BRIEFING

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The stringency of the proposed Euro 7 regulation for cars and vans: An international comparison

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BACKGROUND

In November 2022, the European Commission published its Euro 7 proposal, revising the existing Euro 6 and Euro VI pollutant emissions standards for light- and heavy-duty vehicles, respectively.[1] Even though the proposed emission limits and testing procedures are less stringent than the recommendations of the impact assessment, particularly in the case of light-duty vehicles,[2] the draft regulation faces strong opposition from the automotive industry and some European Union member states for being too ambitious.

To assess the stringency of the proposed Euro 7 emission limits for passenger cars and vans, the following analysis compares the emission limits and test conditions proposed by the European Commission to the policy options analyzed in the Euro 7 impact assessment and to the rules applicable in the United States and China.

1 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; 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.

2 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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TAILPIPE POLLUTANT EMISSIONS

COMPARISON OF EMISSION LIMITS

A direct comparison of the emission limits proposed for Euro 7 with U.S. Environmental Protection Agency (U.S. EPA) Tier 3 final emission standards for nitrogen oxides (NO_x) and non-methane hydrocarbons (NMHC) emissions is not possible and instead requires some preceding analysis.[3]

Euro 7 defines separate emission limits for NOx and NMHC, while the Tier 3 standards limit the combined NO_x+NMHC emissions. The following analysis therefore compares the U.S. NO_x+NMHC emission limits with the sum of NO_x and NMHC limits in the EU and China.[4]

While emission limits in the EU are applicable for each individual vehicle, the U.S. EPA defines fleet average limits for NO_x+NMHC. Since battery electric vehicles (BEVs) have zero pollutant emissions but are counted in the total number of vehicles when calculating the average emissions, the effective NO_x+NMHC requirements for internal combustion engine vehicles (ICEVs) are less stringent than the fleet average limits. Therefore, the fleet average limits need to be translated to equivalent limits for the ICEVs by assuming a share of BEVs.

Furthermore, EU and China emission limits apply to both laboratory testing and real driving emission (RDE) tests performed on public roads. In the United States, emission tests are only performed in the laboratory and involve two test procedures, the Federal Test Procedure (FTP) and the Supplemental Federal Test Procedure (SFTP). The latter includes a high engine load test (US06 test) and a test at high ambient temperature with activated air conditioning (SC03 test) and is thus better comparable to RDE testing than FTP only. Therefore, the less stringent Tier 3 final fleet average SFTP NO_x+NMHC emission limits of 31 mg/km are used for the following comparison instead of the FTP limits of about 19 mg/km.

To translate the Tier 3 fleet average emission limit to an equivalent vehicle-specific limit for ICEVs, Figure 1 shows the maximum fleet average SFTP NO_x+NMHC emissions of ICEVs allowable to still reach the fleet average emission limit of 31 mg/km, depending on the BEV share. If the BEV share is 0%, ICEVs must meet on average the total fleet average emission limit of 31 mg/km. When assuming a BEV share of 30% in 2025, in line with the zero- or low- emission vehicle (ZLEV) incentives of the revised EU CO_2 standards,[5] ICEV NO_x+NMHC emissions must not exceed 44 g/km on average.

This vehicle-specific equivalent Tier 3 final NO_x+NMHC limit of 44 g/km for ICEVs is almost identical to the 45 mg/km limit analyzed in the most ambitious policy scenario (PO2b) of the Euro 7 impact assessment. The NO_x+NMHC limit of the recommended medium ambition scenario (PO3a/PO2a), 75 mg/km, is 1.7 times weaker than the U.S. EPA limit. **The limit recommended by the European Commission for Euro 7 of 128 mg/km is 2.9 times weaker than the Tier 3 final NO_x+NMHC limit.**

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3 John German, *Tier 3 Motor Vehicle Emission and Fuel Standards (Final Rule)*, (Washington DC: ICCT, 2014), https://www.theicct.org/publications/us-tier-3-vehicle-emissions-and-fuel-quality-standards-final-rule. The U.S. EPA Tier 3 final standards limit the sum of non-methane organic gases (NMOG) and NO_x. For simplification, this analysis assumes that NMOG emissions are equal to NMHC emissions. In reality, NMOG are same or higher than NMHC. Therefore, for the same value, an NMOG+NO_x limit would be more stringent than an NMHC+NO_x limit.

