Euro 7: Let's make it count

April 2023

Air pollution from road transport kills 70,000 Europeans prematurely every year and causes a multitude of diseases including cancer, stroke and cardiovascular disease. Despite the shift to zero emission road transport driven by more ambitious car and truck CO_2 standards, internal combustion engine (ICE) vehicles are not disappearing from European roads anytime soon. With **no EU phase out guaranteed for polluting ICEs**; cars, vans, trucks and long haul buses may continue polluting European towns and cities indefinitely. **Over 100 million new ICE cars and 3.1 million large ICE trucks could land on European roads by 2050 and will stay on the roads for decades.** The only way to reduce pollution from those vehicles and improve air quality in Europe is to reduce pollution at the source, through a new and improved Euro 7 vehicle emission standard.

At the end of 2022, the European Commission finally adopted its Euro 7 proposal. For cars, Euro 7 is weak and contradicts the findings of the Impact Assessment and the recommendations of pollution experts from across Europe. Crucially, for cars, Euro 7 fails to :

- **Reduce pollution limits beyond those set for petrol cars 15 years ago** (i.e 60 mg/km for NOx and $6x10^{11}$ /km for particles, risking greenwashing Euro 6 cars as 'clean' Euro 7, since most cars sold today already achieve these limits. This is disappointing, since improvements in in-use exhaust technologies (such as bigger and more efficient three way catalysts, filters and SCR NOx control systems) are able to deliver 50% lower NOx and 85% lower particle pollution for an affordable €300 per car[1], with no changes to the engine needed. More ambitious limits would reduce toxic NOx pollution by 42% already in 2035[2] and allow Europe to keep pace with standards in the U.S. and China.
- **Ensure limits are met throughout the lifetime of the vehicle**, requiring compliance for only 200,000km / 10 years (whichever comes first) does not cover even the average age of cars in 17 Member States including Spain, Poland and Finland. Again, the EU is falling behind the U.S. where emission limits have to be met for 15 years/240,000km.
- **Simplify the Euro standards and prevent greenwashing.** New categories introduced in Euro 7 e.g. for cars with geo-fencing technology (hybrids that can drive zero emission in certain areas) are unnecessary for approving such technologies for sale, confusing for consumers, risk shifting pollution outside of geo-fenced areas and may greenwash polluting cars as 'clean'.

[1] European Commission. (2022, 11, 10) Euro 7 Impact Assessment Report, Part 1.
[2] European Commission. (2022, 11, 10) Euro 7 Impact Assessment Report, Part 1.

- **Reduce brake particles to low levels,** requiring only a weak 40% reduction in brake pollution until 2035. This is despite the availability of European brake particle filter technology which can slash brake pollution from all cars by a minimum of 85% and ensure lifetime compliance for just €77 more than the improved brake pads needed to meet -40%.

- **To set a timeline for the introduction of a particle limit for tyres,** a large source of air and microplastic pollution. The method for measuring tyre pollution is under development as part of the United Nations Global Technical Regulations and should be completed by 2024.

For trucks the Commission's proposal is more ambitious, **and will already deliver a 40% reduction in NOx pollution in 2035 for an affordable additional 2.6% increase in the cost of a medium and 1.9% in the cost of a large truck**. Yet the proposal fails:

- **To reduce pollution from when the engine is first started (cold start) in line with standards in other key automotive markets,** Euro 7 sets a limit of 350 mg/kWh for NOx when a limit of 175 mg/km is achievable with technologies being deployed in the U.S. The lack of ambition on cold start pollution is particularly bad for air quality in towns and cities.

- **Fails to ensure that limits are met throughout the lifetime of the vehicle** requiring small trucks (<16 tonnes) to meet the limits for only 375,000 km and large trucks (>16 tonnes) for 875,000 km. This is a minor 20-25% improvement compared to Euro 6 and is insufficient to cover the whole vehicle lifetime, especially for large trucks which is 1.2 million km and does not keep pace with California which requires compliance for 1.3 million km.

- **Fails to set let limits for harmful particle number (PN) emissions and the greenhouse gasses methane (CH_4) and nitrous oxide (N_2O)** which are aligned with the findings of the Impact Assessment. PN limits are set at double ($2x10^{11}$ vs $1x10^{11}$ /km) and combined the greenhouse gas limit is set at 450 vs. 410 mg/km.

Without improvements to Euro 7, particularly for cars, cities will have no option but to introduce more restrictive low and zero emission zones to comply with the air quality standards proposed in the revision of the Ambient Air Quality Directive, which requires 50% reductions in ambient concentrations of toxic NO_2 and particle pollution. As a priority, policymakers should:

For cars:

- **Reduce pollution limits in line with findings of the Commission's Impact Assessment, setting limits of 30 mg/km for NOx and $1x10^{11}$/ km for particles.** These standards are already met by around half of today's cars tested but stricter limits are needed to ensure all cars are less polluting.

- **Increase the requirement to comply with limits to 240,000 km/15 years to cover the entire lifetime of cars on EU roads**. This will provide simplification and alignment to standards in the U.S.

- **Remove additional Euro 7 categories such as geo-fencing and Euro 7+ which are confusing and unnecessary.**

- **Set brake particle limits at 3 mg/km from the first implementation of Euro 7** to align with what the best European technology can deliver.

- **Commit the Commission to proposing a new regulation for tyre particle pollution, including the testing methodology and limits by not later than the end of 2024,** to ensure that reduction of air and microplastic pollution from tyres is not unnecessarily delayed.

For trucks:

- **Reduce the NOx limit for when the engine is first started from 350 mg/kWh to 175 mg/kWh** to more closely align with key automotive markets.

- **Increase the requirement to comply with limits to 700,000 km and 15 years for small trucks and 1.2 million km for large trucks** to cover their entire lifetime.

- **Reduce the particle number and greenhouse gas emission limits to align with the findings of the Impact Assessmen**t, setting the PN limit at $1x10^{11}$/km and the GHG limit to 410 mg/kWh.

Euro 7 on-road test conditions are clear and achievable

Unlike previous Euro standards, the on-road (RDE) test conditions under which limits have to be met on-road for both light and heavy duty vehicles are clearly defined within the Euro 7 proposal for all vehicle types. While test conditions are widened, **challenging driving conditions such as towing a trailer, at -10 ℃, at altitude are not valid for RDE testing as unlike Euro 6 only one such 'extended' condition can apply at any one time.** Under 'extended' conditions emissions from cars are divided by 1.6 and by 2 for trucks, further reducing difficulty. A methodology will also be defined to ensure unrealistic driving will not count as a valid test.

The Euro 7 requirements for car and truck makers are clear. Now Parliament and Council must progress with strengthening the ambition of the Euro 7 proposal. The technology to do so is available and affordable. At a time when European carmakers are making record profits[3], the EU must ensure that the health of European citizens comes first by delivering a robust Euro 7 standard which slashes pollution and improves air quality in towns and cities across Europe.

[3] T&E. (2023)EURO 7: Carmakers' record profits made at expense of human health.

1. Introduction

Air pollution continues to be a huge problem across Europe with almost all European citizens exposed to toxic air above World Health Organisation (WHO) Air Quality Guidelines[4]. Road transport continues to be a huge contributor to the problem as the biggest source of toxic NO_2 and a significant source of particle pollution[5], causing 70,000 premature deaths per year[6] and a multitude of preventable diseases including cancer, stroke and cardiovascular disease[7]. Children are and teenagers are particularly vulnerable to air pollution as they are still growing[8].

Since 2018, the European Commission has been in the process of developing new Euro 7 emission standards for cars, vans, buses and trucks to reduce pollution from road transport and to improve air quality. The draft proposal was published in November 2022. This position paper provides updated analysis and policy recommendations for the Euro 7 Regulation based on the Commission's draft proposal.

2. Why is Euro 7 still needed?

Despite the increasing rate of electrification driven by more ambitious car and truck CO_2 standards, internal combustion engine (ICE) vehicles are not disappearing from European roads anytime soon. T&E previously forecasts that in the decade prior to the planned 2035 phase out date of new ICE car sales, almost 100 million new ICE cars will be placed on European roads[9]. **A potential allowance of the sale of e-fuel ICE powered cars after 2035[10] - subject to upcoming legislative debate - means that the EU might no longer be on a trajectory to completely eliminate tailpipe pollution from cars.**

E-fuel powered cars still produce large amounts of pollution and research shows that when it comes to toxic NOx pollution they are as bad as fossil powered cars[11]. T&E estimates that **allowing e-fuel cars to be sold could put an additional 26 to 46 million more polluting e-petrol ICE cars on EU roads by 2050[12]** (if instead of decarbonising shipping, e-diesel was wasted in powering EU cars this number could increase further). **This means that almost 150 million polluting ICE cars could end up on EU roads by 2050 and continue to be sold in the EU indefinitely.** All this makes an even stronger case for future proof strict Euro 7 limits, to assure robust air quality regardless of what technology is sold or driven on the roads.

Similarly, ICE heavy-duty vehicles could continue to be sold in the EU indefinitely. Heavy-duty CO2 standards, which drive the uptake of heavy-duty ZEV, only cover around 80% of heavy-duty vehicle sales

[4] EEA. (2022) Europe's air quality status 2022.
[5] EEA. (2022) Sources and emissions of air pollutants in Europe.
[6] European Commission. (2022, 11, 10) Euro 7 Impact Assessment Report, Part 1
[7] EEA. (2022) Air pollution: how it affects our health.
[8] EEA. (2023) Air pollution and children's health.
[9] T&E. (2021) The seven (dirty) air pollution tricks of the auto industry.
[10] T&E. (2023) T&E reaction to the EU and German deal on 2035 zero-emissions car law.
[11] T&E. (2021) Magic green fuels: Why synthetic fuels in cars will not solve Europe's pollution problems.
[12] T&E. (2023) Scholz is fueled with illusions.

in the EU[13]. For vehicles covered under the standards, the European Commission has only proposed a 90% CO_2 reduction target in 2040. This means that ICE trucks and long distance buses can continue to be sold past this date. The standards also define hydrogen combustion vehicles as zero emission (despite their production of NOx pollution[14]) meaning that even if a phase out date for diesel heavy-duty engines is set, polluting hydrogen combustion trucks can continue to be sold. Unless the European Parliament and Council agree to strengthen CO_2 rules, T&E forecasts[15] that another 2.6 million large ICE trucks will be sold between 2027 (when Euro 7 enters into force for trucks) and 2040. After 2040, at least 140,000 heavy-duty vehicles will continue to be sold in Europe annually. Between 2040 and 2050 another half a million large ICE trucks are expected to be sold.

