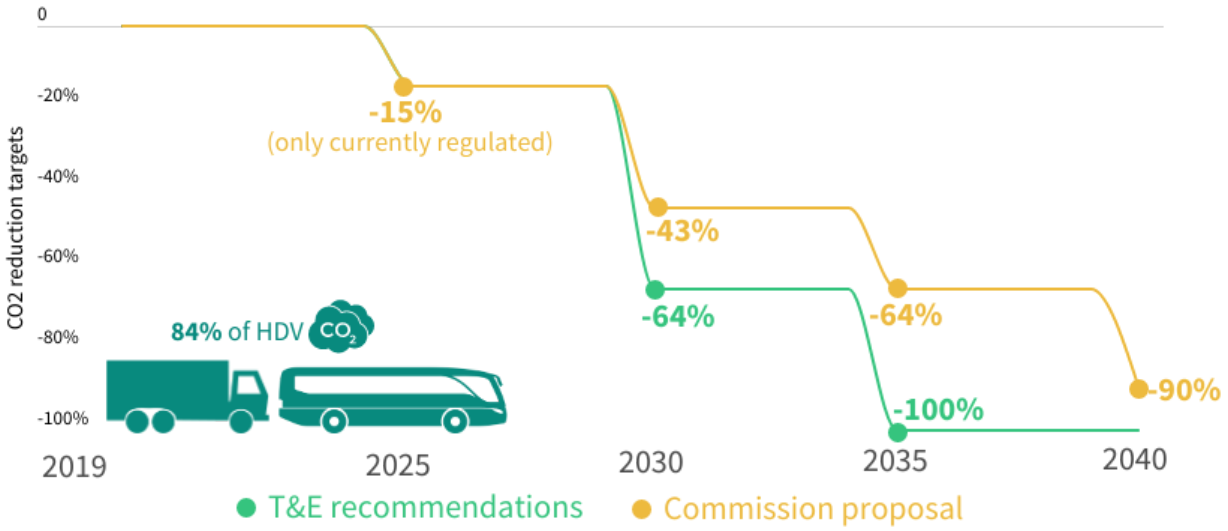


Figure 6. CO_2 targets for trucks and coaches

A CO_2 reduction target leaves flexibility to manufacturers how they want to comply with that target. They can choose their own focus between producing more efficient internal combustion trucks or selling more ZEVs more quickly. Assuming manufacturers focus on ZEVs and moderately increase fuel efficiency of internal combustion trucks by 1.3% per year,[21] a CO_2 target of -65% in 2030 would result in 60% ZEV sales being zero-emission. With Daimler's announcement to sell up to 60% zero-emission trucks and Volvo pledging 70% by 2030, this can be considered feasible from a techno-economic and market perspective.

Recently published sales forecasts based on official talks between German government authorities and European truck manufacturers - the so-called 'cleanroom talks'[22] - confirm such a dynamic market ramp-up. In those talks, truck manufacturers have indicated that 63% of new truck sales in Europe will be zero-emission in 2030, of which 89% would be battery electric and 11% hydrogen fuel cell vehicles.

[21] ICCT (2017). Fuel Efficiency Technology in European Heavy-Duty Vehicles: Baseline and Potential for the 2020–2030 Time Frame. Link.
[22] NOW GmbH (2023). New NOW publication: Market development of climate-friendly technologies in heavy road freight transport. Link.

Table 2. CO_2 targets for trucks and coaches

Vehicle sub-groups (GVW)[23]	VECTO groups	Reporting period of the years			
		2025 - 2029	2030 - 2034	2035 - 2039	From 2040
Medium trucks (5 - 7.4 t)	53, 54	0	64% ~~43%~~	100% ~~64%~~	100% ~~90%~~
Heavy trucks (7.4 - 16 t)	1s, 1, 2, 3	0	64% ~~43%~~	100% ~~64%~~	100% ~~90%~~
Heavy trucks (> 16 t)	4-UD/RD/LH 5-RD/LH) 9-RD/LH 10-RD/LH	15%	64% ~~43%~~	100% ~~64%~~	100% ~~90%~~
Heavy trucks with special axle combinations (all weights)	11, 12, ~~16~~[24]	0	64% ~~43%~~	100% ~~64%~~	100% ~~90%~~
Coaches and primary vehicles of coaches (> 7.5 t)	32-C2/C3/DD 34-C2/C3/DD	0	64% ~~43%~~	100% ~~64%~~	100% ~~90%~~

4.1.2. Bring forward the ZEV targets for urban buses

As proposed by the Commission, urban buses over 7.5 tonnes should be regulated on the basis of a zero-emission vehicle (ZEV) sales target which is aggregated under the global CO_2 target. However, the 100% ZEV target for urban buses should be brought forward to 2027. A number of environmental organisations and cities have called on the EU to set such an earlier target.[25]

[23] Gross vehicle weight.
[24] Vehicle sub-group 16 should be included in the newly proposed separate CO_2 target for vocational vehicles (see section 4.2.1.) as it consists exclusively of vocational vehicles.
[25] Transport & Environment (2022). Without EU action, demand for clean urban buses will not be matched by supply. Link.

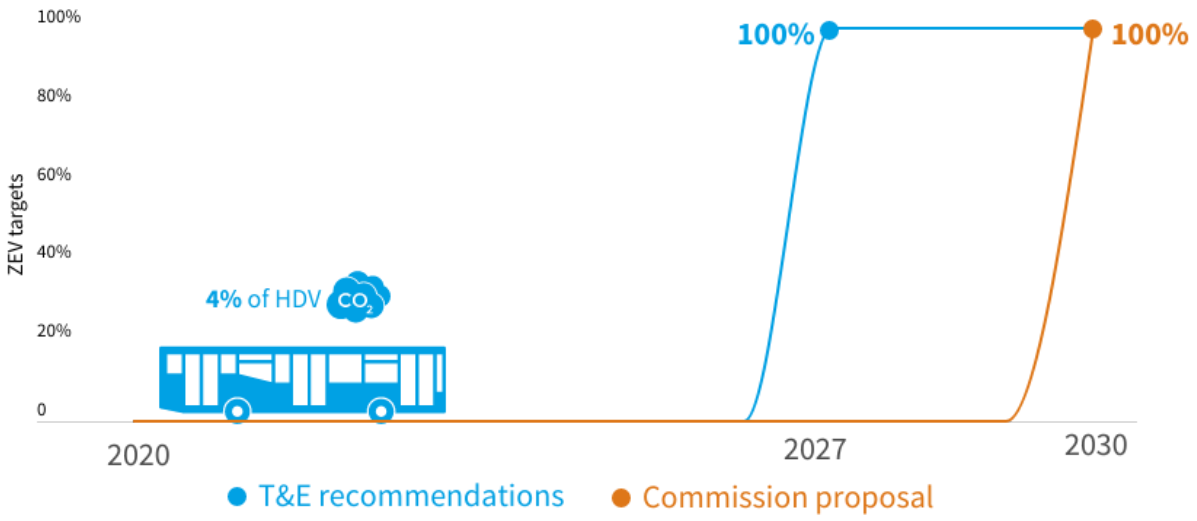


Figure 7. ZEV targets for urban buses

Some bus manufacturers have already decided to go fully electric. Daimler[26] has announced to only offer zero-emission city buses from 2030 and MAN[27,28] is aiming for 90 - 100% city buses to be battery electric by 2030. This is feasible when considering that 23% of all EU sales in 2021 were already zero-emission, with both Western and Eastern European member states leading the way (Netherlands already at 100% and Bulgaria at 73%).[29] It is also necessary given that the EU's Clean Vehicles Directive (CVD),[30] which sets targets for the procurement of 'clean buses', would only deliver around 31% zero-emission bus sales in the years 2026 – 2030.

