Taiwan Ministry of Environment Visit

27th November 2024

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Attendees

Organisation	Name	Roles
JLR	Soon Seng Leong	Emissions Certification Manager - RoW Markets
	Carlos Ferreira da Silva	Regulation Manager - Enviromental
	Robin Maugham	Emission Attributes Lead
	James Jennings	Emissions Calibration Sign Off Lead
	Robin McQueen	Test Operation Manager
	Andeep Dhanjal	Test Compliance Specialist
	Gramoz Salihu	Test Compliance Engineer
	Danny Sharp	Test Lead Engineer
	Andrew Stephenson	Brake Emissions Engineer
	Tomasz Gonet	Brake Engineer
	Alison Nuttall	Sustainability Operation Senior Manager
Visitors		
JLR Taiwan	Charlie Chin	Homologation Lead
Taiwan Ministry of Environment	Hsu,Chung-Hao	Division Chief
	Lee, Ai-Shiou	Environmental Specialist
Industrial Technology Research Institute	Yu, Ho-Ling	Engineer
Automobile Research and Testing Center	Chen, Chia-Mei	Specialist

Agenda

Date	Time	Discussion Topic	Topic Owner
27/11/2024	08:00am 15 minutes	Arrival	
	08:15am 2 hours	Introduction	Soon L
		JLR understanding of the EU7 Legislation Requirement	Carlos FdS
		Chassis Dyno Operations: -Introduction -JLR Laboratory Capability for EU7 -New testing procedures in Euro 7, including PN (Particulate Number) testing for brakes and tires. -JLR RDE (PEMS) Capability for EU7	Robin McQueen / Danny S / Andeep D / Gramoz S / Andrew S
		RDE testing	Robin M
		JLR E10 & above fuel capable models	Soon L / Jim J
		JLR Response to Net-Zero Carbon Emissions policy by 2050	Alison N
	10:15am 45 minutes	B31 Testlabs Tour	Robin McQueen / Andeep D
	11:00am 45 minutes	Refreshments / Lunch	Soon L
	11:45am 45 minutes	Travel to Solihull	
	12:30pm 4 hours	Solihull Plant Tour and LR Experience	David T

EURO 7- (EU)2024/1257 Overview

AQ13 – Product Regulations

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Background

- **EU7** applies emission limits to all categories of motor vehicles, i.e. cars, vans, buses and lorries under one set of rules.

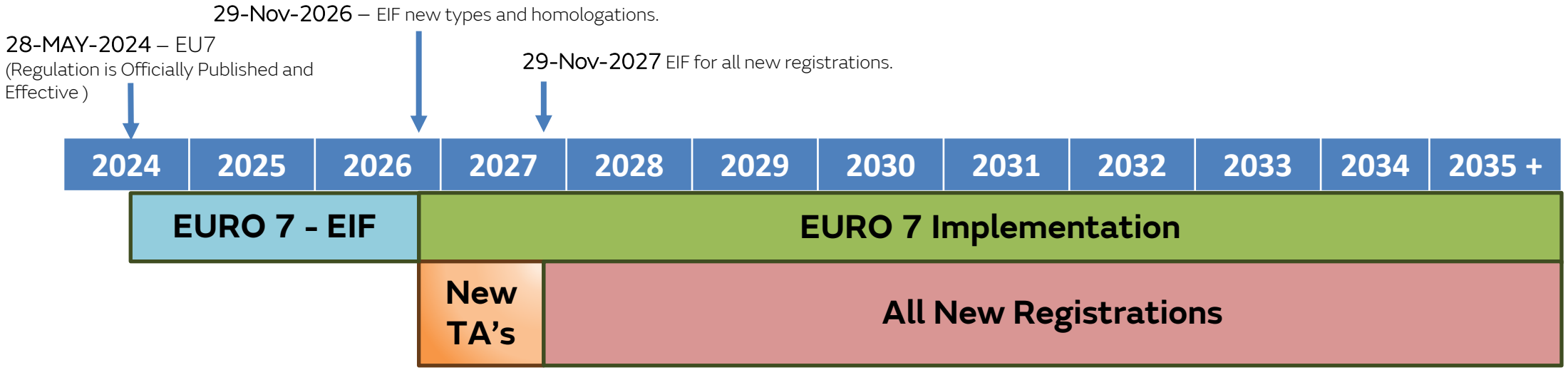
- Electric passenger cars and light commercial vehicles will have to comply with new EU7 battery durability requirements, as well as tests and limits set for other types of non-exhaust emissions such as brakes and tyres.