The current Euro 6 emissions standards for cars, vans, buses and trucks were set 15 years ago, based on outdated technology and are now obsolete. Euro 6 is full of loopholes such as those which allow trucks to pollute in excess of 8 times the legal limit when driving in cities[16] or which results in high pollution from cars when the engine is first started (which occurs mainly in towns and cities). Many toxic pollutants such as small particles remain unregulated and limits have to be met for only a fraction of a vehicle's lifetime. Stricter standards have already been set in other key automotive markets such as China, the U.S. and California and Europe is falling behind. With the average age of EU cars at 12 years and trucks at 14 years[17] (much longer in Central, Eastern and Southern Europe), there is at least another 25 years of polluting cars and over 30 years of polluting trucks on European roads. Given the continuing pollution from ICE vehicles, the EU simply cannot afford to continue to allow road transport to prematurely kill 70,000 people per year when the technology is available to reduce their pollution.

3.Pollutant emission limits

3.1 Cars

3.1.1 Euro 7 pollutant limits fall short of the ambition required

Unfortunately the Commission's proposal for cars fails to reduce pollution limits beyond the Euro 6 limits set for petrol cars 15 years ago and does not take into account the technological leaps that have taken place in emission control since the Euro 6 standard was set.

[13] T&E. (forthcoming). Addendum: addressing the heavy-duty climate problem.
[14] Georgia Tech, Strategic Energy Institute. (2022) NOx emissions from hydrogen-methane fuel blends.
[15] Based on T&E modeling of the heavy-duty CO2 standards using the EUTRM model.
[16] ICCT. (2020, 11, 26) Findings from recent ICCT research on vehicle emission standards. Presentation to the Advisory Group on Vehicle Emission Standards.
[17] ACEA. (2023) Vehicles in use Europe 2023.

Table 1. Car: Euro 6 emission, Euro 7 Impact Assessment scenarios and the Commission's proposed Euro 7 limits.

Limit (mg/km)	Euro 6 petrol	IA Low ambition (1)	IA Medium ambition (2a/3a)	IA High Ambition (2b)	Euro 7 proposal
Nitrogen Oxides (NOx)	60 petrol/80 diesel	60	30	20	60
Particle Number (PN) (no./km)	$6x10^{11}$	$6x10^{11}$	$1x10^{10}$	$1x10^{11}$	$6x10^{11}$
Particulate Mass (PM)	4.5	4.5	2	2	4.5
Carbon Monoxide (CO)	1000 petrol/500 diesel	500	400	400	500
Non-methane hydrocarbons (NMHC)[18]	68 petrol	68	45	25	68
Total hydrocarbons (THC)	100 petrol	100	-	-	100

The proposed Euro 7 limits (table 1) are aligned with the Commission's low ambition scenario from the Euro 7 Impact Assessment (IA). This directly contradicts the recommendation of the Commission's own experts and the findings of the IA. The IA found that the **medium ambition for cars was 'the most effective in achieving the identified objectives, while also being cost-efficient by bringing the highest health and environmental benefits for citizens at low regulatory costs for industry**'.[19] Similarly, the CLOVE consortium of emissions experts (who were tasked by the Commission to develop the Euro 7 standards) recommended significant reductions to the pollutant emissions aligned closely with the medium and high ambition limits as assessed in the Commission's IA. The result of the weak proposal is that limits for NOx and particles (PN) (which are responsible for the majority of air pollution deaths in Europe[20]) are two times and 6 times weaker, respectively, than the minimum reduction recommended by CLOVE and the Impact Assessment.

The lack of reduction in limits means that, in reality, carmakers will have to do little, if anything, to reduce pollution. Already today, Euro 6 diesel and petrol cars are able to achieve Euro 7 limits both inside and outside of Real Driving Emissions (RDE) test boundaries. Testing by CLOVE found that 97% of Euro 6d cars

[18] Under the medium ambition scenario's 1a/3a and the high ambition scenario Non-methane hydrocarbons (NMHC) are measured as Non-methane organic gasses (NMOG).
[19] European Commission. (10,11,2022) Euro 7 proposal.
[20] EEA. (2022) Air Quality in Europe 2022.

achieve the Euro 7 NOx limit inside Euro 6 RDE boundaries and 77% under more challenging driving conditions. Similarly, for particle number (PN) 78% respect the limits inside of RDE boundaries and 68% outside[21].

Unless limits are reduced, Euro 7 will not bring about the air quality improvements that Europe needs, especially in cities. The proposal for the revision of the Ambient Air Quality Directive (AAQD) reduces allowable ambient concentration of NO_2 and PM by 50%. If ICE cars cannot contribute to meeting these targets, **cities will have no alternative but to increase the scope and stringency of low and zero emission zones** to meet their legal obligations under the AAQD. This will directly contradict the Commission's Euro 7 objective of preventing the fragmentation of the single market for cars due to vehicle access restrictions.

3.1.2 More ambitious limits are economically feasible

The cost of meeting the Commission's Euro 7 proposal costs only **€90- €150 per car[22]. Aligning limits with the Commission's medium ambition only cost an average of €300 per car** representing only a small incremental increase in cost compared to Euro 6 and only a small €150 increase compared to the cost of meeting the Commission's Euro 7 proposal. €300 is less than the cost of a paint upgrade on an entry level model such as the Renault Clio[23] or VW Up[24] which costs over €500. This is well within the range of what consumers are willing to pay for less polluting cars. **A survey of new car buyers in the EU found that the majority are willing to pay up to €500 for a less polluting car (fig. 1)[25]**.

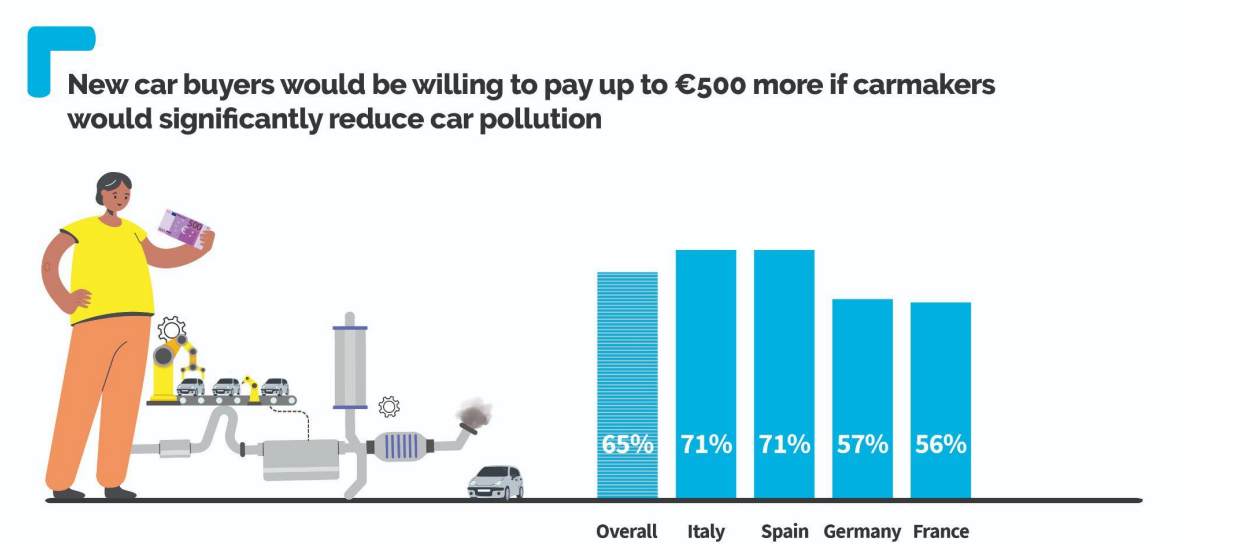


Figure 1. A YouGov poll finds that 2 out of 3 new car buyers in Europe's biggest automotive markets are willing to pay up to €500 more to make cars less polluting.

[21] CLOVE (2021, 04, 08) LDV Exhaust, presentation to the Advisory Group on Vehicle Emission Standards.
[22] European Commission. (2022, 10, 10) Euro 7 standard: new rules for vehicle emissions.
[23] www.renault.de, price checked on 2023, 03, 01.
[24] www.volkswagen.de, price checked on 2023, 03, 01.
[25] T&E. (2022) Most Europeans want tougher car emission rules and are willing to pay.

European carmakers are also in a good financial position and can afford to make cars less polluting. Europe's five biggest carmakers (BMW, Mercedes, Renault, Stellantis and VW) made €64 billion in profit in 2022, more than double 2019 profits and are planning to pay out €27 billion to shareholders[26]. A Euro 7 aligned with the medium ambition would, in total, cost the two biggest carmakers €5.7 and €5.1 billion, respectively[27]. For VW this would be 37% of 2022 profits, only 30% more than the €4.4 billion which VW plans to pay out in dividends this year. For Stellantis this would be 30% of 2022 profits, or less than the €5.7 billion that the carmaker plans to spend on dividends and stock buybacks. For smaller carmakers the total cost of Euro 7 is much lower at €0.5 to €2.7 billion ,[28].

The investment that carmakers have to make in Euro 7 technology will be spread over 10+ years of European ICE car sales, equal to almost 100 million cars[29]. This could be more if e-fuel powered cars are sold after 2035. (see Section 2). This is a much longer payback period than with previous standards. Prior to Euro 6, new emission limits were brought in much more frequently, every 5 years. The investment for Euro 5 cars was spread over around 50 million ICE sales, half of the minimum expected for Euro 7[30].

For European carmakers, making cars less polluting in line with the medium ambition scenario of the Commission's impact assessment is affordable and will be spread over a minimum of almost 100 million ICE sales, double the payback volume of Euro 5.