Table 3. ZEV targets for urban buses

Vehicle sub-groups (GVW)	VECTO groups	Reporting period of the years			
		2027 - 2029	2030 - 2034	2035 - 2039	From 2040
Urban buses (> 7.5 t)	31-LF/L1/L2/DD 33-LF/L1/L2/DD 35-FE 39-FE	100% ~~0%~~	100%	100%	100%

[26] Daimler (2022). Daimler Buses to offer CO2-neutral vehicles in every segment by 2030 – dual-track strategy based on batteries and hydrogen. Link.
[27] European Commission (2023). Impact Assessment accompanying the Proposal for amending Regulation (EU) 2019/1242 as regards strengthening the CO_2 emission performance standards for new heavy-duty vehicles. Link.
[28] MAN (2022). Presentation by Alexander Vlaskamp CEO of MAN Truck & Bus SE at the International Press Workshop of the IAA Transportation. Link.
[29] Transport & Environment (2022). Cities are buying more electric buses, but an EU deadline is needed. Link.
[30] European Union (2019). Directive (EU) 2019/1161 on the promotion of clean and energy-efficient road transport vehicles. Link.

4.2. Introduce targets for those 20% of HDV sales which are unregulated

Trucks which are used for the delivery of goods in the urban-, regional-delivery and long-haul segments are referred to as 'freight trucks' in this paper. They are certified under the Vehicle Energy Consumption Calculation Tool (VECTO) and the certification regulation[31] and are included under the Commission proposal's global CO_2 targets, together with buses and coaches.

So-called 'vocational' and 'non-certified' vehicles (such as garbage, construction and special purpose trucks) and those with special axle combinations remain unregulated. Small trucks between 3.5 and 5 tonnes, which are technically also freight trucks, but are not certified under VECTO either, are also not covered by the regulation.

The Commission proposal excludes these trucks from the scope of the regulation despite them accounting for almost 20% of HDV sales and 12% of fleet emissions. This means that climate emissions from vehicles that drive in European cities every day, including delivery, garbage and construction trucks, are not regulated at all. The decision to not regulate these vehicles is not acceptable. Small trucks, vocational and non-certified vehicles should also be included in the regulation and contribute their fair share to decarbonising the sector.

4.2.1. Introduce separate CO_2 targets for vocational vehicles

So-called 'vocational vehicles' such as garbage, construction and special purpose trucks, and those with special axle combinations are exempt from the targets under the Commission proposal. However, their CO_2 emissions are certified under VECTO and monitored and reported by vehicle manufacturers and EU member states.[32] Vocational vehicles were initially included in an earlier draft of the proposal (which was leaked one week before its publication), but then removed from the final proposal at the last minute.

They should therefore be regulated through a CO_2 target which can be introduced separately from the global CO_2 targets described above. 2040 is an appropriate year to set a 100% zero-emission target for this category of vehicles. To ramp-up sales in the intermediate term, a CO_2 target of -35% should be set in 2030, followed by -85% in 2035.

Vocational trucks may need slightly more time to electrify or have more challenging operational requirements in terms of onboard energy storage, running time or infrastructure. Since they typically run lower mileage, they may also take longer to achieve TCO parity as opposed to freight trucks. Despite this, they offer a significant electrification potential and should contribute to the emissions

[31] European Union (2017). Regulation (EU) 2017/2400 as regards the determination of the CO2 emissions and fuel consumption of heavy-duty vehicles. Link.
[32] European Union (2018). Regulation (EU) 2018/956 on the monitoring and reporting of CO2 emissions from and fuel consumption of new heavy-duty vehicles. Link.

reductions of the sector. The TNO report[33] also examined the time when zero-emission trucks reach TCO and operational parity in the construction segment which is projected to reach 100% by the mid 2030s.

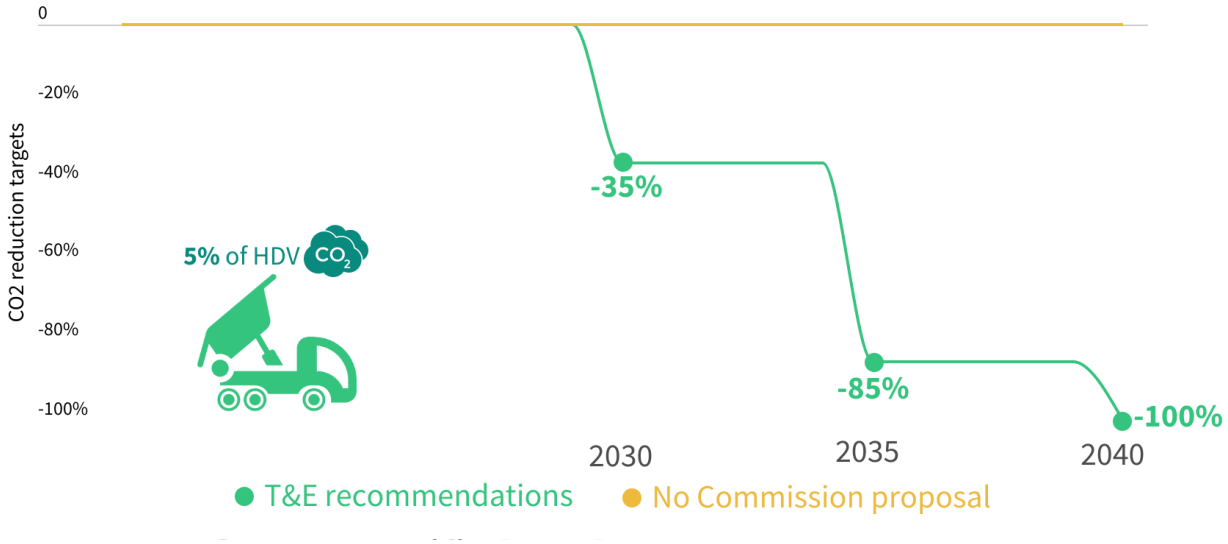


Figure 8. CO_2 targets for vocational vehicles

New vehicle registrations in the exempted sub-groups 4v, 5v, 9v and 10v, should be included here. In addition, many registrations in the vehicle sub-groups 11 and 12, and all vehicles in sub-group 16, which are covered under the global CO_2 targets in the Commission proposal, will in practice be declared as vocational. They will therefore be exempt from the regulation and should instead be covered here. The Commission proposal already includes dedicated mission profile shares, mileage and payload weighting factors for all of these vocational vehicles, so the contribution to emission reductions can be weighted in a similar way as it is done for the global CO_2 targets.

