

Euro 7 emission standard: development

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Road Transport and Air Quality

- EEA estimates 400 000 premature deaths in 2019 due to air pollution in Europe
- Road transport major contributor* especially in cities
- Respiratory illnesses are reason number one for medical treatments in Europe
- Urban Access Restrictions of vehicles with internal combustion engines is a measure to combat pollution linked with traffic
- Low and Zero Emission Zones all over Europe



In 2019: 39% of NOx and 11% of PM2.5 from road transport in Europe



The European Green Deal





European Green Deal and Emission standards for cars (EURO 7)





The European Green Deal



- Strategy for Sustainable and smart mobility
- Revise the CO2 emissions performance legislation for light duty vehicles by June 2021
- Extend EU's Emissions Trading to the maritime sector, and to reduce the free allowances for airlines by June 2021
- Support public charging points: 1 million by 2025
- Boost the production and supply of sustainable alternative fuels for the different transport modes
- Review the Alternative Fuels Infrastructure Directive and the TEN-T Regulation in 2021
- More stringent air pollutant emissions standards for combustionengine vehicles (EURO 7)

The EU as a global leader Accelerating the shift to sustainable and smart mobility

A European Climate Pact



The European Green Deal



European Commission



Fit for 55

- To translate the EU's increased climate ambition into action, the Commission proposed on 14 July 2021 a Fit for 55 policy package, with several elements directly effecting the transition towards zero-emission mobility.
- The stronger CO₂ emission standards for cars and vans will accelerate the transition to zero-emission mobility by requiring average emissions of new cars to come down by 55% from 2030 and 100% from 2035 compared to 2021 levels. As a result, all new cars registered as of 2035 will be zero-emission.
- Political will from both Parliament and Council to reach an agreement soon.



Progress of electrification in Europe

- New proposal for zero emission passenger cars and vans by 2035 in Europe provided a big push towards electrification
- Big surge in demand of electrified vehicles during the last years
- In 2050: around 20% of cars/vans and 65% of buses/lorries expected to still use an internal combustion engine and emit harmful pollutants from their tailpipes

QUARTER 4 FULL-YEAR

New passenger car registrations in the EU by alternative fuel type



Data from ACEA



Euro 7 development process

Development began with a Stakeholder meeting in October 2018*



- 11 Stakeholder meetings in 2019-2022 with more than 250 participants**
- Included in Commission Work Programme 2021
- Adoption planed for 12 October 2022

* https://ec.europa.eu/growth/content/stakeholder-event-preparing-future-european-emission-standards-light-and-heavy-duty-vehicles_en

** For more info on the development process:

https://circabc.europa.eu/ui/group/f57c2059-ef63-4baf-b793-015e46f70421/library/6325a200-9d24-40fc-8fef-ba1fe4da9702



Independent Scientific Advice

- 5 studies from CLOVE consortium
- All major research groups on this issue in Europe involved
- Support by demonstrators
- JRC testing and advice
- Extensive database of measurements
- Modelling for assessment of technologies and impact assessment
- Thousand of studies, scientific papers, position papers consulted



Euro 7 guiding principles

- Proper functioning of internal market
- One Regulation for both light and heavy duty vehicles
- Reduce complexity and compliance costs
- Improve air quality by limiting pollutants at the source, with particular emphasis in urban areas
- Updated emission limits for all relevant pollutants
- Ensure compliance throughout lifetime of vehicle and wide conditions of use
- Exact levels, pollutants, etc. will only be made public during the adoption date



Euro 7 potential technologies



High emissions events/conditions	Technologies to tackle emissions
Cold start – short trips	Heating systems (EHC, burner) with pre-heating functionality and secondary air injection
Low ambient temperature	Heating systems (EHC, burner) for keeping the aftertreatment system warm
Idling, low load driving	Heating systems (EHC, burner) for keeping the aftertreatment system warm
High engine power	Larger aftertreatment systems to manage higher exhaust gas flow
Particle filter regeneration	Optimized filter with high filtration efficiency from the clean state
NO _x emissions from diesel vehicles	Twin urea injection with close-coupled SCR
PN emissions from vehicles w/o filter	Application of particle filters in all types, e.g. gasoline PFI, CNG
NH ₃ emissions from gasoline vehicles	$\rm NH_3$ oxidation catalyst (ASC/CUC) in gasoline vehicles with secondary air injection
	Study on post-EURO 6/VI emission standards in Europe