T&E recommends that EU Policymakers follow the recommendations of the Impact Assessment and emission experts and set the Euro 7 limits for cars in line with the medium ambition scenario of the Impact Assessment.

3.1.3 More ambitious limits are technically feasible

For Euro 7 to bring about the pollution reduction that EU air quality needs, the emission limits for cars should, **at the minimum, be aligned with the outcome of the IA which found the medium ambition to be the most effective and cost efficient.** Setting limits at this level for cars would deliver €56 billion in health and environmental benefits[31]. and **reduce NOx by an additional 42% by 2035, 62% in 2040 and 88% in 2050 compared to keeping the Euro 6 emission standard along with the increased rate of electrification from the revised car CO_2 standards[32]**.

[26] T&E. (2023) Euro 7: Carmakers' record profits made at expense of human health. €27 billion refers to dividend payments and stock buybacks.
[27] European Commission. (2022, 11, 10) Euro 7 Impact Assessment Report, Part 1.
[28] European Commission. (2022, 11, 10) Euro 7 Impact Assessment Report, Part 1.
[29] T&E. (2021) The seven (dirty) air pollution tricks of the auto industry.
[30] 2010-2014 ICE sales. Data on car registrations from the European Environmental Agency.
[31] European Commission. (2022, 11, 10) Euro 7 Impact Assessment Report, Part 1.
[32] European Commission. (2022, 11, 10) Euro 7 Impact Assessment Report, Part 1.

More than half of new cars tested (56%) already meet the medium ambition Euro 7 NOx limit under challenging driving conditions not covered by Euro 6 RDE testing[33] indicating the technology needed to meet more ambitious limits is already being fitted to cars on sale today. However, **tighter limits are needed to bring all cars up to this level of performance. This is the only way to reduce pollution from cars for which carmakers have done only the bare minimum required under Euro 6.**

Aside from many cars sold today already being able to achieve the medium ambition emission limits, emission control technology needed for Euro 7 has also been demonstrated in use on demonstrator cars. The Association for Emission Control by Catalyst (AECC) has fitted Euro 6 cars with the Euro 7 exhaust emission control technology needed to meet the IA medium ambition Euro 7 limits[34]. Pollution is reduced by fitting more efficiently and bigger: three way catalysts, filters and ammonia storage catalyst for petrol cars and diesel oxidation catalysts (DOC), SCR NOx control systems, filters and ammonia storage catalyst for diesel cars.

These are not new technologies. These technologies are already fitted to Euro 6 cars on sale today[35]. The improved versions of these technologies (which will be needed by some cars to meet more ambitious Euro 7 limits) are also already available and represent only a small step change in technology compared to today. For both the diesel and petrol demonstrator cars the programming of the engine (calibration) is also improved[36]. **However, new engines, changes to engine hardware or full hybrid technology are not needed to meet the limits aligned with the medium ambition of the Commission's Impact Assessment**.

The technology to meet more stringent Euro 7 limits is already available and all European carmakers have the expertise needed to make their cars less polluting as they will soon be required to meet stricter limits in other key automotive markets:

- **China:** From July 2023 European carmakers selling in China will have to meet a 40% lower NOx limit than the Commission proposed for Euro 7.
- **U.S.:** On average carmakers already have to meet a 55% lower NOx limit for cars across their whole fleet than proposed for Euro 7 by the Commission. In 2025 the U.S. requirement is further strengthened to require 70% lower average NOx emissions than Euro 7.

  Recently announced daft US rules will progressively require further emissions reductions from 2027[37]. The proposed rule will require fleet average emissions to be 87% lower in 2032 than proposed by Euro 7. **Once sales of zero emission vehicles are discounted from the average,**

[33] CLOVE. (2021, 04, 08) LDV Exhaust, presentation to the Advisory Group on Vehicle Emission Standards.
[34] AECC. (2022, 10, 26) Letter to the European Commission: AECC calls for an ambitious Euro 7 proposal.
[35] Ammonia storage catalysts are fitted to some cars sold today.
[36] AECC (2022, 05, 10) Ultra-low pollutant and CO_2 emissions on demonstrator vehicles with advanced emission controls and sustainable renewable fuels.
[37] EPA. (2023, 04, 11) Proposes Rule: Multi-pollutant emissions standards for model years 2027 and later light-duty and medium duty vehicles.

ICE vehicles will have to emit a maximum of 23 mg/km of NOx on average. This is just over a third of the proposed Euro 7 limit. At the same time the U.S has set ambitious electrification targets which are expected to result in 67% of new sales to be zero emission BEVs in 2032[38]. This shows that setting ambitious electrification targets and stringent pollution rules are not mutually exclusive.

The technology for much lower emissions than set for Euro 7 is being deployed by European carmakers globally, there is no technical reason why more ambitious Euro 7 limits can't be met by cars sold in Europe.

3.2 Trucks and buses

3.2.1 Euro 7 delivers a large reduction in pollution from trucks and buses

For trucks and buses, the Commission has followed its IA and largely proposed limits in line with the IA's medium ambition which is a significant improvement compared to Euro 6. Instead of relying mainly on lab based engine testing at type-approval, compliance with limits will now predominantly be checked on the road. To facilitate this, a new structure for emission limits has been developed.

A cold emission limit is introduced to regulate emissions when the engine is warming up[39], when pollution from the engine is highest. The hot emission limit applies to driving outside of the cold start period. This is set lower than the cold limit as low emissions are easier to achieve once the engine is hot. A new emission budget is also provided for shorter trips which are less than the work done by the engine over 3 World Harmonised Transient Cycle (WHTC) engine laboratory test cycles (this is the cycle used during engine type-approval today). The 3 x WHTC budget sets higher emission limits on tests shorter than 3 WHTC cycles, in city driving this would be equivalent to approximately 60 km / 3 hours of driving[40]. For example, the NOx limit on such trips is increased to 150 mg/kWh from the 90 mg/kWh hot emission limit proposed[41]. This makes it easier for truckmakers to meet Euro 7 limits on shorter tests and in towns and cities where slower speeds and stop start driving make emission control more challenging.

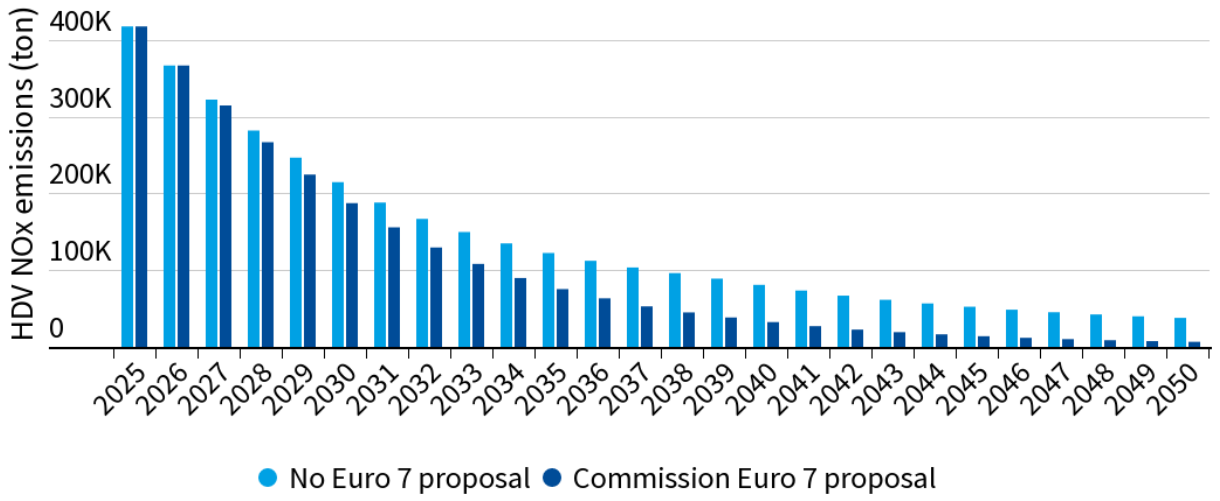
[38] EPA. (2023, 04, 11) Proposes Rule: Multi-pollutant emissions standards for model years 2027 and later light-duty and medium duty vehicles.
[39] Cold start.
[40] ICCT. (2021) ICCTs's comments and recommendations on future Euro 7/VII emission standards.
[41] The emission budget limits for HDV are included in Annex 1.

Table 2. Truck and bus: Euro 6 emission, Euro 7 Impact Assessment scenario and the Commission's proposed Euro 7 limits.

Limit (mg/kWh)	Euro 6 diesel	IA Low ambition (1)	IA Medium ambition cold (2a/3a)	IA Medium ambition hot (2a/3a)	IA High ambition cold (2b)	IA High ambition hot (2b)	Euro 7 cold	Euro 7 hot
Nitrogen Oxides (NOx)	460	460	350	90	175	90	350	90
Particle Number (PN) (no./kWh)	$6x10^{11}$	$6x10^{11}$	$5x10^{11}$	$1x10^{11}$	$5x10^{11}$	$1x10^{11}$	$5x10^{11}$	$2x10^{11}$
Particulate Mass (PM)	10	10	12	8	12	8	12	8
Carbon Monoxide (CO)	4,000	,	3,500	200	1,500	200	3,500	200
Non-methane Organic gasses[42] (NMOG)	160	160	200	50	150	50	200	50
Ammonia (NH3)	10 ppm	10 ppm	65	65	65	65	65	65

The heavy-duty NOx limits proposed will result in a large reduction in NOx pollution. T&E's modeling, which takes into consideration the increased ambition of the heavy-duty CO_2 emission standards proposed by the European Commission in February 2023 (fig. 2), shows that Euro 7 will result in an additional, cumulative reduction of 25% in NOx pollution by 2050. In 2035 NOx emissions from heavy-duty vehicles will be 40% lower than without Euro 7. In 2040 the reduction will increase to 60% and 82% by 2050[43].

[42] Non-methane organic hydrocarbons under Euro 6 and the Commission's Impact Assessment low ambition.
[43] Modeled using T&E's EUTRM model, the Commission's proposal for the heavy-duty CO2 standards and the emission factors from the Commission's medium ambition of the Euro 7 Impact Assessment.



