POSITION BRIEF

JANUARY 2023

HOW TO MAKE EURO 7 MORE EFFECTIVE: AN ANALYSIS OF THE EUROPEAN COMMISSION'S PROPOSAL FOR LIGHT- AND HEAVY-DUTY VEHICLES

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Ambient air quality remains a substantial health risk in the EU, with almost the entire urban population being exposed to pollutant concentrations above the limits defined in the 2021 United Nations World Health Organization guidelines.[1] With the expressed goal to mitigate this situation by making combustion engine vehicles as clean as possible, the European Commission has developed the new Euro 7 emissions standards to adequately limit the pollutant emissions of both light- and heavy-duty road vehicles. Once adopted, it will replace the currently separate emissions standards of Euro 6 for passenger cars and vans and Euro VI for trucks and buses.[2] The draft regulation,[3] together with its annexes[4] and impact assessment,[5] was published on November 10, 2022. This paper analyses the regulatory changes included in the Euro 7 proposal, discusses the proposal's shortcomings, and recommends improvements to the regulation.

1 European Environment Agency, "Europe's Air Quality Status 2022," Briefing, September 19, 2022, https://www.eea.europa.eu/publications/status-of-air-quality-in-Europe-2022.

2 European Union, "Regulation (EC) No 715/2007 of the European Parliament and of the Council of 20 June 2007 on type approval of motor vehicles with respect to emissions from light passenger and commercial vehicles (Euro 5 and Euro 6) and on access to vehicle repair and maintenance information (Text with EEA relevance)," Pub. L. No. 32007R0715, 171 OJ L (2007), http://data.europa.eu/eli/reg/2007/715/2020-09-01; European Union, "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)," Pub. L. No. OJ L 188, 1 (2009), http://data.europa.eu/eli/reg/2009/595/oj.

3 European Commission, "Proposal for a Regulation of the European Parliament and of the Council on Type-Approval of Motor Vehicles and Engines and of Systems, Components and Separate Technical Units Intended for Such Vehicles, with Respect to Their Emissions and Battery Durability (Euro 7) and Repealing Regulations (EC) No 715/2007 and (EC) No 595/2009," COM(2022) 586 final § (2022), https://ec.europa.eu/transparency/documents-register/api/files/COM(2022)586_0/090166e5f39c64d8?rendition=false.

4 European Commission, "Annexes to the Proposal for a Regulation of the European Parliament and the Council on Type-Approval of Motor Vehicles and Engines and of Systems, Components and Separate Technical Units Intended for Such Vehicles, with Respect to Their Emissions and Battery Durability (Euro 7) and Repealing Regulations (EC) No 715/2007 and (EC) No 595/2009," COM(2022) 586 final § (2022), https://ec.europa.eu/transparency/documents-register/api/files/COM(2022)586_1/090166e5f39c64bb?rendition=false.

5 European Commission, "Commission Staff Working Document Impact Assessment Report Accompanying the Document Proposal for a Regulation of the European Parliament and of the Council on Type-Approval of Motor Vehicles and of Engines and of Systems, Components and Separate Technical Units Intended for Such Vehicles, with Respect to Their Emissions and Battery Durability (Euro 7) and Repealing Regulations (EC) No 715/2007 and (EC) No 595/2009," Impact Assessment, November 10, 2022, https://ec.europa.eu/transparency/documents-register/detail?ref=SWD(2022)359&lang=en.

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HOW THE EURO 7 PROPOSAL DISREGARDS THE IMPACT ASSESSMENT

As part of the development of the Euro 7 regulation, the European Commission prepared an impact assessment (IA) to analyze the costs and benefits of four policy options, separately for light- and heavy-duty vehicles, as shown in Figure 1.

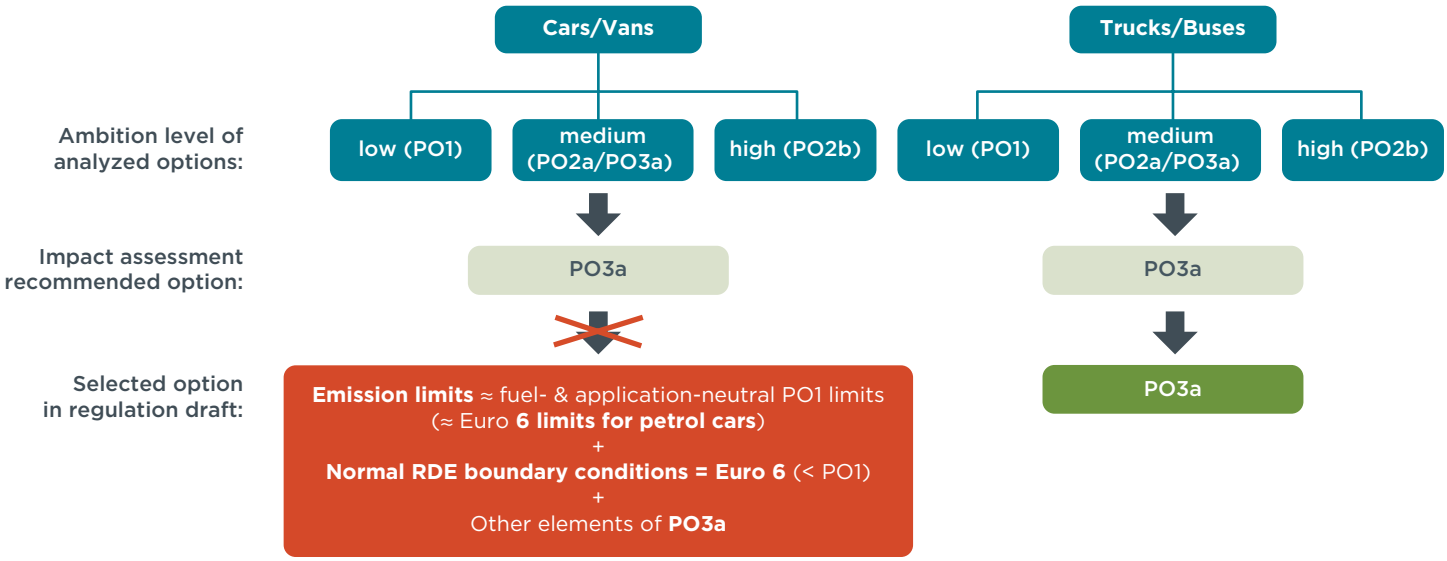

Figure 1. Analyzed and recommended policy options in the Euro 7 impact assessment and the option selected for the draft regulation.