Table 4. CO_2 targets for vocational vehicles

Vehicle sub-groups (GVW)	VECTO groups	Reporting period of the years			
		2025 - 2029	2030 - 2034	2035 - 2039	From 2040
Vocational vehicles (all weights)	4v, 5v, 9v, 10v 11v, 12v, 16	0	35%	85%	100%

[33] TNO (2022). Techno-economic uptake potential of zero-emission trucks in Europe. Link.

4.2.2. Introduce separate ZEV targets for non-certified vehicles

A third category of trucks are 'non-certified vehicles' which are also mostly vocational-like trucks with special axle combinations, but which also include small trucks of 3.5 - 5 tonnes. Many urban delivery trucks supplying stores like supermarkets in urban areas fall under this category. Despite them driving in European cities, they are also exempt under the Commission proposal. Since their CO_2 emissions are not certified under VECTO, a ZEV target which requires manufacturers to sell a certain share of ZEVs from a given year is a feasible way to regulate their emissions.

Transitioning all small trucks sales to zero-emission is feasible from a techno-economic perspective. In line with the TNO report mentioned above, another study has examined the TCO for this vehicle segment and concluded that TCO parity can be reached in all of the six examined European cities without purchase subsidies by 2030.[34]

Typically, these small trucks are type-approved as HDVs. Vehicles type-approved as light-duty vehicles (LDVs) but not regulated under the CO_2 standards for cars and vans should be included here as well to avoid creating a loophole between the two regulations.[35]

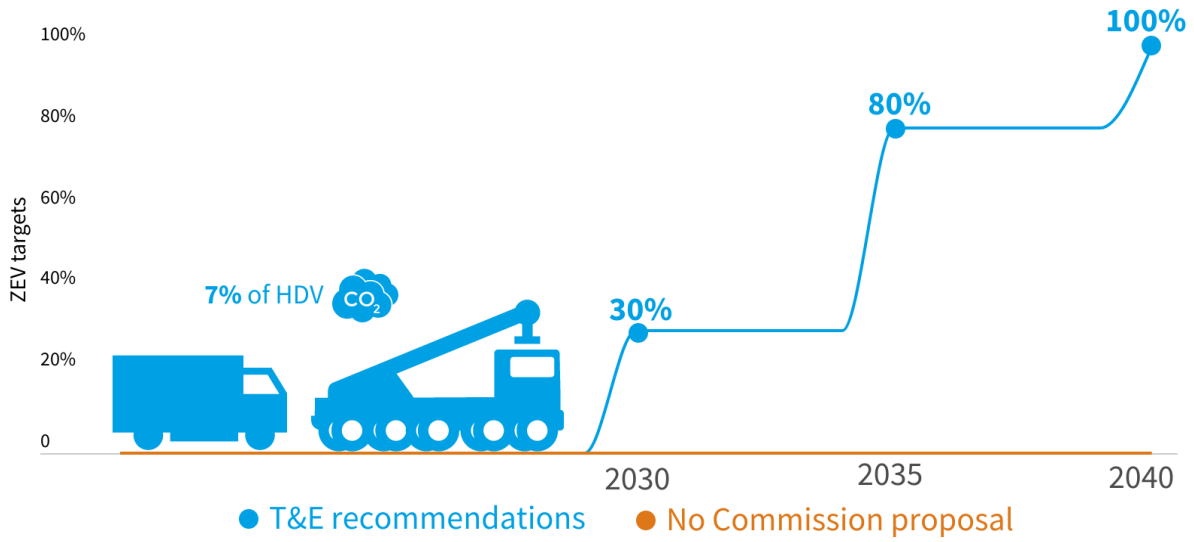


Figure 9. ZEV targets for non-certified vehicles

[34] ICCT and RAP (2022). Electrifying last-mile delivery: a total cost of ownership comparison of battery-electric and diesel trucks in Europe. Link.

[35] Heavy-duty engine type-approval under EU Regulation 595/2009 applies to all vehicles exceeding a reference mass of 2,610 kg. At the request of the manufacturer, vehicle variants with a reference mass up to 2,840 kg can be type-approved under the light-duty chassis dynamometer test as per EU Regulation 715/200. Those vehicles do not fall under the CO_2 standards for cars and vans and must therefore be included under the HDV CO_2 standards.

Heavier non-certified vehicles with special axle combinations may face similar challenges as vocational trucks in terms of their electrification uptake, operational requirements and TCO parity. Therefore, the 100% zero-emission target should also be set in 2040 rather than 2035. To ramp-up sales in the intermediate term, a ZEV target of 30% should be set in 2030, followed by 80% in 2035.

Table 5. ZEV targets for non-certified vehicles

Vehicle sub-groups (GVW)	**VECTO groups**	**Reporting period of the years**			
		2025 - 2029	2030 - 2034	2035 - 2039	From 2040
Non-certified vehicles (all weights)	51, 52, 55, 56 6, 7, 8 13, 14, 15 17, 18, 19	0	30%	80%	100%

While non-certified vehicles do not fall under the monitoring and reporting obligations of vehicle manufacturers, their new registrations are reported by EU member states. This can serve as the basis to verify compliance for this newly created ZEV target. In order to properly account for differences in the emissions impact of smaller and bigger trucks included under this new ZEV target, it should be weighted according to a vehicle's mileage and payload. This can be done based on the mission profile shares as well as mileage and payload weighting factors which belong to the most similar vehicle type included in the regulation. In practical terms, this means that the properties of the next adjacent certified vehicle group can be used for the purpose of weighting non-certified vehicle sales under the new ZEV target (see table 6.).

Table 6. Attribution of non-certified vehicles

Non-certified sub-group Under the new ZEV target	**Attributed to certified sub-group** For the purpose of mission profile shares, mileage and payload weighting factors
51, 52, 55, 56	53
6	1
7	11
8	12
13, 14, 15, 17, 18, 19	16

4.3. Maintain the CO_2 targets for trailers

The Commission proposal introduces CO_2 targets for trailers which will help scale up cost-effective efficiency technologies and enable zero-emission long-haul trucking. Trailers can be made more

energy efficient by reducing their aerodynamic drag, rolling resistance and curb (i.e. empty vehicle) weight. Box-type trailers - which include rectangular-shaped curtainsiders, dry and refrigerated configurations - offer the highest efficiency improvement potential.