Based on T&E EUTRM modelling of the proposed HDV CO2 and Euro 7 standards using PO3a emission factors from the Impact Assessment

Figure 2. Forecast NOx emissions from heavy-duty vehicles. Euro 7 already delivers an additional 40% NOx reduction by 2035.

However, some improvements are still needed to the Euro 7 heavy-duty pollutant limits to ensure that pollution from heavy-duty vehicles is reduced as far as technically possible. High ambition is needed for ICE trucks and long haul buses since they may continue to be sold in the EU indefinitely:

1) **The NOx limit for when the engine is first started (cold start) needs to be reduced from 350 mg/kWh to 175 mg/kWh.** This will bring the emission limit into closer alignment with the standards already set in California which have been extensively proven to be technically feasible[44]. This will particularly have an impact on reducing pollution in urban areas.

2) **The particle number emission limit should be reduced back down from 2 x 10^{11} / kWh to 1 x10^{11} /kWh in line with the medium ambition of the Euro 7 Impact Assessment.**The particle number (PN) limit for heavy-duty vehicles was doubled at the last minute in direct contradiction to recommendations from the Commission's own experts and the findings of the Impact Assessment**.**

3.2.2. Euro 7 for heavy-duty vehicles is economically feasible

The cost of the Commission's Euro 7 proposal including aligning the particle number and the combined limit for greenhouse gasses with the Commission's medium ambition scenario, is €2,600 per medium and €2,800 for a large truck. This is just 2.6% of a medium and 1.9% of a large truck's purchase price[45] and will

[44] California Air Resources Board. (2020)Heavy-Duty Engine and Vehicle Omnibus Regulation and Associated Amendments.

[45] Based on medium and large truck cost as detailed in: European Commission. (2022, 11, 10) Euro 7 Impact Assessment Report, Part 2.

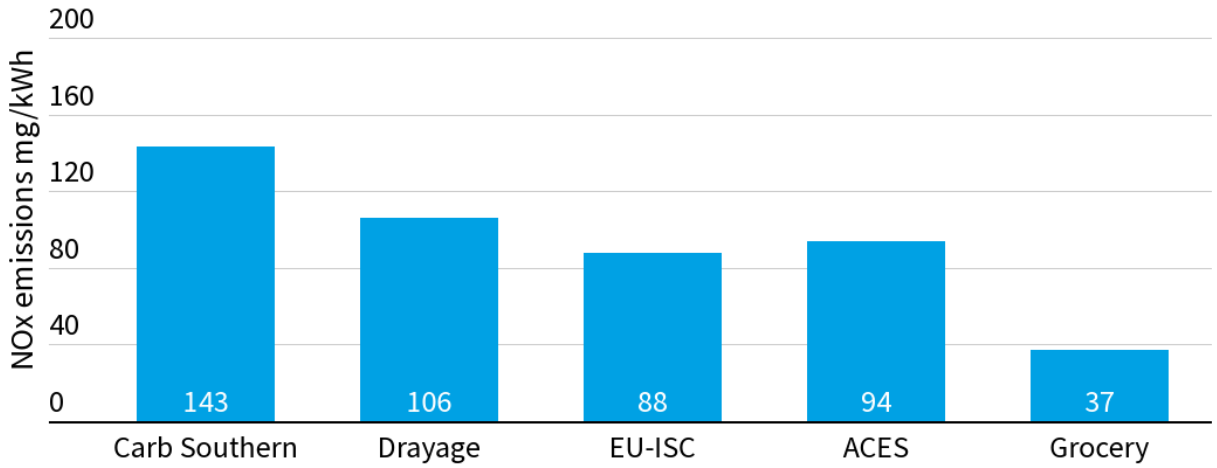
have only a minor impact on the total cost of ownership of the vehicles. Given the large reductions in truck emissions from the implementation of Euro 7

3.2.3. Euro 7 for heavy-duty vehicles is technically feasible

The Euro 7 limits proposed by the commission for heavy-duty vehicles are technically feasible. The Euro 7 heavy-duty demonstrator vehicle built by AECC is able to meet the demands of the Euro 7 proposal[46] using technology already available today through the use of emission control technology which is positioned more closely to the engine to assist with warm up as well as bigger and better SCR NOx control systems, diesel oxidation catalysts and ammonia storage catalysts.

Further improvement in the performance of heavy-duty vehicles is possible, through the reduction of the cold start emission limit to 175 mg/kWh from the 350 mg/kWh proposed. This would particularly have an impact on reducing pollution in towns and cities. For heavy-duty vehicles this is technically feasible. The SouthWestern Institute in the U.S. has undertaken development, testing and verification of low NOx technology to support the development of the already set Californian low-NOx Regulation[47] and U.S. heavy-duty emission standards. The research found that even when the emission control technology is aged to a full vehicle lifetime of 1.3 million km and tested on challenging drive cycles (representing worst case use conditions) the emission limits stay well below the 175 mg/kWh cold start limit (fig. 3)[48]. Even on the most challenging test cycle, emissions are 18% below the limit. **Leaving the cold start emission limit as per the Euro 7 proposal would allow trucks and buses to emit several times more toxic NOx pollution than new emission control technology can deliver. To reduce cold engine pollution and improve air quality in towns and cities the cold NOx emission limit should be reduced to 175 mg/kWh.**

[46] AECC. (2022, 10, 26) Letter to the European Commission: AECC calls for an ambitious Euro 7 proposal.
[47] California Air Resources Board. (2020)Heavy-Duty Engine and Vehicle Omnibus Regulation and Associated Amendments.
[48] Data on the Commercial Vehicle Low NOx emission control technology demonstration provided by the Southwestern Institute to Transport & Environment.



Source: Southwestern Research Institute testing of heavy-duty low NOx technology aged to 1.3 million km, 100th percentile.

Figure 3. Testing of new emission control technologies for trucks on challaning test routes shows that cold start emissions can be well controlled to less than 175 mg/kWh[49].

3.3 New pollutants

T&E welcomes the regulation of previously unregulated pollutants which are harmful to human health and the environment. For cars the Euro 7 proposal includes the extension of the size of particles regulated (as part of the particle number (PN) emission limit) from 23 nm down to 10 nm (Table 4). The introduction of an ammonia (NH_3) emission limit, which was already regulated for trucks in Euro 6, is also welcome. However, the 20 mg/km ammonia limit is weak. The majority of cars already meet this limit[50] meaning it will have little impact on reducing ammonia emissions. This is problematic as in cities road transport is the leading source of ammonia pollution[51] which produces secondary particle pollution and contributes to $PM_{2.5}$ pollution in cities. To have an appreciable impact on reducing emissions, **the ammonia limit should be reduced from 20mg/km to 10mg/km to align with the medium ambition of the Commission's Impact Assessment.** This would require carmakers to make tangible reductions in ammonia pollution from cars.

[49] Provided to T&E by the SouthWestern Research Institute.
[50] CLOVE. (2021, 04, 08) LDV Exhaust; presentation to the Advisory Group on Vehicle Emission Standards.
[51] Cao H., et al. (2021) COVID-19 Lockdowns Afford the First Satellite-Based Confirmation That Vehicles Are an Under-recognized Source of Urban NH3 Pollution in Los Angeles. Environmental Science Technology Letters.

Table 3. Proposed new Euro 7 pollutant emission limits for cars

Limit (mg/km)	Euro 6	IA Low ambition (1)	IA Medium ambition (2a/3a)	IA High Ambition (2b)	Euro 7 proposal
Ammonia (NH3)	-	20	10	10	20
Methane and Nitrous Oxide (CH4+N2O)	-	-	45	20	-
Formaldehyde (HCHO)	-	-	5	5	-

The Commission's decision to regulate the potent greenhouse gas nitrous oxide (N_2O) and cancer causing formaldehyde (HCHO) for trucks and buses (table 4) but not for cars is disappointing. These pollutants are harmful to the environment and human health regardless of the source. It also contradicts the findings of the IA which under the medium ambition scenario recommends introducing a 45 mg/km combined methane and nitrous oxide limit and a 5mg/km limit for formaldehyde for cars. **T&E recommends that a 45 mg/km combined nitrous oxide and methane limit as well as a 5 mg/km formaldehyde limit is introduced for cars in line with the medium ambition of the Impact Assessment to reduce the pollution of greenhouse gasses and cancer causing chemicals from cars.**

T&E supports the introduction of methane and nitrous oxide limits for all trucks however, the separate hot limits proposed for the greenhouse gasses (350 mg/kWh for methane and 100 mg/kWh for nitrous oxide) combined exceed the 410 mg/kWh limit proposed in the medium ambition scenario of the Impact Assessment and recommended by the Commission's own experts. **T&E recommends the proposed methane and nitrous oxide limits for trucks be reduced to combined not exceed 410 mg/kWh as proposed in the medium ambition of the Impact Assessment.**

Table 4. Proposed new Euro 7 pollutant emission limits for trucks and buses. The Euro 7 proposal sets separate limits for methane and nitrous oxide, in the table the limits are presented as combined for ease of comparison.

Limit (mg/kWh)	Euro 6 diesel	IA Low ambition (1)	IA Medium ambition cold (2a/3a)	IA Medium ambition hot (2a/3a)	IA High ambition cold (2b)	IA High ambition hot (2b)	Euro 7 cold	Euro 7 hot
Methane and Nitrous Oxide (CH4+N2O)	500[52]	-	660	410	660	410	660	450
Formaldehyde (HCHO)	-	-	30	30	30	30	30	30

4. Euro 7 conditions are clear and technically feasible

It is important that on-road RDE conditions cover a wide range of driving so that compliance with emission limits can be ensured on the road. The on-road driving conditions proposed for cars and trucks are realistic and achievable, tables comparing the on-road RDE driving conditions for cars and trucks is included in Annex 2.

4.1 Cars

Unlike Euro 6, where all the details of RDE testing were worked out in secondary regulation, for Euro 7 all of the main details of on road tests are already included in the Euro 7 Regulation, meaning that there is little uncertainty for carmakers on the stringency of the testing.