The policy options differ in level of ambition in terms of stringency of emission limits, number of regulated pollutant species, boundaries for real-driving emission (RDE) testing, and durability requirements compared to Euro 6/VI. Of these policy options, PO1 has the lowest ambition level, PO2a and PO3a have a medium ambition level, and PO2b has the highest ambition level. PO3a entails the same requirements as PO2a but combines it with continuous emissions monitoring through the use of on-board sensors. The emission limits of the different policy options in comparison with the current Euro 6/VI values and the limits proposed for Euro 7 are discussed in a separate section below and shown in Table 2 and Table 3.

The IA Identifies policy option PO3a as the preferred option for cars and vans, as well as for trucks and buses, even when taking into account the recently agreed upon 100% CO_2 reduction target for cars and vans in 2035.[6] PO3a achieves the European Commissions' Euro 7 objectives of reducing the complexity of the emission standards, defining up-to-date pollutant emission limits considering today's technology, and ensuring effective emissions control during real-world driving, while being the most coherent with other policies. According to the IA, PO3a would result in the highest health-benefit-to-cost ratio, at low absolute cost. The IA estimates that the Euro 7 compliance cost for option PO3a would result in a consumer vehicle price increase of less than €200, or 1 %, for small to medium size petrol cars. To put these numbers into perspective, the sales price of the VW Golf, EU's most sold vehicle model, increased

6 General Secretariat of the Council, "Proposal for a Regulation of the European Parliament and of the Council Amending Regulation (EU) 2019/631 as Regards Strengthening the CO2 Emission Performance Standards for New Passenger Cars and New Light Commercial Vehicles in Line with the Union's Increased Climate Ambition - Letter to the Chair of the European Parliament Committee of the Environment, Public Health and Food Safety (ENVI)," COREPER decision, November 16, 2022, https://data.consilium.europa.eu/doc/document/ST-14869-2022-INIT/en/pdf.

for a version with petrol engine by more than €2,500, equivalent to 10.5%, over just three years while the total inflation was only 5% across the same period.[7]

However, in case of light-duty vehicles, the European Commission decided to disregard the outcome of the IA, presumably at the last minute. Instead of selecting the IA's recommended option PO3a, the European Commission decided to propose a regulation that falls even below the least ambitious and ineffective option, PO1, for which the IA concludes, "…the low intensity and ambition level of PO1 are not found to match the identified problems and objectives for cars/vans…" and "…PO1 is considered a rather disproportionate policy option."

The European Commission's proposal for cars and vans keeps the Euro 6 emission limits and only makes them fuel and application neutral. In addition, contrary to the information in the Explanatory Note to the draft regulation, the normal ambient condition range for RDE testing is not extended but kept the same as in Euro 6. Details about the proposed emission limits and RDE boundary conditions are discussed in separate sections below.

Even though the proposed rules for cars and vans fall below the least demanding option PO1 analyzed in the IA, the European Commission does not provide an analysis of how effective the proposed rules are for meeting the Euro 7 objectives, how they affect air quality and compliance cost, and if they are coherent with other regulations, such as the proposed Ambient Air Quality Directive revision.[8]

SCOPE, APPROACH, AND TIMELINE OF EURO 7

Currently, two separate emission standards regulate the pollutant emissions of light-duty and heavy-duty vehicles, referred to as Euro 6 and Euro VI, respectively. With Euro 7, one regulation will apply to both vehicle categories, although with different requirements. For the first time in the EU, the emission limits will be technology and fuel-type neutral, with the same pollutant limits and other type-approval requirements applying to all. Also, no differentiation in emission limits is made between passenger vehicles and light-commercial vehicles, and only underpowered light-commercial vehicles are entitled to less stringent emission limits.

Besides these changes in the general approach, Euro 7 revises and introduces the elements listed in Table 1, which are discussed in more detail in subsequent sections.

Table 1. Elements of the draft Euro 7 regulation

Revised elements of Euro 6/VI regulation	New elements in Euro 7
• Extension of scope of regulated tailpipe emission species and revision of limits • Revision of expected useful vehicle life • Real driving emissions test conditions • Extension of low temperature test scope • Extension of on-board fuel and energy consumption monitoring (OBFCM) scope	• Battery durability requirements • Brake particle emission limits • Evaporative and refueling emissions • On-board emission monitoring requirements • Anti-tampering and cybersecurity requirements • Environmental vehicle passport (EVP)

7 Price development prior to Covid-19 pandemic between January 2017 and February 2020. Data is taken from price lists for the German market of VW Golf Comfortline edition with 110 kW petrol engine and 6 gear manual transmission. Inflation rate was obtained from Inflation.eu, "Historic Harmonised Inflation Germany – HICP Inflation.," 2017, http://www.inflation.eu/inflation-rates/germany/historic-inflation/hicp-inflation-germany.aspx.

8 European Commission, "Revision EU Ambient Air Quality Legislation," October 26, 2022, https://environment.ec.europa.eu/publications/revision-eu-ambient-air-quality-legislation_en.

Euro 7 will become mandatory for all new cars and vans from July 2025 onwards and is introduced two years later for heavy-duty vehicles. Voluntary Euro 7 type-approval of vehicles becomes possible as soon as the Euro 7 regulation enters into force.