Setting targets for box-type trailers is possible with their recent coverage by the VECTO certification regulation.[36] They represent 69% of total semi-trailer sales (a trailer without a front axle which is towed by a tractor unit) and roughly 30% of drawbar-trailer sales (a trailer which is hooked onto the rear of the truck).[37] The Commission proposes CO_2 targets for box-type drawbar-trailers and semi-trailers from 2030 which are not included in the global CO_2 targets for vehicles but instead come on top of those.

Table 7. CO_2 targets for trailers

Vehicle sub-groups	Reporting period of the years			
	2025 - 2029	2030 - 2034	2035 - 2039	From 2040
Trailers	0	7.5%	7.5%	7.5%
Semi-trailers	0	15%	15%	15%

5. Why the Commission is right not to include fuels

A crediting system or carbon correction factor for so-called 'renewable and low-carbon' fuels, including advanced biofuels and e-fuels, should not be included in the HDV CO_2 standards as these fuels will remain scarce and expensive, will not help reduce emissions due to sustainability issues and would risk creating regulatory loopholes.

E-fuels will remain expensive

Using e-fuels in the road freight sector is inefficient and unnecessary as cheaper zero-emission alternatives exist. E-fuels would be the most costly compliance option for vehicle makers, transport operators and society as a whole. Trucks are heavily used capital goods that run for more than one million kilometres over their lifetime. This means that energy and fuel costs dominate the TCO, rendering internal combustion trucks running on e-diesel uncompetitive. T&E analysis[38] shows that the TCO of diesel trucks running on e-fuels would be around 50% higher than the TCO of battery electric trucks, even when assuming that those e-fuels would be produced more cheaply in North Africa or other favourable regions and imported to Europe.

[36] European Union (2022). Regulation (EU) 2022/1362 as regards the performance of heavy-duty trailers with regard to their influence on the CO2 emissions, fuel consumption, energy consumption and zero emission driving range of motor vehicles. Link.
[37] ICCT (2018). Market analysis of heavy-duty commercial trailers in Europe. Link.
[38] Transport & Environment (2022). E-fuels in trucks: expensive, scarce, and less green than batteries. Link.

Fuels will remain scarce

While advanced biofuels can technically be produced sustainably, advanced biomass feedstocks are limited in supply. This would also be an issue for e-fuels in the short- and mid-term. Directly electrifying trucks requires half as much green electricity as renewable hydrogen used in fuel cell vehicles and less than a third than running diesel trucks on e-fuels.[39] Scaling up additional renewables, electrolysers, direct air capture (DAC) and e-fuel production facilities would take time and larger e-fuel quantities would likely not be available before 2040.[40]

The limited quantities which will be available by 2030 need to be prioritised to decarbonise hard-to-abate sectors where electrification is not an option including aviation, maritime shipping and the chemicals industry.[41] These sectors will also have a higher willingness to pay for these fuels due to their lack of decarbonisation alternatives. This will make it even more difficult to provide substantial volumes at competitive costs to the road transport sector. A recent analysis shows that, even under optimistic growth assumptions based on which e-fuel production capacities would scale at the same speed as solar PV in the past, the resulting 'global' e-fuel volume could only displace 10% of the 'national' demand from aviation, shipping and chemicals in Germany.[42]

Fuels would not help reduce emissions

Fuels could also not help reduce emissions from HDVs due to sustainability and scalability issues. Food- and crop-based biofuels are associated with significant indirect climate emissions, often causing higher GHGs than their fossil counterpart.[43] Synthetically produced fuels, such as e-fuels, would not be able to reduce air pollutant emissions in any meaningful way.[44]

Including fuels would create regulatory loopholes

A fuel crediting system or carbon correction factor would risk creating regulatory loopholes. Fuel credits would mix well-to-tank (fuels and electricity) and tank-to-wheel (vehicle tailpipe emissions) regulations which could lead to incoherent and, in the worst case, unenforceable legislation. It would blur the roles and responsibilities of different market participants for a regulation that only applies to vehicle manufacturers.

Vehicle manufacturers cannot control what fuel will effectively be used in their trucks over their lifetime, so should not benefit from fuel credits when complying with the CO_2 standards. This would increase the risk of double-counting and cause additional administrative burden for EU and national authorities that would need to track fuel credit trading, sustainability criteria and overall compliance.

[39] Transport & Environment (2020). Electrofuels? Yes, we can … if we're efficient. Link.
[40] Odenweller et al. (2022). Probabilistic feasibility space of scaling up green hydrogen supply. Link.
[41] Transport & Environment (2020). E-fuel would be wasted on cars while it's badly needed to decarbonise planes and ships. Link.
[42] PIK (2023). E-fuels likely to remain scarce for a long time: PIK analysis paper. Link.
[43] ICCT (2017). Potential greenhouse gas savings from a 2030 greenhouse gas reduction target with indirect emissions accounting for the European Union. Link.
[44] Transport & Environment (2021). Magic green fuels: Why synthetic fuels in cars will not solve Europe's pollution problems. Link.

Decarbonising fuels is important to help reduce emissions from the legacy fleet. But instead of doing this by introducing a crediting system or carbon correction factor into the regulation which governs new vehicle sales, fuels should continue to be governed by separate legislation including the Renewable Energy Directive (RED) and the Fuel Quality Directive (FQD).

Recommendation

- Do not introduce a fuel crediting system or carbon correction factor into the regulation

6. Other regulatory elements

6.1. Improve the emission credit and debt system

The Commission proposal extends the emission credit and debt system (also called 'banking and borrowing') from the current expiration date in 2030 to 2040. The system allows manufacturers to earn credits by reducing their fleet emissions below the emissions trajectory line (i.e. a straight line drawn between two 5-year targets). Accumulated credits can then be used to offset any debts vehicle manufacturers may face if their emissions are above the target applicable for a given period (e.g. -15% from 2025 - 2029).

The system provides flexibility to vehicle manufacturers in meeting their 5-year targets in regard to their development cycles and should in principle be maintained. However, the proposal makes an important change to the current regulation: While credits earned until 2024 can only be used to offset any debts earned in 2025, credits earned from 2025 onwards do not expire anymore after 5 years. Instead they can be used to offset debts for 15 years until 2040.

This is contradictory to the initial objective of providing flexibility to account for multi-year development cycles. A vehicle maker should not have the option to bank credits for more than five years given that this is not more than what it typically takes to develop a new vehicle. In the worst case, this may lead to a situation where manufacturers rack up credits in the late 2020s and subsequently delay further emission reductions far into the 2030s.