Technology packages LDV Gasoline 1/2



		Gasoline	
Short name	Technologies/components integrated		
G1 – Base 2020	Base TWC, base GPF		TWC GPF
G2 – Base 2025 opt	Advanced calibration, larger TWC, improved GPF		→ TWC GPF
G3 – MHEV Base 2020	Mild hybrid, base TWC, base GPF		TWC GPF
G4 – MHEV 2025 opt	Mild hybrid, advanced calibration, larger TWC, improved GPF		
G5 – MHEV 2025 opt e-cat	Mild hybrid, advanced calibration, larger TWC, improved GPF, 4kW EHC		AECC demo
G6 – MHEV 2025 opt e-cat 10s	Mild hybrid, advanced calibration, larger TWC, improved GPF, 4kW EHC, 10s preheating, secondary air injection, CUC (NH ₃ catalyst)		
G7 – MHEV 2025 opt burner 10s	Mild hybrid, advanced calibration, larger TWC, improved GPF, 15kW fuel burner, 10s preheating, secondary air injection, CUC (NH ₃ catalyst)		TWC GPF

Technology packages LDV Gasoline 2/2



		Gasoline
Short name	Technologies/components integrated	
G8 – PHEV Base 2020	Plugin hybrid, base TWC, base GPF	
G9 – PHEV 2025 opt	Plugin hybrid, advanced calibration, larger TWC, improved GPF	
G10 – PHEV 2025 opt e-cat	Plugin hybrid, advanced calibration, larger TWC, improved GPF, 4kW EHC	
G11 – PHEV 2025 opt e-cat 60s	Plugin hybrid, advanced calibration, larger TWC, improved GPF, 4kW EHC, 60s preheating, secondary air injection, CUC (NH ₃ catalyst)	
G12 – PHEV 2025 opt burner 30s	Plugin hybrid, advanced calibration, larger TWC, improved GPF, 15kW fuel burner, 30s preheating, secondary air injection, CUC (NH ₃ catalyst)	₩
G13 – PHEV 2025 opt e-cat 60s 8kW	Plugin hybrid, advanced calibration, larger TWC, improved GPF, 8kW EHC, 60s preheating, secondary air injection, CUC (NH ₃ catalyst), passive SCR, LNT	TWC GPF LNT, pSCR, CUC

Study on post-EURO 0/VI emission standards in Europe

Technology packages LDV Diesel



		Diesel	
Short name	Technologies integrated		AFCC demo
D1 – MHEV P0 2025 opt	Mild hybrid, advanced heating calibration, larger EATS		→ LNT SDPF USCR S
D2 – MHEV P0 2025 opt e-cat	Mild hybrid, advanced heating calibration, larger EATS, EHC		→ LNT SDPF USCR SPF
D3 – MHEV P0 2025 opt e-cat preheating	Mild hybrid, advanced heating calibration, larger EATS, EHC, preheating, secondary air injection		LNT SDPF USCR
D4 – PHEV P2 2025 opt	Plugin hybrid, advanced heating calibration, larger EATS		→ LNT SDPF USCR SPF
D5 – PHEV P2 2025 opt e-cat	Plugin hybrid, advanced heating calibration, larger EATS, EHC, turbine bypass	Turbine bypass	

Study on post-EURO 6/VI emission standards in Europe

Technology packages HDV



Technolo	gy scenarios considered	Description
HD0	Average EU VI D	With and without EGR, DOC, DPF and SCR in EATS box
HD1	Best NOx performing EU VI D	Good thermal management, EGR, DOC, DPF and SCR in EATS box
HD2	Optimised diesel with cc SCR	Close couple DOC & deNOx + twin AdBlue dosing, ca. 6.5 : 1 = EATS : engine volumes: NOX DNOX stardard NOX (+ NH3) T T T T T T T T PM Close to engine layout Source: Bosch Under floor layout Engines: hot and cold EGR, low raw NOx during cold starts (<2g/kWh), optimized thermal management, improved turbo-charging, fuel-injection,
HD3	Optimised diesel with cc SCR and pre heating of EATS	= HD 2 + pre heating with diesel burner (5 minutes at 60kW for 330kW engine)
HL2	Optimised LNG HPDI engine	LNG CI engine with diesel ignition injection; emission control technology similar to HD2
HC2	Optimised SI CNG engine	Stoichiometric CNG engine with additional close coupled 3WC and GPF, optimised Lambda control, low lube oil losses,
HD4	Optimised diesel full hybrid with cc SCR and pre heating of EATS	= HD3 + full hybrid (optional electric pre heating instead of diesel burner)

Study on post-EURO 6/VI emission standards in Europe

Durability

- As motor vehicles become more durable, the age of the EU fleet increases
- Current durability of 5 years for cars covers less than 42% of the average lifetime in EU
- And less than 29% of the average lifetime in Greece