- On **10-Nov-2022**, the European Commission published the draft proposal for a new regulation (EU7) with respect to vehicle emissions and battery durability.

- On **13-Mar-2024**, the EU Parliament (with 297 votes in favour, 190 against and 37 abstentions) adopted the deal reached with the Council on the EU7 regulation (type-approval and market surveillance of motor vehicles).

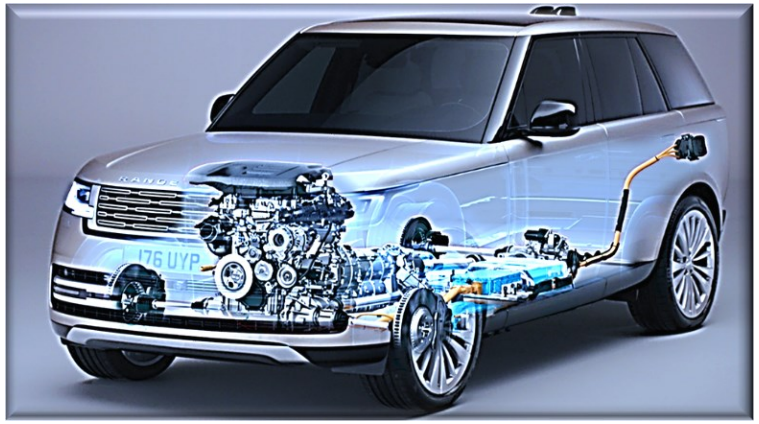
- On **8th May 2024** the European Union has issued Euro 7 Regulation (EU)2024/1257 confirming the EIF Date for Euro 7 Regulation.

Timeline: Euro 7 Regulation (EU)2024/1257



EU7 EIF Date– 28-MAY-2024

- New Types and Homologations – 29-NOV-2026
- All New Registrations – 29-NOV-2027
- Expected Adoption of Implementing act (1st Phase) + OBM/EVP Act: 29-MAY-2025
- Expected Adoption of Implementing act (2ndst Phase) + Brake Particles+ Battery Durability+ Tyre Abrasion+ EV OBFCM+Geo Fencing Act: 29-SEP-2026