Instead, the lifetime of credits should be continuously limited to 5-year intervals as it is already the case until 2025 (and until 2030 for the current regulation). This would require vehicle manufacturers to clear any credits they may have accumulated in 2030, 2035 and 2040 respectively just as they have to do so for any emission debts.

Recommendation

- Limit credits under the emission credit and debt system to 5-year periods up until 2040

6.2. Maintain the integrity of the ZLEV factor

The regulation includes a mechanism to incentivise the sales of zero- and low-emission vehicles (ZLEVs), also called the ZLEV factor, by rewarding manufacturers with additional on-paper CO_2 emission reductions. This applies in the form of a super-credits scheme until 2025, which counts new ZLEVs with a multiplier of up to two against the targets.

From mid-decade, a bonus-only sales benchmark applies. It incentivises manufacturers who reach at least 2% ZLEV sales by reducing their CO_2 reduction target. For each percentage point above the 2%, the target will be reduced accordingly. The benchmark is capped at 5%, which means that a manufacturer's target can be reduced by up to 3 percentage points.

An incentive mechanism can have merit to act as a temporary stimulus to kick-start the zero-emission truck market. But it should be ended when it is expected that ZLEVs will account for a significant share of sales. In this respect, the Commission's proposal to end the ZLEV factor in 2030 is reasonable and should be maintained. Continuing the ZLEV factor beyond the end of this decade means the targets are diluted by 3 percentage points as all vehicle manufacturers will reach the maximum bonus. Increasing the benchmark beyond those 3 percentage points would dilute the targets even further without incentivising any additional uptake of ZLEVs.

Recommendation

- End the ZLEV factor in 2030 and maintain the current benchmark cap at 5%.

6.3. Do not lower penalties for non-compliance

The regulation foresees penalties if vehicle manufacturers fail to comply with the targets. Under the previous regulation, these so-called 'excess emission premiums' were set at 4,250 EUR/gCO_2/tkm from 2025 - 2029, and 6,800 EUR/gCO_2/tkm from 2030 onwards. However, the new proposal reduces the higher penalty from 2030 also to 4,250 EUR.

This is effectively nullifying the initial regulatory reasoning back in 2018. In its 2018 proposal, the Commission had initially proposed 6,800 EUR for all years from 2025. The Commission had explained

in its impact assessment[45] that 'in order to be effective, financial penalties should be set at a level significantly exceeding the average marginal cost of the technologies needed to meet the targets.'

Based on this reasoning, they had derived the 6,800 EUR from the penalties as previously calculated for the CO_2 standards for cars and vans by adjusting them to the higher mileage of HDVs and their payload. This penalty was subsequently lowered to 4,000 EUR/gCO_2/tkm for the earlier years in the General Approach of the Council.[46] In inter-institutional negotiations with the European Parliament, the penalty was slightly increased again to 4,250 EUR for 2025 and kept at 6,800 EUR from 2030.

The lowering of the penalty from 2030 should be reversed by co-legislators and the penalty of 6,800 EUR reinstated. This would ensure that the system remains effective in ensuring the environmental integrity of the regulation.

Recommendation

- Reinstate the current excess CO_2 emissions premium of 6,800 EUR/gCO_2/tkm from 2030.

7. Industry headed for zero emissions, but certainty needed

The HDV CO_2 standards are the key supply-side policy to mandate Europe's truck makers to invest, manufacture and sell clean trucks. If co-legislators in the European Parliament and Council do not agree on more ambitious CO_2 standards, they would fail to send the necessary signal and create investment certainty for Europe's industry.

Changing technology requires significant transformation of and investment in manufacturing, the workforce and new value chains. Without a strong regulatory driver to invest, scale up and sell those trucks, voluntary commitments will not materialise on their own. Given the increasing demand for batteries and critical raw materials, electric trucks will also compete with electric cars and vans. This requires a strong signal to ramp up the battery value chain also for the upcoming demand from the heavy-duty sector.[47] Likewise, the roll-out of truck charging and refuelling infrastructure relies on sufficient planning certainty for operators who must know how many clean trucks to expect on the road.

Today, Europe's truck manufacturers are world leaders in developing commercial vehicle technology. They have established a growing presence in global and emerging markets, including the

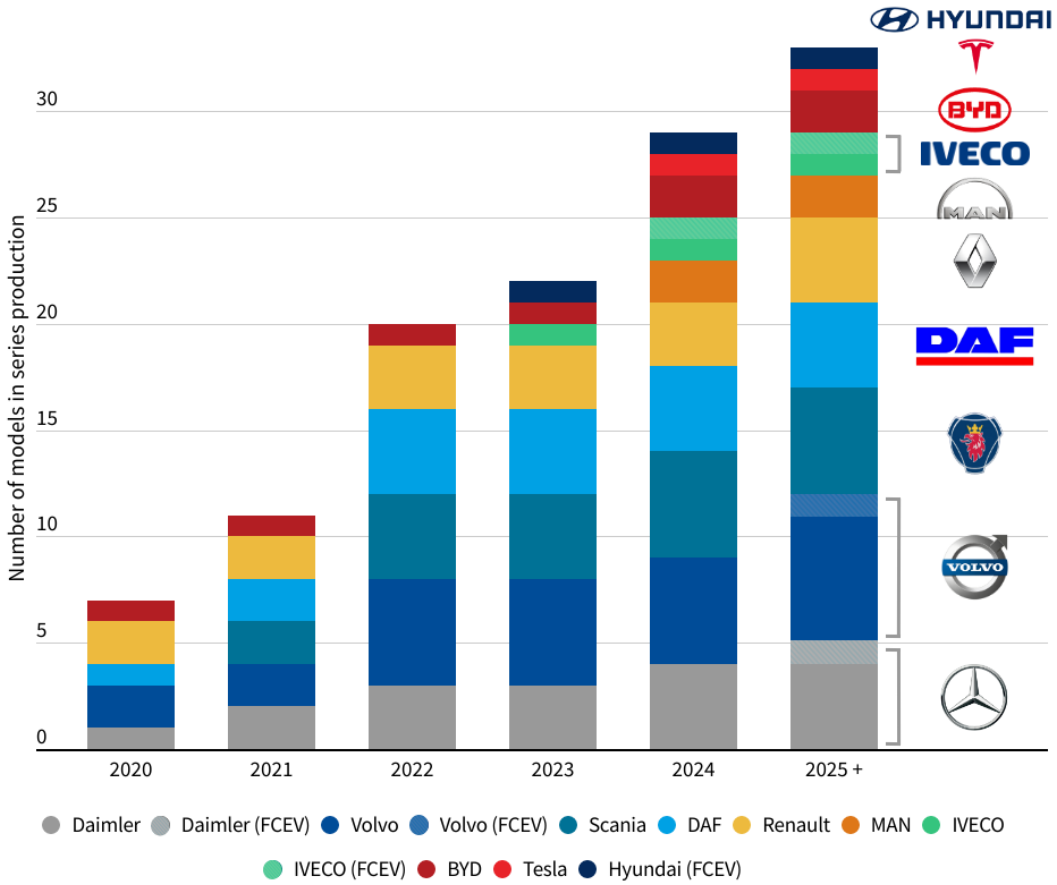
[45] European Commission (2018). Impact Assessment accompanying the Proposal setting CO2 emission performance standards for new heavy duty vehicles. Link.
[46] Council of the European Union (2018). Proposal for a Regulation of the European Parliament and of the Council setting CO2 emission performance standards for new heavy-duty vehicles - General approach. Link.
[47] Transport & Environment (2023). How not to lose it all. Two-thirds of Europe's planned battery production is at risk without further action, a new T&E analysis finds. Link.