EMISSION LIMITS

While the impact assessment recommends applying the emission limits analyzed in policy option PO3a, the European Commission proposes emission limits for light-duty vehicles that are the same as for cars analyzed in the low ambition scenario PO1, as shown in Table 2. A comparison with the Euro 6 limit reveals that the only increase in the stringency of Euro 7 regarding emission limits is owed to making the limits technology, fuel-type, and application neutral. Furthermore, enabled by progress in measurement technology, the particle number limit for Euro 7 takes into account particles as small as 10 nm, while in Euro 6 only particles of 23 nm or larger were counted. Nitrogen oxides (NO_x) emission limits proposed for Euro 7 are two times weaker and particle number limits are 6 times weaker than the limits in the recommended PO3a scenario.

The proposed Euro 7 emission limits lag behind the potential of today's technology to address air quality problems in the EU. **We therefore recommend that the European Commission follows the recommendation of its own impact assessment and introduces the PO3a emission limits shown in Table 2 for light-duty vehicles.**

Furthermore, the Euro 7 proposal adds only ammonia (NH_3) as a newly limited pollutant for cars and vans, while the impact assessment policy option PO3a recommends additional limits for the emissions of cancer-causing formaldehyde (HCHO) and the powerful greenhouse gas nitrous oxide (N_2O). For trucks and buses, emissions of these harmful substances will be limited with Euro 7, and **we suggest introducing limits for N_2O and HCHO emissions for cars and vans as well, following the impact assessment recommendation**.

Table 2. Passenger cars and vans – Comparison of emission limits of the current Euro 6 regulation, proposed Euro 7 regulation, and the four impact assessment policy options. PO3a was recommended by the impact assessment.

Emission species and limits in mg/km	Euro 6[b]	Euro 7 proposal	Impact assessment policy options		
			PO1[d]	PO2a/PO3a	PO2b
Nitrogen oxides (NO_x)	60–125	**60**	60–82	**30**	20
Particulate matter (PM)	4.5	**4.5**	4.5	**2**	2
Particle number (PN_{10})[a]	6.0e11	**6.0e11**	6.0e11	**1.0e11**	1.0e11
Carbon monoxide (CO)	500–2,270	**500**	500–740	**400**	400
Total hydrocarbons (THC)	90[c]–160	**100**	100–160	N/A	N/A
Non-methane hydrocarbons (NMHC)	68–108	**68**	68–108	**45[e]**	25[e]
Ammonia (NH_3)	N/A	**20**	20	**10**	10
Methane (CH_4) + Nitrous oxides (N_2O)	N/A	N/A	N/A	**45**	20
Formaldehyde (HCHO)	N/A	N/A	N/A	**5**	5

[a] Unit of PN limit is #/km; [b] Ranges indicate different limits for different engine technologies, fuel types and applications (cars, small and large vans); [c] Under Euro 6, a combined limit for THC+NO_x is applied for compression ignition vehicles. For maximum NO_x emissions, the resulting THC limit is 90 mg/km; [d] Ranges indicate different limits for different applications (cars, small and large vans); [e] Non-methane organic gases (NMOG)

For trucks and buses, the Euro 7 regulation proposal mostly follows the recommendation of the impact assessment to implement the PO3a emission limits, with following exceptions, as shown in Table 3. The proposed Euro 7 CH_4 + N_2O limit for hot start tests is about 10% higher than recommended in the impact assessment and the particle number limit for these tests is double the recommended value.

Overall, Euro 7 for heavy-duty vehicles provides a significant increase in stringency, especially for hot engine operation emissions.

Table 3. Trucks and buses – Comparison of emission limits of current Euro VI regulation, proposed Euro 7 regulation and the four impact assessment policy options. PO3a was recommended by the impact assessment.

Emission species and limits in mg/kWh	Euro VI[c]	Euro 7 proposal		Impact assessment policy options				
					PO2a/PO3a		PO2b	
		Cold	Hot	PO1a	Cold	Hot	Cold	Hot
Nitrogen oxides (NOx)	460	**350**	**90**	460	**350**	**90**	175	90
Particulate matter (PM)	10	**12**	**8**	10	**12**	**8**	12	8
Particle number (PN_{10})[a]	6e11	**5e11**	**2e11**	6e11	**5e11**	**1e11**	5e11	1e11
Carbon monoxide (CO)	4,000	**3,500**	**200**	4,000	**3,500**	**200**	1,500	200
Total hydrocarbons (THC)	N/A	N/A	N/A	660	N/A	N/A	N/A	N/A
Non-methane organic gases (NMOG)	160[d]	**200**	**50**	160[d]	**200**	**50**	150	50
Ammonia (NH_3)[b]	10 ppm	**65**	**65**	10 ppm	**65**	**65**	65	65
Methane (CH_4) + Nitrous oxides (N_2O)	500[e]	**660**[f]	**450**[f]	N/A	**660**	**410**	660	410
Formaldehyde (HCHO)	N/A	**30**	**30**	N/A	**30**	**30**	30	30

[a] Unit of PN limit is #/kWh; [b] Euro VI and PO1a contain a limit for the maximum NH_3 concentration; [c] Only diesel vehicle transient test cycle limits shown for simplicity; [d] Non-methane hydrocarbons (NMHC); [e] CH_4 limit, only for gas powered engines; [f] Separate limits for CH_4 and N_2O proposed for Euro 7

As part of the Euro 7 regulation, manufacturers can voluntarily type-approve vehicles for more stringent emission limits, labeled as Euro 7+. Neither the impact assessment nor the explanatory memorandum explain the rationale for introducing the Euro 7+ rating. However, it could be used for deciding if vehicles are authorized to drive in low emission zones or for vehicle taxation purposes.