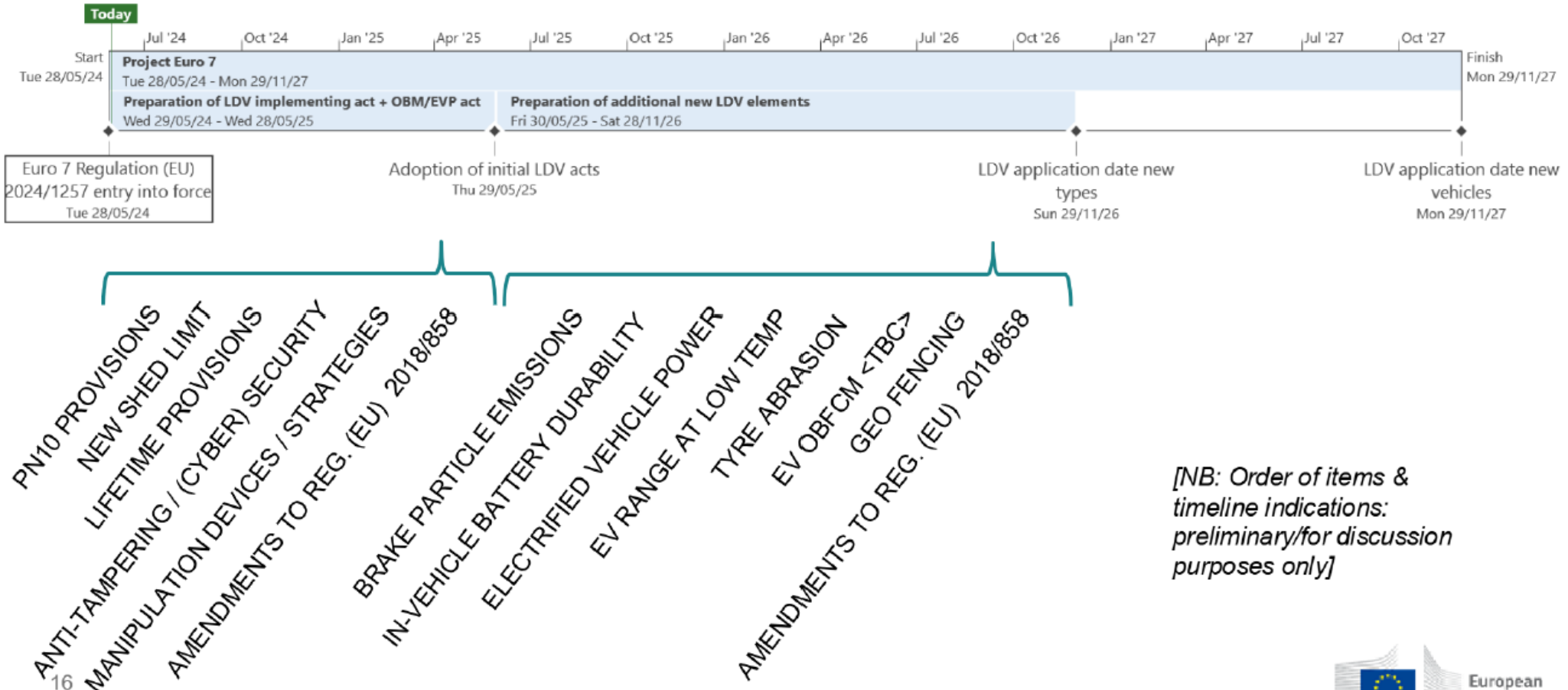


Draft Implementing Act Structure Timeline Euro7

Timeline – LDV

[Preliminary – for discussion]

No changes



[NB: Order of items & timeline indications: preliminary/for discussion purposes only]

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European Commission

DRAFT Euro 7 transposition into UN Regulations – LDV

EIF
- Euro 7 Regulation (EU) 2024/1257 entry into force: 28 May 2024

LDV
- Adoption of initial LDV implementing acts*: 29 May 2025

* Art. 14(8) Euro 7 Regulation - brake emissions, in-vehicle battery durability, tyre-abrasion, anti-tampering excluded - *tbd*

TCMV vote
- Vote by TCMV on 'UNECE mega-decision': January 2026

Council WP
- Council 'mega-decision' adoption: before March 2026

EU new types
- LDV application date *new types*: **29 November 2026**

EU new vehicles
- LDV application date *new vehicles*: 29 November 2027

UNECE

No changes

GRPE 91
- Inform about Euro 7 transposition plan in GRPE 91st session: October 2024

GRPE 92
- Informal Document proposal in GRPE 92nd session: Febr./March 2025

GRPE
- Working Document submittals: July 2025 (3 months before GRPE 93rd)