U.S.[48], China[49] and India[50]. Failing to set a target to reduce CO_2 emissions from new trucks and buses by 100% would put Europe's technological edge in the heavy-duty segment at risk just when the U.S. is joining China in the race for industrial leadership following the *Inflation Reduction Act*. In the worst case, it could lead to Europe's domestic automotive and supplier industry falling behind and losing its global leadership to the growing competition from overseas.

7.1. Electric (long-haul) trucks are coming in 2024

European truck manufacturers, including Daimler, MAN, Scania and Volvo are now focussing on bringing electric trucks to the mass market for all vehicle segments, and including for long-haul starting from 2024. Around 30 zero-emission truck models have already been announced to go into mass production for the European market by 2025 (see figure 10).

[48] ICCT (2020). Race to zero. How manufacturers are positioned for zero emission commercial trucks and buses in North America. Link.
[49] ICCT (2021). The evolution of commercial vehicles in China: a retrospective evaluation of fuel consumption standards and recommendations for the future. Link.
[50] ICCT (2021). Market analysis of heavy-duty vehicles in India for fiscal years 2019–20 and 2020–21. Link.



Notes: Refers to announced year of large-scale series production of battery electric and hydrogen fuel cell trucks for the European market. Daimler plans FCEV series production for 2027; Volvo by the second half of the 2020s.

Sources: OEM announcements.

Figure 10. Series production of zero-emission trucks in Europe

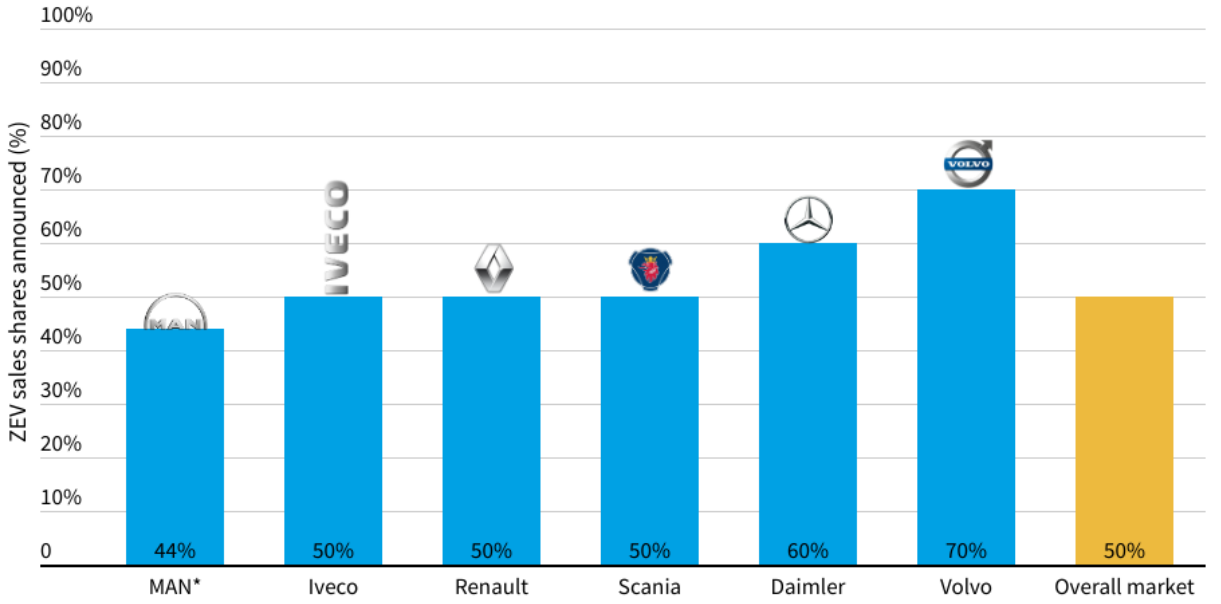
Daimler is readying its 500 km range *eActros LongHaul* truck for series production in 2024.[51] MAN will also begin series production of its *eTruck* with a range of 450 km by 2024.[52] By the same year, Scania will offer battery-powered 40-tonne trucks capable of running four and a half hours between breaks for 560 km.[53] And by 2025, the company also intends to offer electric vocational vehicles such as construction, mining and timber trucks.[54] Volvo has already started the series production of its Volvo FH Electric last year which offers 500 km with a short stop for charging.[55] DAF will begin the series production of its *XD Electric* and *XF Electric* with a 500 km range from 2023.[56] IVECO intends to begin

[51] Daimler (2022). Charged for tomorrow: Mercedes-Benz Trucks presents the eActros LongHaul for long-distance transport for the first time at the IAA Transportation 2022 in Hanover. Link.
[52] MAN (2022). MAN and ABB E-mobility rev up for the next phase of electromobility in long-haul trucking. Link.
[53] Scania (2023). Annual and Sustainability Report 2022. Link.
[54] Scania (2021). Scania's commitment to electrification – our initiatives so far. Link.
[55] Volvo (2022). Volvo's heavy-duty electric truck is put to the test: excels in both range and energy efficiency. Link.
[56] DAF (2022). DAF Trucks demonstrates industry leadership at IAA 2022. Link.

series production of the Nikola Tre BEV with a 500 km range in 2023.[57] In addition, the series production of FCEVs is planned for the end of the decade by several manufacturers in Europe including Daimler, Volvo and IVECO.

7.2. Truck makers aim for over 50% zero-emission truck sales in 2030

European truck manufacturers have announced that they intend to ramp up ZEV sales rapidly over the coming years. An estimated 7% of total truck sales will be zero-emission by 2025, rising to 50% by 2030 on average and up to 70% for individual manufacturers (see figure 11).[58] Recently published data based on official talks between German government authorities and European truck manufacturers - the so-called 'cleanroom talks' - show an even more dynamic market ramp-up, with 63% of new truck sales in Europe to be zero-emission in 2030.[59] However, these are only voluntary announcements. Stringent CO_2 standards are needed in order to ensure these announcements materialise.