In this light, it is concerning that the Euro 7+ stage will require only 20% lower emissions than the proposed Euro 7 limits, even though test data for cars shows that many Euro 6 vehicles already have much lower emissions than required by Euro 6 and, therefore Euro 7.[9] This would create the danger of manufacturers labeling current Euro 6 technology vehicles as Euro 7+, despite not being cleaner and without driving any technology progress. **We support the principle of Euro 7+, however, only if these vehicles are significantly cleaner than Euro 7 vehicles. Considering the NO_x limit of 20 mg/km proposed for cars and vans in the most ambitious policy option PO2b, which is one third less than the PO3a limit, we recommend Euro 7+ limits to be at least 33 % lower than the PO3a limits.**

VEHICLE USEFUL LIFE / DURABILITY

In its impact assessment, the European Commission acknowledges that the useful life of EU vehicles significantly exceeds the lifetime considered in the Euro 6/VI regulations. The proposed Euro 7 regulation addresses this deficiency by raising the regulatory lifetime limits for both light- and heavy-duty vehicles. However, the proposed adjustments do not sufficiently cover the average useful life of EU vehicles.

9 International Council on Clean Transportation, "Comments to the European Commission on the Development of Euro 7/VII Pollutant Emission Standards for Cars, Trucks, and Buses," May 10, 2021, https://theicct.org/comments-to-the-european-commission-on-the-development-of-euro-7-vii-pollutant-emission-standards-for-cars-trucks-and-buses/; M Clairotte et al., "Joint Research Centre 2019 Light-Duty Vehicles Emissions Testing: Contribution to the EU Market Surveillance : Testing Protocols and Vehicle Emissions Performance." (Joint Research Centre of the European Commission, 2020), https://op.europa.eu/publication/manifestation_identifier/PUB_KJNA30482ENN.

As shown in Figure 2, the proposal increases the calendar lifetime for light-duty vehicles from 5 years as defined in Euro 6 to 8 years, while the mileage limit of 160,000 km remains unchanged. The discrepancy in the Euro 6 regulation between the durability requirement of 160,000 km and the distance threshold of 100,000 km, above which no in-service conformity testing is allowed, is resolved by Euro 7. As a new element, the European Commission introduces an "additional lifetime," where 20% less stringent emission limits apply,[10] and which comprises cars and vans with a maximum mileage of 200,000 km or up to the age of 10 years.

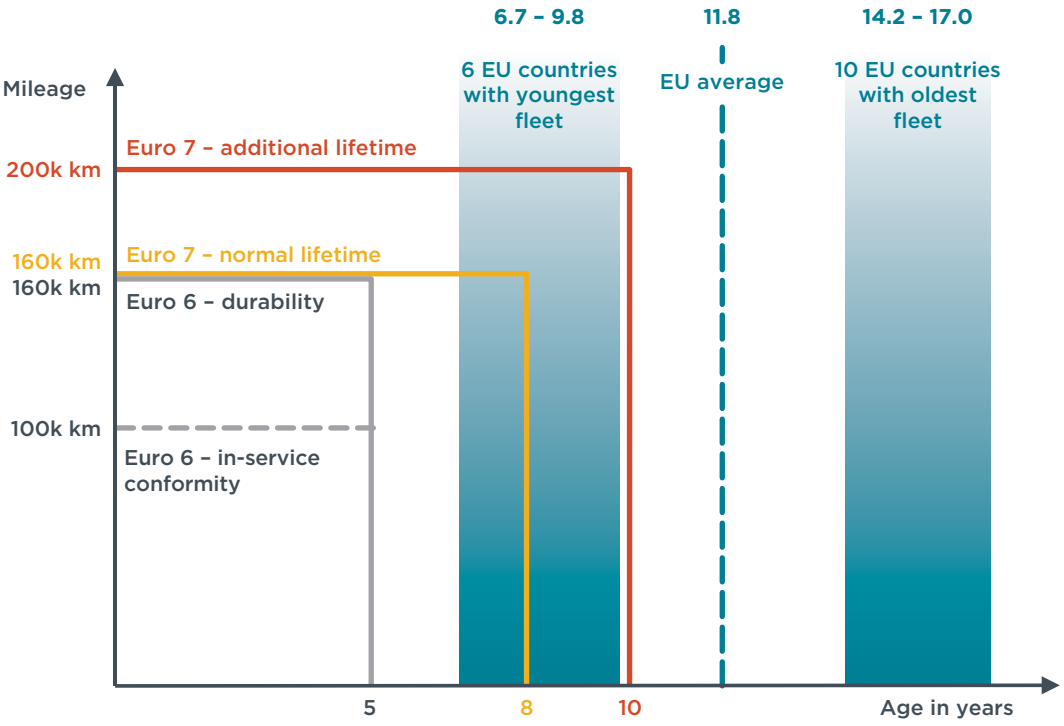

Figure 2. Euro 6 and Euro 7 durability requirements for light-duty vehicles compared to the average age of EU passenger car fleet. *Source*: EU passenger car fleet average age information in years in 2020 from ACEA, "Vehicles in Use, Europe 2022," January 2022, https://www.acea.auto/publication/report-vehiclesin-use-europe-2022/.

However, even with the proposed changes, a large share of the EU's light vehicles fleet remains uncovered by the durability requirements, considering that the average age of passenger cars reached 11.8 years in 2020, with 10 EU countries having fleets older than 14 years on average.[11] Measurements performed by the ICCT in Warsaw, Poland, showed that around 70% of vehicles are older than 8 years or have a mileage over 160,000 km, and almost 60% are older than 10 years or have a mileage over 200,000 km.[12] Furthermore, old vehicles still travel high annual mileages and, therefore, contribute substantially to the total fleet emissions. In Germany for example, a country with a comparably young fleet of 9.5 years on average in 2019, over 50% of the cars were older than 8 years and these vehicles drove over 40% of the total fleet mileage.[13]

The proposed values do not reflect the useful life of light-duty vehicles in the EU, and **we recommend increasing the normal vehicle lifetime covered by the regulation**

10 Gaseous pollutants emissions may be 20% higher than the applicable limits during the additional lifetime.

11 ACEA, "Vehicles in Use, Europe 2022."

12 Kaylin Lee et al., "Evaluation of Real-World Vehicle Emissions in Warsaw" (Washington DC: TRUE Initiative, 2022), https://theicct.org/publication/true-warsaw-emissions-apr22/.