The changes proposed by the Commission for on-road RDE testing for cars are limited. Under 'normal' RDE conditions the main changes are:

- There is no change in temperature or altitude testing requirements.
- Restrictions on trip dynamics, distance, trip order and share of driving on urban, rural and motorway roads are removed.
- A new 10km emission budget is introduced for the first 10km of the test. This means that for any trip 10km or shorter the emission limit is fixed at 10x the pollutant limit e.g. for NOx, 10 x 60

[52] Applies to gas engines only

mg/km = 600 mg. This makes it easier for carmakers to meet the limits when the engine is first turned on, when emissions are higher.

- Fast accelerations above 20% of maximum wheel power are not allowed during the first 2 km, making it easier to meet emission limits during the period when the engine is still warming up.
- Minimum mileage for a car to be eligible for testing is reduced from 15,000 km to 10,000 km.

Independent test data shows that Euro 6d cars driven on trips which do not comply with Euro 6 RDE trip requirements in terms of trip distance, trip order and share of driving on urban, rural and motorway roads, still meet the Euro 7 emission limits[53,54]. Restrictions on the maximum acceleration when the engine is first started also make it easier to comply with limits.

Under 'extended' boundary conditions the main changes are:

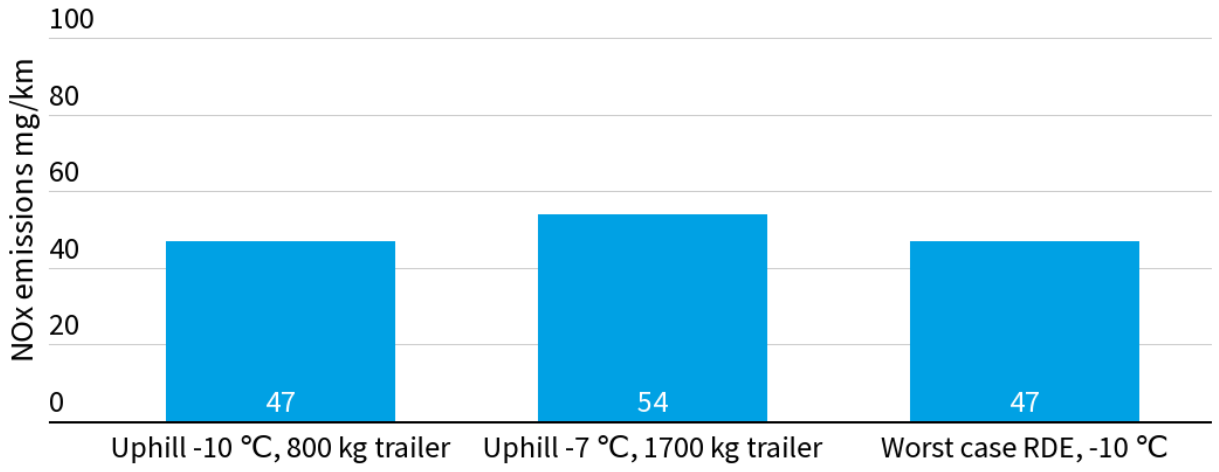
- The temperature range is extended from -7 to 35 ℃ to -10 to 45 ℃.
- The altitude boundary is increased from 1300m to 1800m.
- Trailer towing is allowed.
- Driving between 145 - 160 km is no longer limited to a maximum of 3% of the trip.
- Fast accelerations above 20% of maximum wheel power are allowed during the first 2km.
- Minimum mileage for a car to be eligible for testing is reduced from 15,000 km to 3,000km.

However, when 'extended' boundary conditions apply, emissions are divided by 1.6, making it easier for carmakers to comply with the limits. Also, only one 'extended' condition can apply at any time during the test which means that more challenging driving conditions such as towing a trailer, at -10 ℃, at altitude would not be valid for RDE testing. This makes the limits in extended boundary conditions easier to meet compared to Euro 6 as under Euro 6 any number of extended conditions could apply. Additionally, the Commission is also working on a methodology within the Euro 7 Implementing Regulation to ensure that unrealistic driving[55] which could not be carried out safely on the road will not count as a valid RDE test.

Test data from CLOVE shows that there are already Euro 6 cars on the road that can meet the requirements of Euro 7 RDE testing. Tests (fig. 4[56]) shows that a Euro 6d-temp car (which is the standard before the current Euro 6d) can meet the current Euro 7 limit even under the most challenging driving

[53] Deutsche Umwelthilfe. Table: PEMS measurements up to June 2022.
[54] FVT (2021,01,18) CO_2 and emissions performance of PHEV vehicles.
[55] European Commission. (2023, 03,16) Presentation to the Advisory Group on Vehicle Emission Standards: RDE Annex Drafting.
[56] CLOVE. (2021, 04, 27) LDV Exhaust; presentation to the Advisory Group on Vehicle Emission Standards.

conditions which are not covered by Euro 7 RDE tests (a combination of uphill driving, cold weather: -10 ℃ + 800 kg trailer towing and uphill driving, cold weather: -7 +1700 kg trailer towing), when the 1.6 divider is applied to the emission results. This means that the car can meet the proposed Euro 7 NOx limits when just one of those driving conditions applies e.g. cold weather or trailer towing as is proposed for Euro 7.



Source: CLOVE testing of Euro 6d-temp petrol car as presented to the advisory group on vehicle emission standards. Results divided by 1.6 for extended boundary conditions.

Figure 4. Emission results of a Euro 6d-temp car tested by CLOVE under a combined range of challenging driving conditions which are not allowed for Euro 7. Despite the challenging conditions the car meets the proposed Euro 7 limit.

If the medium ambition NOx limits were set, the car would have exceeded the limit by 17- 24 mg/km. **However, it should be noted that this is an older generation 6d-temp vehicle (a Euro 6d would have likely performed better) and this is measured under a combination of challenging driving conditions which is not allowed for Euro 7 testing. It is likely that if only one extended condition applied that the car would have come close to .** As such while the conditions under which cars have been tested on the road have been extended, some cars already on the road today can meet the Euro 7 limits even under very challenging driving conditions which are not allowed in Euro 7 and are likely to comply with more ambitious limits in line with the Commission's medium proposal also. Euro 6d cars which may not be compliant with the tighter limits yet, can be made so by fitting with already available technology such as larger and more efficient filters, three way catalysts, upgraded Selective Catalytic Reduction (SCR) systems and updated calibration. No changes to engine hardware is needed. Therefore, the proposed RDE testing conditions proposed are realistic and achievable. **Meeting more ambitious Euro 7 limits, aligned with the medium ambition of the Impact Assessment under the proposed Real Driving Emission driving conditions is technically feasible.**

4. 2 Trucks

For trucks the on road emission testing boundary conditions are largely aligned with the medium ambition of the Commission's Impact Assessment. As for cars only one extended on road driving test condition (such as cold temperature, altitude or low payload) can apply at any one time.

The main improvements compared to Euro 6:

- Emission limits need to be met when the engine is first started (cold start), previously cold start emissions were excluded when the engine coolant temperature was less than 30 ℃ and emission limits during this period did not have to be met.
- A payload of less than 10% is allowed under extended conditions, previously a minimum 10% payload was required.
- All engine loads are included, previously low engine load was excluded.
- All emissions are regulated, previously 10% of the highest emissions were excluded.
- Under extended conditions the temperature range is extended from -7 to 35 ℃ to -10°C to 45 °C.
- Under extended driving conditions 2 times high emission limits are applied.

This is a significant improvement compared to Euro 6 where weak provisions in points 1-4 above constituted emission loopholes for heavy-duty vehicles and resulted in on-road NOx emissions in cities which in some cases were eight times the legal limits[57]. These improvements will ensure that emission limits are also respected by trucks driving in cities, where air pollution has the highest negative impact on human health.

Meeting Euro 7 emission limits under such driving conditions for trucks is technically feasible. California has introduced a new test called the Low Load Cycle to ensure compliance under low load, low speed driving conditions such as covered by bullet points 1-3. However, California requires larger reductions in NOx pollution than required by the Euro 7 proposal[58]. Test data in fig. 3 in section 3.2.3. Shows that heavy-duty trucks fitted with new emission control technologies can meet much lower limits than proposed by the Commission for Euro 7 even under challenging driving conditions.

[57] ICCT. (2020, 11, 26) Findings from recent ICCT research on vehicle emission standards. Presentation to the Advisory Group on Vehicle Emission Standards.
[58] ICCT. (2021) ICCT's Comments and technical Recommendations on future Euro 7/VII Emission standards.

The on-road driving conditions proposed for Euro 7 trucks are achievable using available emission technology and are needed to close the loopholes in Euro 6 which in some cases result in trucks which emit eight times the legal limits on the road. The 2x emission multiplier makes it easier for truck makers to meet limits under extended boundary conditions.

5. Durability

Durability refers to the length of time and mileage for which pollutant emission limits need to be met on the road. During this period compliance with emission limits can be checked as part of Type-Approval Authority and European Commission in-service compliance and market surveillance checks.

Cars

The Euro 7 proposal increases the Euro 6 durability requirement from 5 years and 100,000km (whichever comes first) to:

- Main lifetime: 160,000 km or 8 years (whichever comes first) during this period normal emission limits apply.
- Additional lifetime: 200,000 km or 10 years (whichever comes first) during this period limits for gaseous pollutant limits are increased by 1.2 times, e.g the limit for NOx increases from 60 mg/km to 72 mg / km.

While the increase in durability limits is an improvement compared to Euro 6, it still falls far short of even the average age of cars in the EU (12 years)[59], let alone the average age of cars in Central, Southern and Eastern Europe. However, older vehicles in the fleet are not confined to those countries, 17 out of 24 eu Member States for which data is available have an average car age greater than 10 years (fig. 5) and the average lifetime of a car in Europe is 225,000 km[60]. However many cars may stay on the road much longer. Durability requirements are much higher in the U.S., requiring compliance for 240,000km or 15 years indicating that higher durability limits are technically and economically feasible.

[59] ACEA. (2023) Vehicles in use Europe 2023.
[60] European Commission. (2022, 11, 10) Euro 7 Impact Assessment Report.

Figure 5. 17 EU member States out of 24 (for which data is available) have an average passenger car age greater than the 10 year emission durability limit proposed under Euro 7[61].