Notes: The overall market averages have been estimated based on the 2019 sales share of each OEM in Europe. OEMs which have not made public announcements are assumed to only deliver enough ZEVs to comply with the current HDV CO_2 standards.

*Based on MAN's announcement of 60% ZEV sales shares in the urban and regional delivery and 40% in the long-haul segment and a 20%/80% split based on the manufacturer's vehicle registrations during the reference period 2019/2020.

Source: T&E analysis, data from public OEM announcements and ACEA sales shares (2019).

Figure 11. Zero-emission sales announced by truck manufacturers for Europe

[57] IVECO (2022). Iveco Group displays its product milestones towards net zero carbon mobility at IAA Transportation 2022. Link.
[58] Transport & Environment. (2021). EU truck targets too weak to incentivise transition to zero-emission vehicles. Link.
[59] NOW GmbH (2023). New NOW publication: Market development of climate-friendly technologies in heavy road freight transport. Link.

7.3. Feasibility of reaching 100% zero-emission truck sales by 2035

There is increasing consensus among vehicle manufacturers that BEVs will play a dominant role in decarbonising the heavy-duty sector. Studies by environmental organisations,[60] research groups[61] and truck manufacturers[62] expect TCO parity of long-haul BEVs in Europe before or by the mid 2020s depending on the jurisdiction and available national policy incentives. Two of Europe's largest truck makers are already moving into this direction: Daimler has announced to only sell zero-emission trucks from 2039 in Europe.[63] Scania is aiming to go fully electric by 2040[64] and has pledged to fully transition to zero-emission truck and bus sales by that date under the Global Memorandum of Understanding.[65]

Zero-emission trucks are already significantly cleaner than their diesel counterparts and this will further improve over time. The life cycle GHG emissions of electric trucks running on the EU electricity grid are already more than 50% lower than diesel.[66,67] Today, Europe's electricity grid is already 39% renewable.[68] Based on the current plans by the EU member states, it is projected that 63% of the EU's electricity generation will be renewable by 2030, 82% by 2040 and 89% by 2050.[69] More ambitious policies are expected to further accelerate the greening of the grid over that timeframe.

However, some observers still question whether it is feasible from a cost and operational perspective to transition all trucks in Europe to 100% zero-emission sales in the timeframe which is needed to achieve Europe's climate targets. Others raise questions with regards to potential operational limitations of battery electric and hydrogen fuel cell trucks such as insufficient vehicle range, additional downtime due to longer charging and refuelling times, or potential payload[70] losses.

T&E, in collaboration with *Agora Verkehrswende*, commissioned the independent research organisation *Netherlands Organisation for Applied Scientific Research* (TNO) to provide answers to these questions. The report by TNO[71] assesses the techno-economic feasibility of reaching 100% zero-emission vehicle sales for urban and regional delivery, long-haul as well as construction trucks in all EU countries and the UK. It compares the TCO - the most important purchase factor for European fleets[72] - of diesel, battery-powered and fuel cell trucks and assesses when zero-emission alternatives fulfil all operational requirements such as sufficient driving range, no additional time losses due to recharging or refuelling, and similar payload capabilities.

[60] Transport & Environment (2021). How to decarbonise long-haul trucking in Germany. Link.
[61] ICCT (2021). Total cost of ownership for tractor-trailers in Europe: Battery-electric versus diesel. Link.
[62] TRATON (2021). Deep dive e-mobility - the TRATON perspective. Link.
[63] Daimler (2019). Daimler Trucks & Buses targets completely CO2-neutral fleet of new vehicles by 2039 in key regions. Link.
[64] Eurotransport (2022). Scania ab 2040 nur noch elektrisch. Link.
[65] Calstart (2023). Global MoU Subnational Government & Private Sector Endorsers. Link.
[66] Scania (2021). Scania publishes life cycle assessment of battery electric vehicles. Link.
[67] ICCT (2023). A comparison of the life-cycle greenhouse gas emissions of European heavy-duty vehicles and fuels. Link.
[68] European Union (2022). EU energy in figures. Statistical pocketbook 2022. Link.
[69] Ember (2022). European Clean Power Pathways Explorer. Stated Policy scenario. Link.
[70] 'Payload' refers to the weight of cargo a truck is capable and permitted to carry in addition to the vehicle's empty weight.
[71] TNO (2022). Techno-economic uptake potential of zero-emission trucks in Europe. Link.
[72] Bain & Company (2022). European Truck Market Outlook 2022. Link.

It shows that all new urban, regional and long-haul trucks can be zero-emission by 2035 across all European markets, with some national markets such as in Northern Europe expected to go even faster (see figure 12). All new sales in those freight segments will have a lower TCO compared to diesel while delivering the same capabilities in terms of range, payload and driving times.