13 Kraftfahrt-Bundesamt, "Statistik - Verkehr in Kilometern - Inländerfahrleistung - Jahr 2014 - 2021 (VK)," May 31, 2022, https://www.kba.de/DE/Statistik/Nachrichten/2022/Statistik/vk_2014_2021.html.

to at least 200,000 km and 10 years. For the extended lifetime, Europe should align with international best practices. In the United States, the federal durability requirements are 240,000 km or 15 years.[14]

The age of the European Union's heavy-duty vehicles fleet is even older than that of light-duty vehicles. As shown in Figure 3, the average age of the medium and heavy truck fleet reached almost 14 years in 2020, with Greece having the oldest fleet of over 21 years on average.[15] For buses, the average age is 12.8 years for the same year, again with Greece having the oldest fleet of over 19 years. Furthermore, the European Commission reported in 2018 that the average lifetime mileage of heavy-duty vehicles in the EU is about 1.2 million km.[16]

For Euro 7, the European Commission proposes an increase of the calendar age lifetime for heavy trucks and buses from 7 years to 15 years but keeps the maximum distance of 700,000 km as defined in Euro VI unchanged. As for light-duty vehicle, an extended lifetime is introduced for trucks and buses vehicles of up to a mileage of 875,000 km with no calendar age limit. For medium trucks and buses, the maximum calendar age is slightly increased to 8 years while the Euro VI mileage limit of 300,000 km is kept. The extended lifetime for medium-duty vehicles is set to 375,000 km.

To cover the average mileage lifetime of heavy-duty vehicles in the EU and to globally harmonize regulatory requirements, we recommend aligning the Euro 7 lifetime with the **California Air Resources Board (CARB) durability periods that gradually increase to about 1.3 million km in 2031 for heavy trucks and buses and to about 560,000 km for medium-duty vehicles**.[17]

14 John German, "Tier 3 Motor Vehicle Emission and Fuel Standards (Final Rule)," Policy update (Washington DC: ICCT, 2014), https://www.theicct.org/publications/us-tier-3-vehicle-emissions-and-fuel-quality-standards-final-rule.

15 ACEA, "Vehicles in Use, Europe 2022."

16 European Commission, "Commission Staff Working Document Impact Assessment - Accompanying the Document - Proposal for a Regulation of the European Parliament and of the Council Setting CO2 Emission Performance Standards for New Heavy Duty Vehicles - Part 1/2," Pub. L. No. SWD(2018) 185 final (2018), https://doi.org/10.5040/9781782258674.

17 California Air Resources Board, "Final Regulation Order - Amendments to Title 13, California Code of Regulations" (2020), https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2020/hdomnibuslownox/froa-1.pdf.

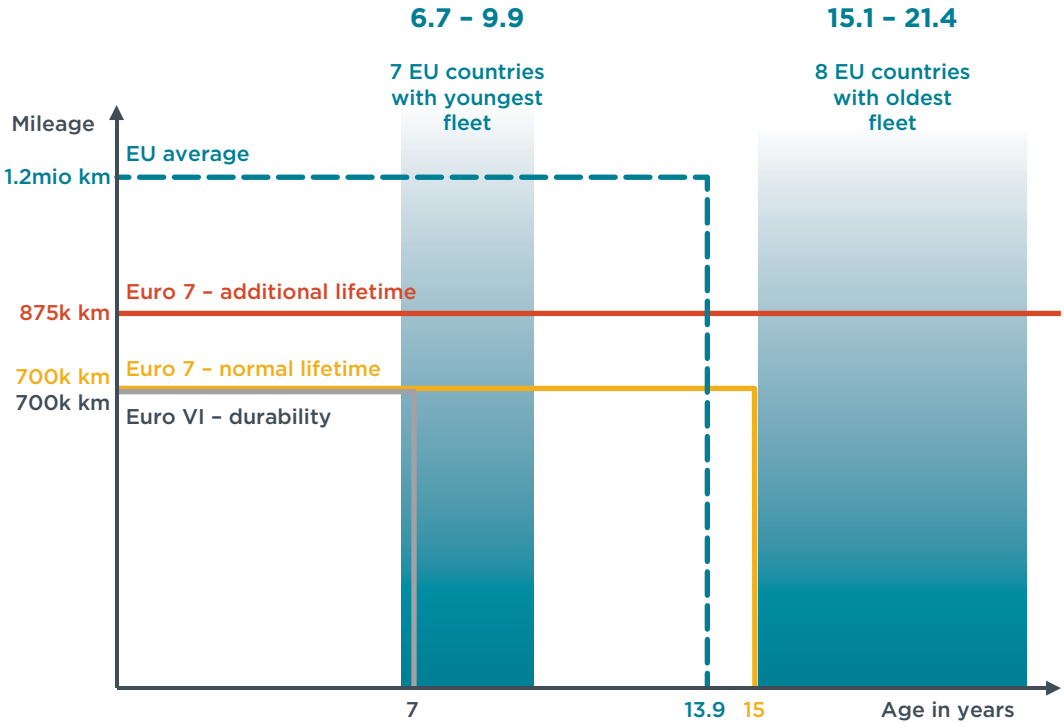

Figure 3. Euro VI and Euro 7 durability requirements for heavy trucks and buses compared to average age of the EU medium and heavy-duty truck fleet. Sources: EU fleet average age of medium and heavy trucks in 2020 in years from ACEA, "Vehicles in Use, Europe 2022." EU fleet average mileage from European Commission, Commission Staff Working Document Impact Assessment- Accompanying the document - Proposal for a Regulation of the European Parliament and of the Council setting CO2 emission performance standards for new heavy-duty vehicles - Part 1/2.