[61] Adapted from: ACEA. (2023) Vehicles in use Europe 2023.

Durability requirements which fall short of the lifetime of vehicles shift the small incremental cost of having more durable emission control devices at manufacture to large repair bills for consumers when the system fails or brakes after the mandatory compliance period. The introduction of the continuous emission monitoring system in Euro 7 and planned improvements in Periodic Technical Inspections (PTI) will mean that vehicles with defective emission control systems will be easily identified and repairs will be required. To protect consumers from large repair bills, the EU should align its durability requirements of cars with those in the U.S.

For cars the durability requirement should increase from 200,000km and 10 years to 240,000 km and 15 years.

Trucks

For trucks there is only a minimal improvement in durability requirements for Euro 7.

For trucks up to 16 tonnes, durability requirements are:

- Main lifetime: 300,000 km remains unchanged from Euro 6, age limit is increased from 6 years to 8.
- Additional lifetime: An additional lifetime up to 375,000 km is introduced. During the additional 75,000 km, higher emission limits will apply. These will be set out in future secondary regulation.

This is far shorter than the 700,000 km recommended by the CLOVE consortium of experts. Eight years falls short of the average age of trucks in the EU which is 14 years and far short of the age in some Member States where the average age is as high as 23 years.

For trucks larger than 16 tonnes:

- Main lifetime: 700,000 km remains unchanged from Euro 6, maximum age increased from 7 years to 15.
- Additional lifetime: An additional lifetime up to 875,000 km is introduced. During the additional 75,000 km, higher emission limits will apply. These will be set out in future Implementing Regulation.

As for small trucks the durability requirements fall short of the lifetime of trucks particularly when it comes to mileage. The average EU large truck will drive 1.2 million km over its lifetime[62], meaning that the proposed durability requirements will cover just 72% of a truck's lifetime. California has already set stricter requirements which increase up to 1.3 million km[63] for the durability of large trucks, indicating that greater durability requirements than proposed in Euro 7 are technically and economically feasible.

[62] European Commission. (2018) HDV CO2 standards: Impact Assessment.
[63] CARB. (2021) Heavy-Duty Omnibus Regulation.

To ensure that emission limits are respected throughout the lifetime of the truck, the durability requirements for trucks smaller than 16 tonnes should be increased to 700,000 km, 15 years and for large trucks to 1.2 million km.

6. Additional Euro 7 categories

The Commission has proposed to introduce additional Euro 7 categories for vehicles:

- **Euro 7G:** Geo-fencing technology which switches the car to zero emission driving in certain geographical areas.
- **Euro 7A:** Adaptive emission technology which reduces pollution based on the expected usage of the vehicle based on e.g. a pre-programmed route in the sat-nav.
- **Euro 7+:** 20% lower gaseous emissions and 90% lower particle emissions

The introduction of additional categories in type-approval regulation has never been done before. For example cars with safety technologies beyond the minimum required are not approved under a special safety label. Introducing new categories into Euro 7 is problematic:

1) **New categories risk greenwashing highly polluting cars as 'clean'.** While the Euro 7+ category requires a 90% reduction in particle number emissions which is ambitious, the required reduction for gaseous pollutants is just 20%. Most cars sold today already emit 20% less gaseous emissions e.g. NOx than the proposed Euro 7 limit[64]. This means that the 7+ category will not encourage carmakers to make their cars less polluting, reduce pollution from cars or improve air quality. It will simply re-label Euro 6 cars as 'clean' Euro 7+.
2) **Geo-fencing technology may not reduce pollutant emissions.** Test data (fig. 6) shows that when a plug-in hybrid's internal combustion engine is turned on after a period of zero emission driving there is a large spike in pollutant emissions.

[64] CLOVE. (2021, 04, 08) LDV Exhaust: Presentation to the Advisory Group on Vehicle Emission Standards.

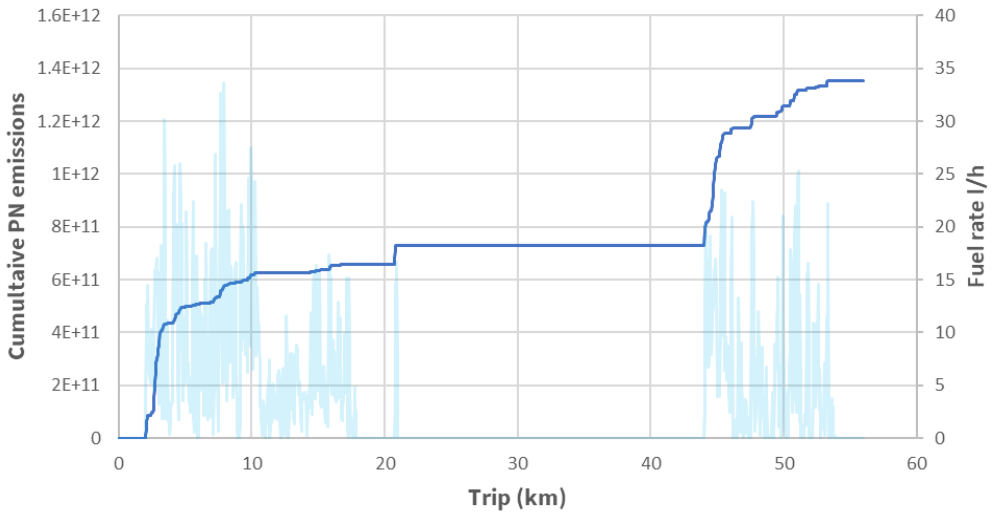


Figure 6. Particle number test data from T&E's testing of the BMW 3 series plug-in hybrid. There is a large spike in particle emissions when the engine is turned on after a period of zero emission driving[65].

Test data from the European Commission's Joint Research Center[66] shows that spikes in pollution from the ignition of the ICE can be so large that they cancel out the pollution savings from periods of zero emission driving and result in overall emissions of PHEVs being the same or more than conventional ICE's. Any advantage from zero emission driving for particle emissions[67] were found to cancel out in as little as 70 seconds of driving. This means that geo-fencing technology is unlikely to reduce pollution from ICE's.

Use of geo-fencing technology is more likely to simply shift pollution to outside of geo-fenced zones. Additionally, if a lot of cars with geo-fencing technology switch on their engine just outside of a geo-fenced area (on the limited number of roads leading in and out of such zones) then air quality may be negatively impacted just outside of the geo-fenced zones.

3) **Use of Geo-fencing technology may increase internal combustion engine use overall.** T&E's testing[68] of BMW's geo-fencing technology showed that the plug-in hybrid saved battery charge in case of entry into a geo-fenced area. This resulted in the PHEV using the internal combustion engine more than needed when driving on roads outside of the geo-fenced area. Widespread use of geo-fencing technology on PHEVs may result in increased ICE use and higher CO_2 emissions.

4) **The geo-fencing category could be misleading since PHEVs can't be driven in zero emission mode continuously[69].** Independent tests have shown that some PHEVs can't drive zero emission

[65] Data from testing reported in: T&E. (2022) Plug-in hybrids 2.0: A dangerous distraction, not a climate solution.
[66] Melas A.. et al.. (2022) On-road and laboratory emissions from three gasoline plug-in hybrid vehicles-Part 2: Solid Particle Number Emissions. *Energies*.
[67] Particle number emissions.
[68] T&E. (2020) Plug-in hybrids 2.0: A dangerous distraction, not a climate solution.
[69] ICCT (2021) Plug-in hybrid vehicle CO_2 Emissions: How they are affected by ambient conditions and driver mode selection.

in cold weather[70] so PHEVs may not be able to maintain their geo-fencing capabilities through the winter. Manuals also state that many PHEVs (most likely all) have to periodically turn on the ICE to maintain the engine and prevent fuel degradation. For example the manual for the Renault Captur PHEV states that if the car is not refilled with at least 10 litres of petrol every three months the ICE will come on automatically. In this case the car then has to be driven using the ICE long enough to reduce the fuel level in the tank by half and the tank must then be topped up with a minimum of ten liters of fuel[71]. This means that those consumers who drive in geo-fenced areas will have to drive unnecessary miles outside of them in order for the engine to be maintained, increasing CO2 emissions.

5) **They are likely to be confusing for consumers.** A Euro 7 car can be type-approved under multiple categories but a Euro 7AG+ car will mean little to the average buyer. Equally, the EU 7 regulation does not specify where adaptive or geo-fencing technology have to be operational. Consumers could pay a premium for a Euro 7G or Euro 7A car, but not be aware that the technology does function in the city or area in which they live or drive. For example BMW's geo-fencing technology only works in 138 cities in Europe[72] and there is no information publicly available on which areas of the city the geo-fencing technology actually covers.

6) **They are not technically necessary.** Additional categories are not necessary for carmakers to fit the technology to their vehicles or for Type-Approval Authorities or the European Commission to check if the technology functions correctly at Type-Approval or during in-service conformity or market surveillance activities.

Instead of the introduction of new, additional, confusing categories in Euro 7, which are unlikely to reduce pollution and go directly against the Commission's objective of simplifying the Euro standards, **automakers who fit geo-fencing or adaptive emission control technologies to their vehicles should sign a declaration during type-approval outlining the conditions and geographical areas under which the technology operates** for each vehicle model to which the technology is fitted. This information can also be added to the Environmental Vehicle Passport (EVP), providing consumers with the necessary information to understand how and when the technology works. This approach would allow Member State Type-Approval Authorities and the European Commission to check if such systems are functioning as declared and consumers will receive the information necessary on the functioning of the technology. **This is sufficient to ensure that the technology and associated claims are adequately regulated in the EU.**

T&E recommends that additional categories are removed from Euro 7 as it is confusing for consumers and is unlikely to reduce pollution. Instead carmakers should sign a declaration at

[70] ICCT (2021) Plug-in hybrid vehicle CO_2 Emissions: How they are affected by ambient conditions and driver mode selection.
[71] https://gb.e-guide.renault.com/eng/Captur-2/E-TECH-Plug-Hybrid. Accessed October 2022.
[72] BMW (2021,11,25) Emission-free city centers: BMW eDrive Zones now available in 138 European cities.

type-approval outlining how and when the adaptive or geo-fencing technology is operational so that compliance can be verified at type-approval and throughout the lifetime of the vehicle.