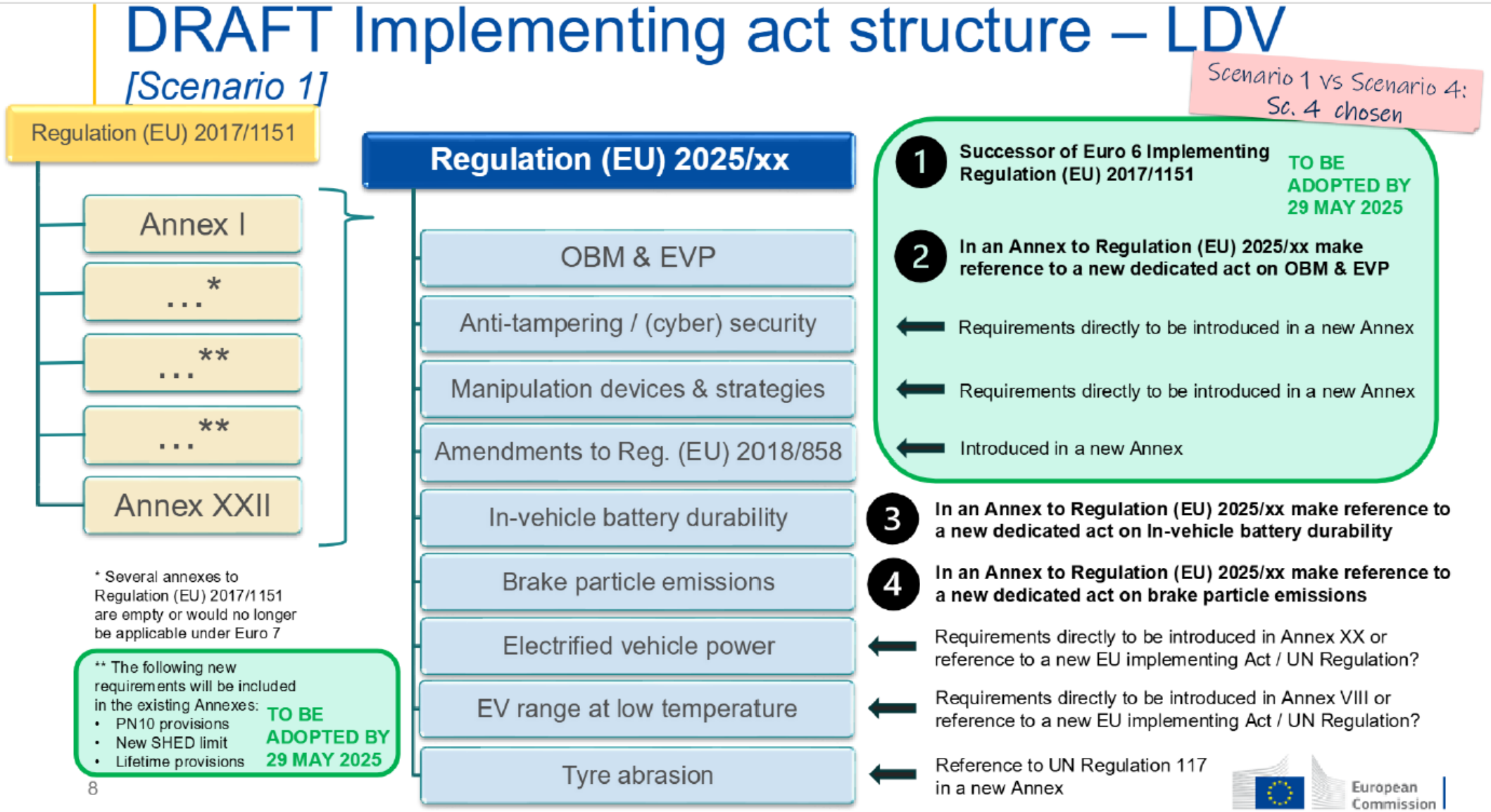
GRPE 93
- Endorsement of amendment proposals in GRPE 93rd session: October 2025

WP.29 198
- WP.29 vote on amendment proposals: March 2026

entry into force
- WP.29 adoption period of ~6 months: **29 November 2026** (UN entry into force)

European Commission

Draft Implementing Act Structure Euro7



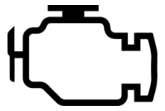
Overall EU7 Regulation Current Structure-2024