BATTERY DURABILITY AND STATE-OF-HEALTH MONITOR

The European Commission proposes to introduce durability requirements for the traction battery, with the goal of increasing trust in the long-term performance of electric vehicles and value of second-hand vehicles. To allow authorities to monitor compliance with the durability requirements and to inform consumers about a vehicle's battery status, electric vehicles will be equipped with state-of-health monitors that continuously determine the performance of the battery. In addition, the battery durability will be verified during in-service and market surveillance testing. **We recommend that the data determined and provided by the battery state-of-health monitor is verified during these tests**, as described in the UNECE Global Technical Regulation No 22.[18] While the battery performance verification is foreseen to be performed only in the laboratory, **the determined battery performance should also be available to the consumers during real-world operation.** That means the performance should not be artificially limited by the vehicle electronics.

The proposed durability rules require that a car's battery performance degrades less than 20% after 5 years and less than 30% after 8 years. However, this would only preserve the status quo, as reflected in the battery warranties manufacturers currently provide, on average, with 70% battery performance after 8 years or 160,000

18 UNECE, "Addendum 22: United Nations GTR No. 22," ECE/TRANS/180/Add.22 § (2022), https://unece.org/sites/default/files/2022-04/ECE_TRANS_180a22e.pdf.

km.[19] For light commercial vehicles, the European Commission proposes even less stringent targets of only 75% and 65% after 5 and 8 years, respectively.

Considering the average service life of vehicles in the EU, to motivate technological progress and ensure resource efficiency and competitiveness, and to harmonize requirements globally, we recommend using the recently adopted CARB Advanced Clean Cars II regulation as guidelines.[20] On this basis, **we suggest that vehicles type approved until 2029 are required to have 70% battery performance retention after 10 years or 240,000 km and to increase the performance retention requirement to 80% from 2030 onwards. To align the 5-year requirement with these recommendations, we suggest an 85% battery performance retention until 2029 and 90% from 2030 onwards.**

REAL-DRIVING EMISSIONS TEST REQUIREMENTS

Since the introduction of Euro 6c, type-approval and in-service conformity require on-road real-driving emissions (RDE) tests, which has helped to reduce real-world emissions. However, the type-approval procedure regulation currently sets constraints for RDE tests regarding vehicle speed, CO_2 emissions, driving style, trip composition, and ambient conditions. These constraints limit how the tests are performed and, therefore, their real-world representativeness.

AMBIENT CONDITIONS

In the explanatory memorandum contained in the Euro 7 draft regulation document, the European Commission explains: "For cars and vans, the exhaust emission limits are set at the lowest level currently imposed under Euro 6 for cars …, while durability requirements as well as real-driving testing boundaries are set as in option 3a." If the proposed regulation would contain the real-driving testing boundaries of PO3a, the conditions where light-duty vehicles need to be fully emissions compliant, referred to as normal ambient conditions, would range from an ambient temperature of -7°C to +35°C and up to an altitude of 1,300 m.

However, the draft regulation proposes that normal ambient conditions for cars and vans do not change from what is designated in Euro 6. As consequence, cars and vans are allowed to have 60% higher pollutant emissions when operated outside a temperature window of 0°C and 35°C or above an altitude of only 700 m, while trucks and buses must comply with the emission limits for any trip performed at an ambient temperature between -7°C and 35°C and up to an altitude of 1,600 m. Only the extreme temperature thresholds, beyond which an RDE test is invalid, were aligned with those for trucks and buses, that is -10°C and +45°C and a maximum altitude of 1800 m.

This means that the normal boundary condition requirements for light-duty vehicles are even less stringent than in the lowest ambition scenario analyzed in the impact assessment, PO1, which foresees the same temperature range from -7°C to 35°C and altitude range up to 1,300 m. Since no impact assessment was performed for the proposed continued use of Euro 6 RDE normal ambient conditions for Euro 7 cars and vans, there is no evidence that would justify using less stringent requirements than defined in the PO3a option and that would provide a rationale for applying different ambient conditions for light- and heavy-duty vehicles.

19 UNECE.

20 Anh Bui, Dale Hall, and Stephanie Searle, "Advanced Clean Cars II: The next Phase of California's Zero-Emission Vehicle and Low-Emission Vehicle Regulations," Policy Update (Washington DC: ICCT, 2022), https://theicct.org/wp-content/uploads/2022/11/accii-zev-lez-reg-update-nov22.pdf.

We therefore recommend aligning the normal RDE ambient conditions, where full emission compliance is required, for cars and vans with the values proposed for heavy-duty vehicles. This means that normal ambient temperature ranges from -7°C to 35°C and normal altitude up to 1,600 m.

OTHER REQUIREMENTS

The Euro 7 proposal drops most Euro 6 requirements for trip duration and trip composition, meaning that a vehicle must be emissions compliant regardless of the trip speed profile or the distance traveled. In the case of cars and vans, to account for higher distance-specific emissions encountered during short-distance cold-started trips, the European Commission introduces an emissions budget that applies for any trip up to a distance of 10 km. While this provides a reasonable approach, the same emissions budget applies to all trips, regardless of if started with a cold or hot engine. In combination with the alleviated emission limits when operating outside the narrow normal ambient temperature window, the emissions budget approach can result in very high emissions during common vehicle usage. For example, in the case of nitrogen oxides (NO_x), the emission budget is 600 mg. For an average inner-city trip in Germany of about 5.5 km performed just below 0°C, [21] meaning that 60% higher emissions are tolerated, vehicles are allowed to emit about 175 mg NO_x per kilometer, which is almost three times higher than the current Euro 6 limit of 60 mg/km for petrol cars.