7. Non- exhaust pollution

T&E welcomes the proposed regulation of non-exhaust particle emissions from brakes and tyres for cars and vans within the Euro 7 regulation.

7.1 Brakes

Break wear is the leading source of non-exhaust particles which are harmful to human health due to their small size[73]. The Euro 7 proposal sets the following brake particle pollution limits:

1) 7 mg/km limit until 2035
2) 3 mg/km limit from 2025

While T&E supports the introduction of a brake particle limit, the 7 mg/km limit applicable until 2035 is weak, requiring only a 40% reduction in particle emissions compared to the average brake emissions from cars today (11 mg/km). This is far short of the minimum 85% reduction that the best available technology (brake particle filters) can deliver[74].

Brake particle filters are an affordable solution to reduce brake particle emissions to the minimum. For a PHEV or HEV they cost around €77 extra per car compared to improved brake pads (which are needed to meet 7mg /km limit)[75] . For regular ICE cars the additional cost compared to better brake pads is €62 for the car. The cost of maintenance is also low, requiring only occasional filter changes at a cost of €1-€2[76]. In contrast consumers will be required to spend an additional €23-€38 everytime brake pads are replaced which could be every 48,000 to 56,000km when driving in cities[77].

Brake particle filters ensure lifetime compliance as they function throughout the lifetime of the vehicle. With brake pads on the other hand there is no guarantee that the correct replacement brake pads will be fitted when replaced and there is no way to check this during Periodic Technical Inspections (PTI). This could result in poorly performing replacement brake pads being fitted as occurs with replacement

[73] European Commission. (2022) Euro 7 Impact Assessment.
[74] European Commission. (2022) Euro 7 Impact Assessment.
[75] Based on a forecast brake particle filter mass production price of €100 obtained from manufacturers and a brake pad price for PHEV and BEV of €23 for PHEV and BEV and €38 for MHEV and ICE (European Commission. (2022) Euro 7 Impact Assessment).
[76] Information provided directly from the brake vacuum manufacturer.
[77] Bridgestone. (2021, 04 ,01) When to Replace Brake Pads

emission control systems[78]. This means that brake limits may only be met on the road for 25% of a car's lifetime[79] .

T&E recommends that the 3 mg/km particle limit applicable for brakes from 2035 is brought forward to 2025 to ensure that the most effective technology for reducing brake emissions is fitted to all cars as soon as possible so that brake particle pollution is reduced to minimal levels already in the 2020's.

7.2 Tyres

Particle pollution from tyre's constitutes a growing share of particle pollution from vehicles. This source of particle pollution is not only an air quality problem, tyres are also a leading source of microplastics. Its estimated that 450,000 tonnes of microplastics are released from EU tyres every year[80], equivalent to 23 billion soft drink bottles[81]. A third of microplastics released by tyres end up in the world's oceans[82] and there is increasing concern on the impact of microplastic pollution on human health with studies showing that humans inhale and ingest thousands to millions of microplastic particles every day[83]. Microplastics have been found throughout the human body including the lungs[84], blood[85] and placentas of pregnant women[86] and have been shown to cause damage to human cells[87].

Generally, heavier cars produce more tyre particles[88] and the EU car fleet has been getting heavier with the continued growth in the size of cars and the growing share of large SUV's sold, which reached 50% of new EU car sales in 2022 (fig. 7). If this trend continues, pollution from tyres is likely to continue to increase unless less action is taken to reduce this source of air and microplastic pollution.

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[78] TUV Nord. (2015) Examination of the emission behavior of various replacement catalytic converters with and without the "Blue Angel" quality seal when new and after aging in accordance with the RAL-UZ184 Basic Award Criteria.

[79] Based on brake pad durability of 56,000 km (Bridgestone. (2021, 04 ,01) When to Replace Brake Pads) and a car lifetime of 225,000 km (T&E. (2022) How clean are electric cars?

[80] Cost-benefit analysis of policy measures reducing unintentional release of microplastics: stakeholder workshop (2022, 21, 03).

[81] Calculated based on a bottle weight of 19.9g. Bottle weight source: Coca-Cola (2022, 05, 16) We're saving 6,800 tonnes of plastic per year by introducing new lighter weight necks for carbonated soft drink bottles.

[82] Evangeliou, N., et al. (2020) Atmospheric transport is a major pathway of microplastics to remote regions. *Nature Communications*.

[83] Kannan K., Vimalkumar K. (2021) A Review of Human Exposure to Microplastics and Insights Into Microplastics as Obesogens. *Frontiers in Endocrinology.*

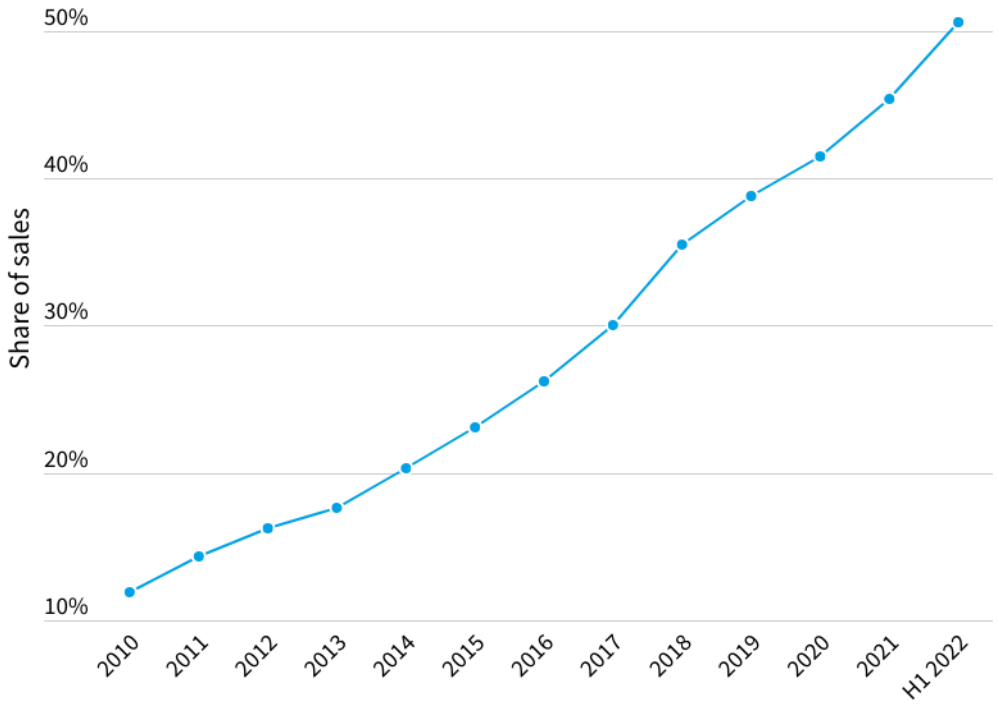
[84] Lauren C. Jenner., et al. (2022) Detection of microplastics in human lung tissue using μFTIR spectroscopy. *Science of The Total Environment*.

[85] Heather A. L., et al. (2022) Discovery and quantification of plastic particle pollution in human blood. *Environment International*.

[86] Antonio R., et al.(2021) Plasticenta: First evidence of microplastics in human placenta. *Environment International*.

[87] Evangelos D., et al. (2021) A rapid review and meta-regression analyses of the toxicological impacts of microplastic exposure in human cells. *Journal of Hazardous Materials*.

[88] ADAC. (2022) Tyre wear particles in the environment.



Source: EEA registration data (2010-2021) and Dataforce (H1 2022)

Figure 7. Share of SUVs in new car sales in the EU. More than 50% of car sales are now large SUVs.

On-road tests by ADAC[89] show that there is a big difference in the pollution performance of tyres on the market. The least polluting brand's tyres produced an average of 95 mg /km particle pollution, the worst brand's almost 50% more (136 mg/km). While particle emissions vary depending on a range of factors including tyre size or if the tyre is designed for summer or winter use, there is a big difference between the most and least polluting tyres. The least polluting produce 59 mg/km of particles, the worst 171 mg/km. This suggests that it will be possible to optimize future tyre particle emission limits at a level which minimizes pollution while maintaining the safety characteristics of the tyres.

While T&E welcomes the proposed delegation of power in Euro 7 to the Commission to propose future secondary regulation on tyre pollution, setting out both measurement methods and limits, policymakers must ensure that the regulation on tyre pollution is proposed as soon as possible. At present there is no binding timeline for the proposal within Euro 7 and with the majority of the work at UN level, there is a risk that the proposal may be unreasonably delayed. To reduce this risk, **T&E recommends that policymakers include a binding commitment within Euro 7 for the Commission to propose a regulation on tyre pollution by the end of 2024 at the latest**.

[89] ADAC. (2022) Tyre wear particles in the environment.

8. Battery durability

T&E welcomes the introduction of EV battery durability requirements within the Euro 7 regulation, supplemented with dashboard battery status for the driver as well as in-service conformity and market surveillance testing which is essential for ensuring in use compliance. Battery durability requirements are essential for sustainability and for bolstering consumer trust in EV technology, particularly in the second hand market. If ambitious, battery durability standards can also drive battery innovation.

However, the battery durability requirements proposed by the Commission for Euro 7 are weak and do not go beyond what batteries in EVs can already achieve today. The requirement proposed by the Commission of 80% maximum battery capacity after 5 years and 70% after 8 years or 160,000km **do not go beyond the battery warranties already offered for cars.** Warranties of 70% after 8 years or 160,000km are already the most common on the market[90] and offered by the majority of carmakers. Even on smaller, cheaper BEVs such as the Peugeot 208[91], Fiat 500e or Renault Zoe[92], this is the level of cover offered.

The proposed requirements for light commercial vehicles i.e. vans are even weaker, requiring only 75% capacity after 5 years and 65% capacity after 8 years. Yet for **electric vans on the market, battery warranties on offer are already higher than the battery durability requirements proposed by the Commission and aligned with those offered for cars.** As examples, the Renault Master and Kangoo E-Tech vans offers a minimum guarantee of 70% capacity for 8 years, 160,000km[93] as does Peugeot's e-Boxer[94], e-expert[95], e-partner[96] and Marcedes' E-Sprinter[97].