Average age of the EU fleet

BY VEHICLE TYPE, IN YEARS / 2018 - 2020



Euro 7 Impact Assessment

- Submitted on 7 July 2021
- Negative opinion on 9 July 2021 (in order to redo calculations with Fit for 55 package proposals, i.e. ZEV for cars/vans by 2035)
- IA was recalculated with new fleet previsions and slightly adapted options to account for the cars/vans ZEV mandate
- Reassessed by RSB with positive outcome on 26 January 2022



Policy options evaluated in IA

	Euro 6/VI	PO1 – Low Zero- Pollution Ambition	PO2a – Medium Zero- Pollution Ambition	PO2b – High Zero- Pollution Ambition	PO3a – PO2a and Medium Digital Ambition
Simplification	-	Simplification measures	Simplification measures	Simplification measures	Simplification measures
Emission Limits	Euro 6/VI (60/80 mg/km NO _x)	Euro 6/VI (60 mg/km NO _x ,)	Medium Ambition (30 mg/km NO _X ,)	High Ambition (20 mg/km NO _X ,)	Medium Ambition (30 mg/km NO _X ,)
Boundaries	Euro 6/VI (RDE)	Low ambition of boundaries	Medium ambition of boundaries	High ambition of boundaries	Medium ambition of boundaries
Durability	Euro 6/VI (100 000 km/ 5 years)	Low Increase (160 000 km/ 8 years)	Average Increase 200.000 km/ 10 years*	Full Increase 240.000 km/ 15 years**	Average Increase 200.000 km/ 10 years*
Brake emissions LDV	-	-	Improved brake pads (7 mg/km)	Brake filters (5 mg/km)	Improved brake pads (7 mg/km)
On-Board Monitoring	-	-	-	-	NOx, NH3 and PM diagnostics with available sensors

* For N2, N3<16t, M3<7.5t: up to 375.000 km For N3>16t, M3>7.5t: up to 875.000 km

** For N2, N3<16t, M3<7.5t: Up to 450.000 km For N3>16t, M3>7.5t: Up to 1.050.000 km



Cars and Vans: evaluated emission limits

Euro 6 limits	Gasoline vehicles			Diesel vehicles		
(mg/km)	Cars	Small vans	Large vans	Cars	Small vans	Large vans
NO _x	60	75	82	80	105	125
PM	4,5	4,5	4,5	4,5	4,5	4,5
PN (#/km)*	6 x 10 ¹¹					
CO	1000	1810	2270	500	630	740
THC	100	130	160	-	-	-
NMHC	68	90	108	-	-	-
THC+NOx	-	-	-	170	195	215
Evaporative	2g/test	2g/test	2g/test			

*Only for GDI, not PFI

Evaluated emission limits Lower Option	Cars	Small vans	Large vans
NO _x	60	75	82
РМ	4.5	4.5	4.5
PN (#/km)	6×10 ¹¹	6×10 ¹¹	6×10 ¹¹
CO	500	630	740
THC	100	130	160
NMHC	68	90	108
THC+NOx	20	20	20
Evaporative	2 g/test	2 g/test	2 g/test



Cars and Vans: evaluated emission limits

Evaluated emission limits Medium Option	Cars and vans	Large vans if underpowered
NO _x	30	45
РМ	2	2
PN _{>10nm} (#/km)	1×10 ¹¹	1x10 ¹¹
CO	400	600
NMOG	45	45
NH ₃	10	10
N ₂ O+CH4	45	55
НСНО	5	10
Evaporative	0,5 g/test+ORVR	0,7 g/test+ORVR
Brake emissions	7	7
Battery Durability in 5/8 years	80/70%	80/70%

Evaluated emission limits Stricter Option	Cars and vans	Large vans if underpowered
NO _x	20	30
PM	2	2
PN _{>10nm} (#/km)	1×10 ¹¹	1×10 ¹¹
CO	400	600
NMOG	25	25
NH ₃	10	10
N ₂ O+CH4	20	25
НСНО	5	10
Evaporative	0.3 g/worst diurnal test + ORVR	0.5 g/worst diurnal test + ORVR
Brake emissions	5	5
Battery Durability in 5/8 years	90/80%	90/80%

Evaluated Boundaries options (LDV)