Therefore, supplementing the alignment of the light-duty RDE boundary conditions with the heavy-duty provisions, **we recommend applying the emissions budget only for cold started RDE tests.**

For trucks and buses, the Euro 7 proposal requires that all periods of the on-road test are considered when determining emission compliance, while for Euro VI, phases with low average engine load are excluded. Similar to the provisions for cars and vans, an emissions budget for trucks and buses applies for short real-driving emission tests.

LOW TEMPERATURE TEST FOR ALL VEHICLES

For light-duty vehicles, the Euro 7 proposal foresees a laboratory test at low temperature to demonstrate emissions compliance and achievable range during type-approval. No exclusion is made and, therefore, we understand this requirement will apply to all cars and vans regardless of powertrain or fuel type.

This change in the test procedure would ensure emissions compliance at temperatures that cannot be frequently verified during in-service conformity due to their unpredictable occurrence. In case of battery electric vehicles, the change would generate knowledge regarding how low ambient temperature affects range and energy consumption, information which is useful for the consumer and would be a driver for the development of efficient heating and battery temperature conditioning systems.

It should be noted that the current Euro 6 emission standards also contain some low temperature emission limits at -7°C for all vehicle categories, but the European Commission only applies these limits to petrol fueled vehicles. Therefore, **particular attention should be given to the implementing regulation that will define the low temperature test requirements.**

21 Regine Gerike et al., "Sonderauswertung zum Forschungsprojekt „Mobilität in Städten – SrV 2018" Stadtgruppe: SrV-Städtepegel," Mobilität in Städten – SrV 2018 (Dresden: TU Dresden, March 2020), https://tu-dresden.de/srv.

BRAKE AND TIRE PARTICLE EMISSIONS

For the first time, the European Commission proposes an emissions limit for particles stemming from friction brake abrasion; however, this limit only applies to cars and vans. This attempt to regulate non-exhaust emissions is important since they will gain relevance with the continued transition towards zero-exhaust-emission mobility. The proposed limit of 7 mg/km, applicable until the end of 2034, can be achieved by a combination of regenerative braking and using improved brake pads.[22] Meanwhile, suction and filtration hardware that would result in much lower emissions is already becoming available for both light- and heavy-duty vehicles.[23] **We therefore suggest advancing the introduction of the more stringent limit of 3 mg/km currently foreseen by the Euro 7 proposal for 2035 to 2027.**

Euro 7 also intends to address particle emissions from tire abrasion. The European Commission is required to propose appropriate emission limits by the end of 2024.

EVAPORATIVE AND REFUELING EMISSIONS

The Euro 7 proposal also updates the requirements on evaporative emissions, which occur when vapor generated in the fuel system of petrol vehicles is vented into the atmosphere. The new limits are substantially lower than for Euro 6, reducing from 2 grams to 0.5 grams over the 2-day test. This limit falls between the existing requirements set in the United States and China and brings the European industry to a level that has been the norm for some years in these regions.

We also support that Euro 7 introduces a refueling emissions limit for the first time in the EU, which is expected to force the introduction of onboard refueling vapor recovery (ORVR) systems on petrol vehicles. The limit is set at the same level as in the United States and China, which is 0.05 grams of vapor per liter of fuel refueled. The larger storage canister required by the ORVR system will also result in benefits for evaporative emissions beyond the scope of the 2-day test.

ON-BOARD EMISSION MONITORING

Another new element proposed for Euro 7 is on-board emission monitoring (OBM), a concept already introduced in the United States and China. The OBM system uses exhaust sensors to monitor a vehicle's emissions performance and to register and record any exceedance. The draft regulation foresees that the OBM systems are capable of over-the-air transfer of emissions performance information, which enables fleet wide emission compliance verification and, therefore, reduces the demonstration tests required for type-approval.

We support the introduction of OBM in all vehicles as we consider it a cornerstone for fleetwide emission compliance over the vehicle lifetime. However, the draft regulation does not specify which emission species should be subject to on-board monitoring. For clarity and to give sensor manufacturers planning certainty, **we recommend defining the species to be monitored based on sensors that are currently available and including a provision that other species will be subject to monitoring as soon as new sensors are market-ready.**

22 European Commission, "Euro 7 Vehicle Emission Standards: A European Green Deal Proposal - Technical Studies for the Development of Euro 7: Testing, Pollutants and Emission Limits," Technical Studies for the Development of Euro 7 (2022), https://data.europa.eu/doi/10.2873/97170.

23 Tallano Technologies, "Solutions To Reduce Particulate Matter Emissions," (2022), https://www.tallano-technologies.com/en/; MANN+HUMMEL, "Brake Dust Particle Filter," (2021), https://oem.mann-hummel.com/en/oem-products/fine-dust-filters/brake-dust-particle-filter.html.

To simplify vehicle selection and reduce bureaucracy for in-service conformity testing, thereby increasing the frequency of independent testing, **we suggest using the OBM information as indicator of a vehicle being eligible for emission in-service conformity testing** instead of using an extensive criteria catalogue, as currently required.

ON-BOARD FUEL AND ENERGY CONSUMPTION MONITORING

Since January 2021 and 2022, most new cars and vans, respectively, with combustion engines must be equipped with on-board fuel and energy consumption monitoring (OBFCM) devices. The data collected is used to monitor the gap between real-world and type-approval CO_2 emissions, as well as the share of electric driving of plug-in hybrid electric vehicles.

The Euro 7 proposal foresees that OBFCM will be required for all vehicle categories, including heavy-duty vehicles, and will not exclude any vehicle or fuel type. While OBFCM data currently can only be derived by physical access to the vehicle, Euro 7 will require vehicles to be equipped with technology to transmit OBFCM data over the air.