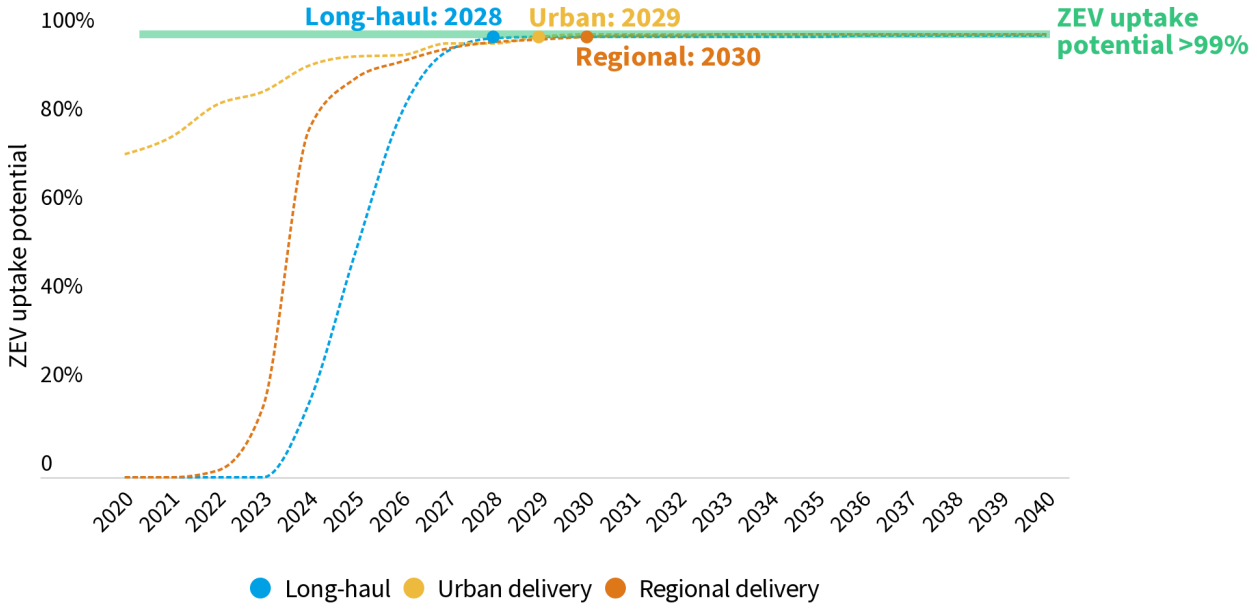


Figure 12. ZEV uptake potential for freight trucks in Europe based on TNO

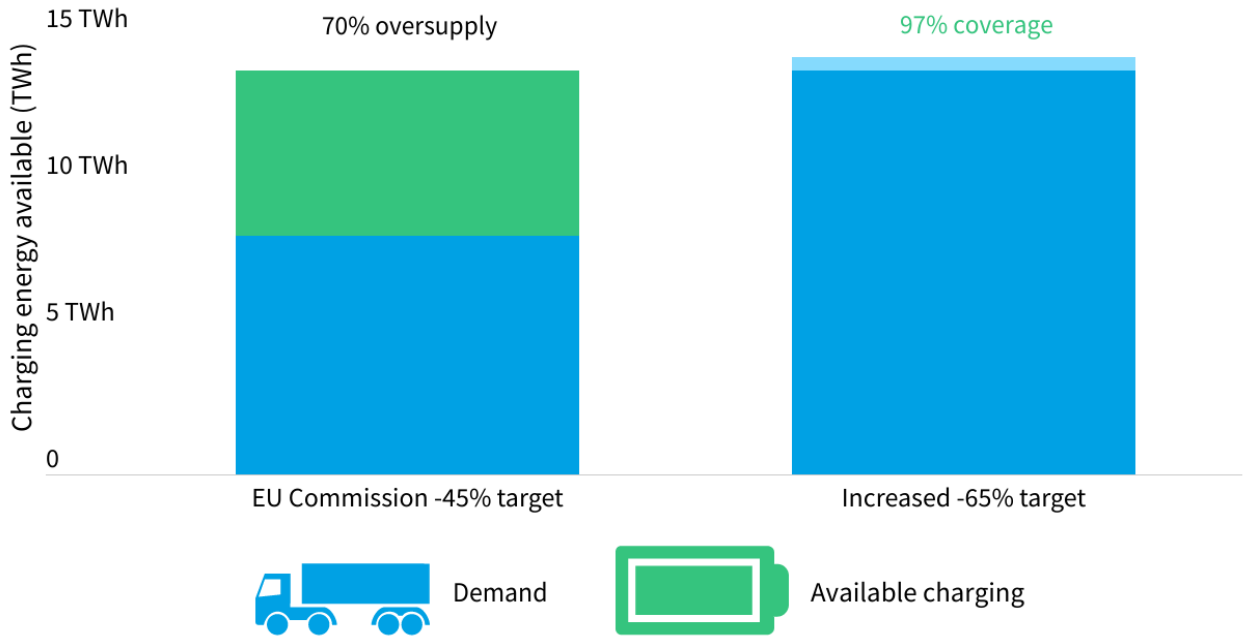
However, the techno-economic feasibility which TNO assessed is by itself not enough to enable the market ramp-up of clean trucks. Without strong supply-side policy in the form of ambitious CO_2 standards, the ZEV uptake potential identified by TNO would be merely hypothetical and fail to materialise in reality. One of the reasons for this is that truck makers are not yet producing ZEVs at scale. This only underscores the need for strong supply-side policy to shift production and develop value chains for zero-emission trucks fast enough.

7.4. AFIR is setting binding infrastructure targets from 2025

The recently agreed Alternative Fuels Infrastructure Regulation (AFIR)[73] sets mandatory targets for high-power truck charging infrastructure across the European road network from 2025 onwards. EU member states have to ensure full coverage charging infrastructure along the Trans-European Transport Network (TEN-T), in major cities and in transport hubs by 2030, as well as rolling out hydrogen refuelling stations along the TEN-T core network and in urban nodes. This will provide Europe with a fully fledged public infrastructure network dedicated to HDVs.

[73] Council of the EU (2023). Alternative fuel infrastructure: Provisional agreement for more recharging and refuelling stations across Europe. Link.

According to T&E analysis[74], the agreed targets under AFIR and additional deployment plans in Germany will provide sufficient public charging infrastructure across the EU for a CO_2 target of -65% under the HDV CO_2 standards, and will provide significantly more than what would be needed for a -45% CO_2 target as proposed by the Commission (see figure 13). EU member states now have an interest in increasing the supply of ZEVs to ensure a sufficient utilisation of the new infrastructure.



Notes: Projected gross energy demand from HDVs in EU-27 (TTW) in 2030 that needs to be provided by public charging and available charging energy.

Sources: T&E calculations based on T&E (2022), EU (2023).

Figure 13. Projected public charging demand and supply in 2030

Progress on the ground is not waiting. Besides Germany, other EU member states such as the Netherlands[75] and Austria[76] are also already working on national deployment plans that go beyond AFIR with more member states expected to follow suit in the coming years. Private actors are also making roll-out plans: The joint venture *Milence* owned by the five major truck brands Daimler, MAN, Scania, Volvo and Renault Trucks plans to install 1,700 public truck charging points across Europe by the second half of the 2020s.[77] CharIN, the industry's standardisation initiative, has launched the

[74] Transport & Environment (2023). Fully charged for 2030. Link
[75] LOLA (2023). Boosting a nationwide publicly accessible fast charging network for freight transport. Link.
[76] BMK (2023). Masterplan Güterverkehr. Link.
[77] TRATON (2021). The TRATON GROUP, Daimler Truck, and Volvo Group sign joint venture agreement for European high-performance charging network. Link.

Megawatt Charging System (MCS),[78] complementing the Combined Charging System (CCS) standard to quickly charge HDVs with high daily driving ranges. The technology will be commercially available in 2024. Research has shown that high-power truck charging is not only technically and economically feasible but would also not pose fundamental challenges with respect to the grid connection and integration.[79,80]

Further information

Fedor Unterlohner
Freight Manager
Transport & Environment
fedor.unterlohner@transportenvironment.org
Mobile: +32 (0)485 639492

Square de Meeûs, 18, 2nd floor | B-1050 | Brussels | Belgium
www.transportenvironment.org | @transenv | fb: Transport & Environment

[78] CharIN (2022). CharIN e. V. officially launches the Megawatt Charging System (MCS) at EVS35 in Oslo, Norway. Link.
[79] Transport & Environment (2022). Flicking the switch on truck charging. Link.
[80] NOW GmbH (2022). Easy charging at service areas – new study published on setting up network connections for e-truck charging hubs. Link.