4 Hui He and Liuhanzi Yang, *China's Stage 6 Emission Standard for New Light-Duty Vehicles (Final Rule)*, (Washington, DC: ICCT, 2017), https://theicct.org/sites/default/files/publications/China-LDV-Stage-6_Policy-Update_ICCT_20032017_vF_corrected.pdf.

5 Regulation (EU) 2023/851 of the European Parliament and of the Council of 19 April 2023 Amending Regulation (EU) 2019/631 as Regards Strengthening the CO_2 Emission Performance Standards for New Passenger Cars and New Light Commercial Vehicles in Line with the Union's Increased Climate Ambition, Official Journal of the European Union, Pub. L. No. (EU) 2023/851, OJ L 110/5 (2023), https://doi.org/10.5040/9781782258674.

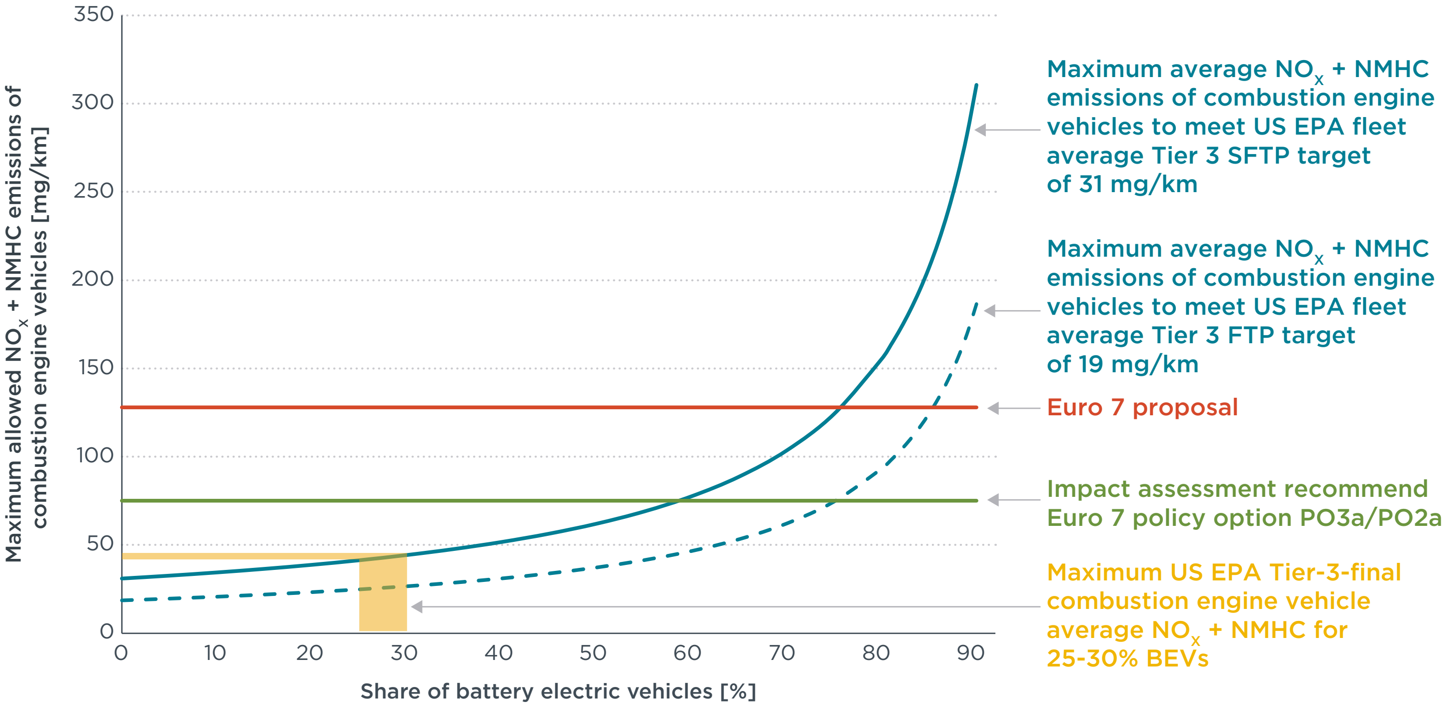

Figure 1. Comparison of combined NO_x+NMHC emission limits proposed for Euro 7 with medium ambition impact assessment policy options PO3a/PO2a and US EPA Tier 3 final SFTP and FTP requirements.