We support these improvements but emphasize the importance of introducing verifiable real-world accuracy requirements for OBFCM data. Furthermore, while we welcome that Euro 7 will require OBFCM for all vehicles, we consider the timing, especially for battery electric vehicles, to be too late. Currently, battery electric vehicles are not required to have OBFCM devices, even though the recent revision of the light-duty vehicle CO_2 standards requires the European Commission to assess impact of electric vehicle efficiency requirements and to develop a method to assess life-cycle emissions. For both purposes, representative real-world energy consumption information is essential. **We therefore recommend introducing OBFCM requirements for battery electric vehicles before July 2025, when Euro 7 enters into force.**

ANTI-TAMPERING PROVISIONS

With Euro 7, manufacturers will be required to design their vehicles to prevent tampering with the emissions control system. For Euro 7 vehicles already in service, manufacturers are also obliged to remove any discovered vulnerabilities that might lead to tampering.

ENVIRONMENTAL VEHICLE PASSPORT

For transparency regarding emissions performance and fuel and energy consumption, the European Commission foresees that each Euro 7 vehicle will be accompanied by an environmental vehicle passport (EVP). The intended purpose of the EVP is to identify vehicles with features resulting in lower emissions or better durability, for example those labeled as Euro 7+. The EVP will contain all relevant emission, consumption, durability, and related information determined during type-approval and will be stored in the vehicle electronically. The data can be viewed in the vehicle information system and will be retrievable for off-board usage. Furthermore, a hardcopy of the EVP should accompany each new vehicle.

Information stored in the EVP can also be useful for independent in-service conformity and market surveillance testing by third parties and to improve transparency. For this purpose, **we recommend that the EVP contains all the**

information required to verify the values declared by the manufacturer during type approval and emission compliance.

SUMMARY AND RECOMMENDATIONS

The proposed Euro 7 regulation lacks ambition, especially for light-duty vehicles. For cars and vans, the proposal does not significantly increase the stringency of pollutant emission limits compared to Euro 6, nor does it widen the normal RDE boundary conditions. The proposal also fails to adjust the durability requirements to values representative of the useful life of vehicles in the European Union. Therefore, Euro 7 is not in line with the "zero pollution ambition for a toxic-free environment," a target the European Commission has set as part of the European Green Deal.[24] It is of concern that the weakening of the RDE boundary conditions, compared to the policy options investigated for the impact assessment, was presumably done without analyzing their efficiency and how they align with the Euro 7 objectives and other policies.

Table 4 summarizes both the improvements introduced by the Euro 7 proposal and the deficiencies of the draft regulation.

Table 4. Improvements of Euro 7 compared to Euro 6/VI and weaknesses of the regulation proposal

Improvements of Euro 7 compared to Euro 6/VI	Weaknesses of Euro 7 proposal
• Euro 7 emission limits are fuel-type, technology, and application neutral. • Stringent heavy-duty emission limits are in line with technological capabilities. • For trucks and buses, nitrous oxide and carcinogenic formaldehyde emissions are limited. • Restrictive RDE test requirements are removed. • Battery durability requirements are introduced. • Type-approval testing at low ambient temperature is required for all cars and vans. • A limit for brake particle emissions is introduced. • More stringent evaporative emissions limits apply and a limit for refueling emissions is introduced. • On-board emission monitoring is mandatory. • Requirement for on-board fuel consumption monitoring devices applies to all vehicles. • All vehicles are required to have over-the-air connectivity capability. • Manufacturers are required to prevent tampering. • Each vehicle will have an electronic passport with emission and consumption information.	• Emission limits for light-duty vehicles are largely the same as the Euro 6 limits for petrol cars. • Nitrous oxide and formaldehyde emissions remain unregulated for cars and vans. • Normal RDE boundary conditions for cars and vans are the same as for Euro 6. • Vehicle durability requirements do not adequately reflect the service life of the EU vehicle fleet. • Battery durability requirements only reflect average manufacturer warranty provisions. • On-board emission monitoring does not define pollutant species to be measured.

24 European Commission, "Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions - Pathway to a Healthy Planet for All - EU Action Plan: 'Towards Zero Pollution for Air, Water and Soil'," (2021), https://eur-lex.europa.eu/resource.html?uri=cellar:a1c34a56-b314-11eb-8aca-01aa75ed71a1.0001.02/DOC_1&format=PDF.

To further strengthen the Euro 7 regulation and to bring it closer to the European Commission's own impact assessment, its longer-term policy targets, as well as comparable emission regulations in China and the United States, we recommend the improvements summarized in Table 5.

Table 5. Recommendations to improve the proposed Euro 7 regulation

Recommendations
• Adjust the emission limits for light-duty vehicles to 30 mg/km for nitrogen oxides (NO_x), 2 mg/km for particle mass, 400 mg/km for carbon monoxide (CO), 45 mg/km for non-methane organic gases (NMOG), and to 1.0e11 #/km for particle number.
• For cars and vans, introduce a combined methane (CH_4) + nitrous oxides (N_2O) limit of 45 mg/km and a formaldehyde (HCHO) limit of 5 mg/km.
• Limits for the voluntarily Euro 7+ level should be at least 33% below the Euro 7 emission limits.
• Increase the normal lifetime of light-duty vehicles to at least 200,000 km or 10 years and the extended lifetime to 240,000 km or 15 years.
• Increase the lifetime of heavy trucks and buses to 1.3 million km and to 560,000 km for medium trucks and buses.
• Adjust the normal RDE ambient conditions for light-duty vehicles to -7 to 35 °C and 0 to 1,600 m.
• Increase the battery durability lifetime to 10 years or 240,000 km and raise the performance retention requirement from 70 % to 80 % from 2030 onwards.
• Advance the introduction of the 3 mg/km brake particle emissions limit for cars and vans from 2035 to 2027.
• Specify the pollutants to be measured by the on-board emissions monitoring system based on sensor availability and define the pollutants that should be included in the monitoring as soon as sensors become available.
• Use the on-board emission monitor as an indicator for in-service conformity testing eligibility.
• Ensure that the environmental vehicle pass contains all information required for in-service verification tests.