Setting Euro 7 battery durability thresholds at a level which is already achieved by the majority of BEV cars sold today and for vans at a level which is lower than already offered as part many BEV van's warranties will fail to drive innovation and progress in the segment. It risks European carmakers falling behind in the global electrification race as other key automotive markets set more ambitious standards. Already from 2026 California has stronger durability standards than proposed for Euro 7 with a minimum of 70% charge after 10 years or 240,000km. This increases to 80% in 2030[98].

[90] UNGTR. (02,04,2022) Addendum 22: United Nations Global Technical Regulation No. 22.
[91] www.peugeot.fr/electrique-et-hybride/rouler-en-electrique/technologie-electrique.html Accessed 02/02/2023
[92] Autobild. (2021, 07, 08) This is how long the manufacturer's guarantee for e-car batteries is valid.
[93] Renault E-Tech electric warranty terms & conditions for all models registered from 1st of August 2022. Available on the higher battery capacity 45kW Kangoon and 53kW Master.
[94] Stellantis. (2021) Peugeot launches e-boxer van in the UK.
[95] Peugeot. (2017) Next generation van: All-new Peugeot e-expert.
[96] Peugeot. (2022, 10, 05) Peugeot partner & e-partner van, prices and technical specifications, model year-23.
[97] www.greencarguide.co.uk/blog/mercedes-benz-esprinter-electric-panel-van-review. Accessed 02/02/2023
[98] CARB. (2022, 08, 25) California moves to accelerate to 100% new zero-emission vehicle sales by 2025.

To ensure that EU carmakers and suppliers are leaders in the global EV race, and to increase consumer trust in EV technology **T&E recommends that Euro 7 battery durability requirements for cars and vans are aligned with the requirements set in California:**

- **2025-2029: Minimum 70% charge after 10 years, 240,000 km.**
- **2030: Minimum 70% charge after 10 years, 240,000 km.**

Additionally, to align with the Commission's Euro 7 proposal and to facilitate easier in service conformity and market surveillance testing earlier in the vehicles life the 5 year battery durability requirement should be set to:

- **2026-2029: 85%**
- **2030+: 90%**

9. Conclusion

The European Commission's proposal for cars fails to reduce pollution limits beyond the Euro 6 limits set for petrol cars 15 years ago and does not take into account the technological leaps that have taken place in emission control since the Euro 6 standard was set. This is disappointing given that more ambitious emission limits (in line with the findings of the Commission's Impact Assessment) are available with improvements to today's exhaust emission control technology for an affordable €300 per car. Crucially with no new engines, or updated to engine hardware needed. Such a Euro 7 would reduce NOx by an additional 42% by 2035, 62% in 2040 and 88% in 2050 compared to keeping the Euro 6 emission standard along with the increased rate of electrification from the revised car CO_2 standards.

The potential allowance of the sale of e-fuel ICE powered cars after 2035[99] - subject to upcoming legislative debate - means that the EU might no longer be on a trajectory to completely eliminate tailpipe pollution from cars. This makes reducing pollution from ICE vehicles at the source all the more urgent, **to improve the Euro 7 proposal for cars policymakers as a priority should:**

- **Reduce pollution limits in line with findings of the Commission's Impact Assessment, setting limits of 30 mg/km for NOx and 1x10^{11}/ km for particles.** These standards are already met by around half of today's cars tested but stricter limits are needed to ensure all cars are less polluting.
- **Increase the requirement to comply with limits to 240,000 km/15 years to cover the entire lifetime of cars on EU roads**. This will provide simplification and alignment to standards in the U.S.

[99] T&E. (2023) T&E reaction to the EU and German deal on 2035 zero-emissions car law.

- **Remove additional Euro 7 categories such as geo-fencing and Euro 7+ which are confusing and unnecessary.**
- **Set brake particle limits at 3 mg/km from the first implementation of Euro 7** to align with what the best European technology can deliver.
- **Commit the Commission to proposing a new regulation for tyre particle pollution, including the testing methodology and limits by not later than the end of 2024,** to ensure that reduction of air and microplastic pollution from tyres is not unnecessarily delayed.

For trucks and buses, the European Commission has largely followed its Impact Assessment, proposing a Euro 7 which is a significant improvement compared to Euro 6. However, with no phase out for heavy-duty internal combustion engines agreed and other key automotive markets such as the U.S. forging ahead with more ambitious heavy-duty pollution standards, the EU risks accepting sub-optimal emission control technologies and losing technical leadership. To bring Euro 7 standards into closer alignment with other markets, policymakers should:

- **Reduce the NOx limit for when the engine is first started from 350 mg/kWh to 175 mg/kWh** to more closely align with key automotive markets.
- **Increase the requirement to comply with limits to 700,000 km and 15 years for small trucks and 1.2 million km for large trucks** to cover their entire lifetime.
- **Reduce the particle number and greenhouse gas emission limits to align with the findings of the Impact Assessmen**t, setting the PN limit at $1x10^{11}$/km and the GHG limit to 410 mg/kWh.

The Euro 7 requirements for car and truck makers are clear. Now Parliament and Council must progress with strengthening the ambition of the Euro 7 proposal. The technology to do so is available and affordable. At a time when European carmakers are making record profits[100], the EU must ensure that the health of European citizens comes first by delivering a robust Euro 7 standard which slashes pollution and improves air quality in towns and cities across Europe.

[100] T&E. (2023)EURO 7: Carmakers' record profits made at expense of human health.

Annex 1

3x WHTC budget for heavy-duty vehicles

Limit (mg/kWh)	Euro 7 (proposal)
NOx	150
PM	10
PN (#/km)	$3x10^{11}$
CO	2700
NMOG	75
NH3	70
CH4	500
N2O	140

Annex 2:

Comparison of RDE testing requirements for light-duty vehicles:

Parameter	Euro 6 RDE boundaries	Euro 7 (PO 2a + 3a)	Euro 7 (PO 2b)	Euro 7 (proposal)
Extended driving Multiplier	1.6x higher emissions allowed for whole test	2x higher emissions allowed when extended condition applies	3x higher emissions when extended condition applies	1.6x higher emissions when extended condition applies

Temperature (℃)	Normal: 0 –30 ℃ | Extended: -7 –0 ℃ & 30 –35 ℃	Normal:-7 to 35 ℃ Extended: -10°C to -7°C or 35°C to 45°C	Normal:-7 to 35 ℃ Extended: -10°C to -7°C or 35°C to 45°C	Normal: 0 to 35 ℃ Extended: -10°C to 0°C or 35°C to 45°C
Maximum altitude (m)	Normal: 0 –700 m | Extended: 700 –1300 m	Normal:1300 m Extended: 1300 - 1800 m	Normal: 1600 m Extended: 2200 m	Normal: 700m Extended: 700 - 1800 m
Elevation gain	<1,200 m per 100km	No limit		
Maximum Speed(km/h)	145 km/h with < 3% motorway time minutes at 160 km/h	Normal : 145 km/h Extended: 145 km/h -160 km/h	Up to 160 km/h Extended: above 160 km/h	Normal : 145 km/h Extended: 145 km/h -160 km/h
Trip distance (km)	Min. 16km in each segment (urban, rural, motorway), restrictions on trip composition	Any trip, normal limits for tests longer than 10 km (budget approach for trips less than 10 km)	Any trip, normal limits for tests longer than 10 km (budget approach for trips less than 10 km)	Any
Driving dynamics	Restrictions on acceleration	Normal: As in Euro 6 Extended: Any but extreme driving prohibited	Normal: Restriction first 2km Extended: Any but extreme driving prohibited	
Towing/ aerodynamic modifications	Not allowed	Normal: Not allowed Extended: Allowed according to specification of OEM and up to	Normal:Not allowed Extended: Allowed	Normal: Not allowed Extended: Allowed according to specification of OEM and up to

		the regulated speed		the regulated speed
Minimum mileage before testing	15,000 km	Normal: 10,000 km Extended: 3,000 km	Normal: 3,000km Extended: 300 km	Normal: 10,000 km Extended: 3,000 -10,000 km

Comparison of on-road testing requirements for heavy-duty vehicles:

Parameter	Euro VI boundaries	Euro 7 (PO 2a + 3a)	Euro 7 (PO 2b)	Euro 7 (proposal)
Extended driving Multiplier		2x higher emissions when extended condition applies	2x higher emissions when extended condition applies	2x higher emissions when extended condition applies
Temperature (℃)	Normal: -7 to 35 ℃	Normal: -7 to 35 ℃ Extended: -10°C to -7°C or 35°C to 45°C	Normal: -7 to 35 ℃ Extended: -10°C to -7°C or 35°C to 45°C	Normal: -7 to 35 ℃ Extended: -10°C to -7°C or 35°C to 45°C
Cold start	Not included when coolant is <30 °C	Included	Included	Included
Maximum altitude (m)	1600	Normal: 1600 m Extended: 1 600 to 1 800m	Normal: 1600 m Extended: 1 600 to 2200 m	Normal: 1600 m Extended: 1 600 to 1 800m
Auxiliaries	None	As per normal use	As per normal use	As per normal use
Min trip (kWH)	4x laboratory WHTC test	Any (for MAW evaluation 4× WHTC) Extended: Any	Any (for MAW evaluation 4× WHTC)	Any (for MAW evaluation 4× WHTC)
Payload	10-100%	Normal: > 10% Extended: < 10%	Any	Normal: > 10% Extended: < 10%

Engine load (kW/kW_{rated})	>10% per window	All	All	All
Windows	90% below the limit	90% with lower limit +100% with higher limit	90% with lower limit +100% with higher limit	90% with lower limit +100% with higher limit
Minimum mileage before testing	15,000 km	Normal: 5,000 km for <16 t, 10,000 >16 t Extended: 3,000 km	Normal: 3,000 km for <16 t, 6,000 >16 t Extended: 300 km <16t, 6,000 >16t	5 000 km for <16t TPMLM 10 000 km for > 16t TPMLM Extended: Between 3 000 km and 5 000 km for <16t TPMLM Between 3 000 km and 10 000 km for > 16t TPMLM

Further information

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