Table 1 compares the proposed Euro 7 emission limits for NO_x+NMHC, particulate matter (PM), particulate number (PN), carbon monoxide (CO), and carcinogenic formaldehyde (HCHO) with the policy options analyzed in the impact assessment and the current Euro 6 limit, as well as the US EPA Tier 3 final and China 6b requirements.

Compared to the China 6b emission limits, the Euro 7 proposal also lacks ambition. Even though China 6b has already been implemented, the Chinese NO_x+NMHC emission limit of 70 mg/km for cars is more ambitious than the impact assessment recommended value of 75 mg/km. **Compared to the proposed Euro 7 NO_x+NMHC limit of 128 mg/km, China 6b is more than 1.8 times more stringent for cars and 1.2 time more stringent for large vans.**

Table 1. Emission limits for passenger cars and vans of the current Euro 6 regulation, proposed Euro 7 regulation, impact assessment policy options, U.S. Tier 3, and China 6b.

Emission species and limits in mg/km	Euro 7 impact assessment policy options		Euro 6[c]	Euro 7 proposal	U.S. EPA Tier 3 final	China 6b[i]
	PO2a/PO3a	PO2b				
NO_x + NMHC	75[b]	45[b]	128-190[d]	128	SFTP[f]: 44[b,g]	70-105
Particulate matter (PM)	2	2	4.5	4.5	US06[h]: 3.7	3
Particle number (PN10)[a]	1.0e11	1.0e11	6.0e11[e]	6.0e11	N/A	6.0e11[e]
Carbon monoxide (CO)	400	400	500–2,270	500	SFTP[f]: 2,610	500-740
Formaldehyde (HCHO)	5	5	N/A	N/A	2.5	N/A

Notes: Under U.S. Tier 3, the sum of NO_x and hydrocarbon emissions are limited. For comparison, the equivalent limits for EU and China are calculated from separate NO_x and hydrocarbon limits.

[a] Unit of PN limit is #/km; [b] NO_x + Non-methane organic gases (NMOG); [c] Ranges indicate different limits for different engine technologies, fuel types, and applications (cars, large and small vans); [d] Euro 6 sets no NMHC limit for diesel engines. Therefore, only values for petrol vehicles are shown.; [e] Includes only particles down to 23 nm (PN23); [f] Supplemental Federal Test Procedure; [g] Equivalent limit for internal combustion engine vehicles assuming a battery electric vehicle fleet share of 30%; [h] For the more demanding US06 emission test, more lenient emission limits apply than for the Federal Test Procedure test; [i] Ranges indicates different limits for cars, small and large vans.

COMPARISON OF APPLICABLE TEST PROCEDURES

As mentioned previously, the test procedures and boundary conditions where the emission limits apply differ between the European Union, China, and the United States.

Euro 7. In the European Union, light duty vehicles are tested both in the laboratory at 23°C using the Worldwide harmonized Light vehicles Test Procedure (WLTP) and under real world conditions on public roads. For RDE tests, the current Euro 6 test procedure sets several requirements for the trip composition, vehicle speed, trip duration, trip distance, stop duration, driving dynamics, and CO_2 emissions, as well as boundary conditions, for a test to be valid. As consequence, instead of being able to verify emission compliance for the wide range of normal daily driving use cases, RDE tests are usually performed on defined routes by trained drivers to achieve valid tests.

With Euro 7, the European Commission intends to remove most of the above-mentioned restrictions. At the same time, likely to avoid misuse and unusual driving, the average power for driving after a cold start is restricted to only 20% of the maximum available power for the first 2 kilometers. If the average wheel power exceeds 20%, limits that are 1.6 times the least stringent limits will apply.

U.S. EPA Tier 3 final. No RDE tests are required to demonstrate emissions compliance under the U.S. EPA Tier 3 final emission limits. To address driving conditions with high engine loads and when using air conditioning systems at high ambient temperatures, additional emission limits are defined for the supplemental federal test procedure. The SFTP consists of three tests: A cold started FTP, a hot started US06 with high engine load, and a hot started SC03 performed at 35°C with simulated solar radiation and active air conditioning. The measured emissions of these tests are weighted, and the final results are compared to the SFTP NMOG+NO_x limit for compliance verification.

While the SFTP covers a much wider range of engine operation points and ambient conditions than the WLTP in the EU, it does not cover the wider and more random range of driving and ambient conditions that could be encountered during RDE testing.