Parameter	Current RDE boundaries	Low Ambition Normal	Low Ambition Extended	Medium Ambition Normal	Medium Ambition Extended	High Ambition Normal	High Ambition Extended
Limit multiplier			4		2		3
Ambient temperature [°C]	Moderate: 0 – 30°C Extended: -7 – 0°C & 30 – 35°C	-7°C to 35°C	-10°C to 45°C	-7°C to 35°C	-10°C to 45°C	-7°C to 35°C	-10°C to 45°C
Max. speed	145 km/h	145 km/h	160 km/h	145 km/h	160 km/h	160 km/h	Above 160 km/h
Aggressiveness	Speed-based calculated maximum limits	As in RDE	Outside RDE	Restriction to the average power at cold start	Higher average power at cold start	Restriction to the average power at cold start	Higher average power at cold start
Max. altitude	Moderate: 0 – 700m Extended: 700 – 1300m	1300 m	1600 m	1300 m	1800 m	1600 m	2200 m
Trip composition/ distance	33% urban, 33% rural, 33% highway at least 16 km each	Any trip more than 10 km	-	Any	-	Any	-
Towing/aerodyn amic modifications	Not included	Not allowed	Allowed within OEM limits and specs	Not allowed	Allowed within OEM weight limits and specs	Not allowed	Allowed within OEM weight limits and specs
Minimum mileage	15,000 km	10,000 km	-	10,000 km	Between 3,000 and 10,000 km	3,000 km	Between 300 and 3,000 km

Lorries and buses : Evaluated emission limits

Euro VI (heavy duty (mg/kWh)	Positive ignition vehicles	Compression ignition vehicles	
	Euro VI	Euro VI	Euro VI
	Transient testing	Transient testing	Steady-state testing
NOx	460	460	400
PM	10	10	10
PN (#/kWh)	6,0 x 10 ¹¹	6,0 x 10 ¹¹	8,0 x 10 ¹¹
CO	4000	4000	1500
THC	-	160	130
NMHC	160	-	-
NH ₃ (ppm)	10	10	10
CH ₄	500	-	-

Evaluated Emission Limits HDV (mg/kWh) Low Ambition Option	Positive ignition vehicles
NOx	460
PM	10
PN (#/kWh)	6,0 x 10 ¹¹
CO	4000
THC	660
NMHC	160
NH ₃ (ppm)	10



Lorries and buses : Evaluated emission limits

Evaluated limits HDV (mg/kWh) Medium Ambition	Cold emissions	Hot emissions	Evaluated limits HDV (mg/kWh) High Ambition	Cold emissions	Hot emissions
NO _x	350	90	NO _x	175	90
PM	12	8	PM	12	8
PN _{>10nm} (#/km)	5×10 ¹¹	1×10 ¹¹	PN _{>10nm} (#/km)	5×10 ¹¹	1×10 ¹¹
CO	3500	200	CO	1500	200
NMOG	200	50	NMOG	150	50
NH ₃	65	65	NH₂	65	65
N ₂ O+CH4	660	410	N₂O+CH4	660	410
НСНО	30	30	<u>нсно</u>	30	30
Brake emissions	Review	Review	Brake emissions	Review	Review
Battery Durability	Review	Review	Battery Durability	Review	Review

+ Optional idle limit of 5g/h NOx if engine does not shut off in 5 min when parked



Evaluated Boundaries options (HDV)

Parameter	Current boundaries	Low Ambition Normal	Low Ambition Extended	Medium Ambition Normal	Medium Ambition Extended	High Ambition Normal	High Ambition Extended
Limit multiplier			3		2		2
Ambient temperature [ºC]	-7°C to 35°C	-7°C to 35°C	-10°C to 45°C	-7°C to 35°C	-10°C to 45°C	-7°C to 35°C	-10°C to 45°C
Minimum trip duration	More than 4 WHTC	More than 4 WHTC	Between 3 and 4 WHTC	Any (for MAW evaluation 4× WHTC)	-	Any (for MAW evaluation 4× WHTC)	-
Evaluation (MAW)	1x WHTC window	1x WHTC window		1x WHTC window	-	1x WHTC window	
Engine loading	Only work windows > 10% valid	All		All	-	All	
Payload		Higher than or equal to 10%	Less than 10%	Higher than or equal to 10%	Less than 10%	Any	-
Maximum altitude (m)	1600	Up to 1300	From 1300 to 1600	Up to 1600	From 1600 to 1800	Up to 1600	From 1600 to 2200
Minimum mileage	15,000 km	10.000 km	-	5 000 km for <16t TPMLM 10 000 km for > 16t TPMLM	Between 3 000 km and 5 000 km for <16t TPMLM Between 3 000 km and 10 000 km for > 16t TPMLM	3 000 km for <16t TPMLM 6 000 km for > 16t TPMLM	Between 300 km and 3 000 km for <16t TPMLM 6 000 km for > 16t TPMLM

Euro 7 next steps

- Final set of emission limits, but also testing boundaries and pollutants to be regulated will only be known with the adoption of the proposal
- All studies will be made available together with the proposal
- Work already started on the implementing regulations needed to have everything ready asap
- Necessary lead time is taken into account



Thank you



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