China 6b. As in the European Union, the WLTP is used in China to verify compliance with the China 6b emission limits during type-approval. In addition to the laboratory test, RDE tests are performed for type-approval and in-service conformity verification. The RDE test requirements closely follow those of Euro 6, with some exceptions. Most notably, Euro 6 and the proposed Euro 7 require emissions compliance for both cold and warm started RDE tests, whereas China 6b only verifies emissions in warm started tests. For China 6b, RDE tests are valid if performed at an altitude up to 2,400m, whereas the Euro 6 and proposed Euro 7 regulation only allow testing up to 1,300m.

Due to the mandatory RDE test, China 6b emission limits can be better compared with the Euro 7 limits than with U.S. Tier 3 final limits. Considering the inclusion of cold start and the largely unrestricted testing conditions of Euro 7 RDE tests, a hypothetically identical emissions limit value could be considered more stringent under Euro 7 than under China 6b.

While the NO_x+NMHC emission laboratory limit applicable in China today is more than 1.2 to 1.8 times more stringent than the proposed Euro 7 limit, China 6b includes an RDE conformity factor of 2.1, which does not exist in the Euro 7 proposal.

COMPARISON OF EVAPORATIVE AND REFUELING EMISSION LIMITS

Evaporative emissions occur when vapor generated in the fuel system of gasoline vehicles is vented into the atmosphere, either directly or as permeation through tanks and hoses. Refueling emissions, another source of evaporative emissions, result from the displacement of fuel vapors during tank filling and minor fuel drips. These volatile hydrocarbons contribute to ozone and $PM_{2.5}$, as they easily convert into secondary organic aerosols.

The primary technology used to control evaporative emissions from motor vehicles is the carbon canister. Two main parameters influence the effectiveness of carbon canisters: the volume and the purging rate. Generally, the canister size and purging strategies are designed to meet certification test requirements. Thus, more challenging test procedures and stricter emission limits force better designs of the evaporative emission control systems.

Table 2 shows a comparison of the evaporative emission standards under Euro 6, U.S. EPA Tier 3, China 6b, and the proposed Euro 7 limits that are applicable to light-duty vehicles.

Table 2. Evaporative emission limits for light-duty vehicles under Euro 6, proposed Euro 7, U.S. EPA Tier 3, and China 6b emission standards.

Test	Euro 6	Euro 7	China 6	U.S. EPA Tier 3
Hot-soak + 2-day diurnal test	2 g/test	0.5 g/test	0.7 g/test	0.3 g/test
Refueling test	NA	0.05 g/liter of fuel dispensed	0.05 g/liter of fuel dispensed	0.05 g/liter of fuel dispensed

The evaporative emission standards in the United States are the most comprehensive and stringent of the four standards analyzed. The U.S. standards include tests and limits to account for diurnal evaporative and refueling emissions, in addition to running losses, high-temperature diurnal emissions, canister bleeding, and leaks, among others.

The China 6 standard has an evaporative emissions limit of 0.7 g/test over the 2-day diurnal emission test including hot-soak and mandates a conditioning temperature of 38 ± 2°C prior to the test, which is higher than in the United States and the EU. In addition, China 6 also sets a refueling emissions limit of 0.05 g/L. This provision forced the introduction of onboard refueling vapor recovery (ORVR) systems.

The adoption of tighter limits for evaporative and refueling emissions under Euro 7 can drive the adoption of low-cost larger canisters and the improvement of purging strategies. The refueling emissions standard is of particular importance. Capturing emissions during refueling by the vehicle's canister is more effective than the current Stage II controls, which involves vapor recovery at the fuel pump, and can prevent emissions in case of Stage II system malfunctions. Experience in the United States and China shows that ORVR has a higher capture efficiency than Stage II and is not sensitive to fuel composition, does not require continuous maintenance and inspection, or entail a higher cost. Furthermore, the larger canister required by the ORVR system will provide extra storage capacity not only for refueling, but also for high evaporative emissions events that occur in use, such as during summer heat waves when air quality issues due to ground-level ozone are most pronounced.

CONCLUSION

While the Euro 7 proposal by the European Commission does not tighten the nominal emission limits to match those in the United States and China, it includes important provisions that would lead to modest emission reductions. However, for Euro 7 to successfully drive available cost-effective technologies to the market, it is advisable to consider NO_x emission limits at the levels present in other jurisdictions, and to preserve all elements included in the Euro 7 proposal.