Pollutant & CO2 emissions:
- Reg. (EU) 2017/1151

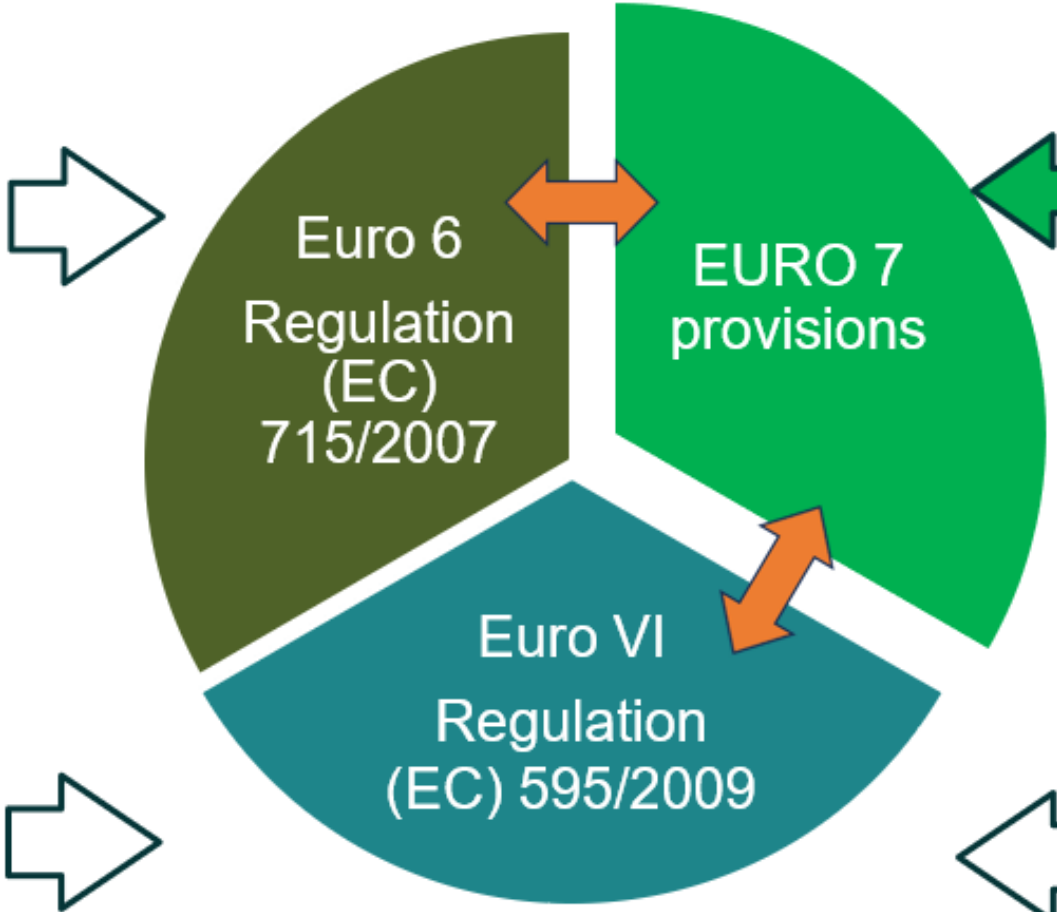
- UNR 24-03
- UNR 83-08
- UNR 85-00
- UNR 154-02
- UNR 168-00

Pollutant emissions:
- Reg. (EU) 582/2011

- UNR 49-07
- UNR 85-00



: +CO2 emissions



NEW elements in EURO 7:
- **On-Board Monitoring**
- **Brake particle emissions**
- **Battery durability**
- **Tyre abrasion**

HDV CO2 emissions:
- Reg. (EU) 2017/2400
- Reg. (EU) 2022/1362

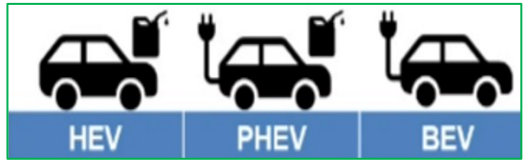
What's New In The EU7 Regulation?

For All types of Vehicles Including BEV

- Limits for emissions from brakes
- Rules on microplastic pollution from tyres
- Vehicles need to comply with emissions rules for longer period
- More effective emissions tests
- Digital monitoring of compliance
- Better market surveillance tests

For Electric and Plugin Hybrid Vehicles

- Battery durability requirements



EU7 Chapter II Manufacturers Obligation

Article 4 -Obligations of the manufacturers concerning the construction of vehicles, systems, components, and separate technical units.

Manufacturers shall ensure that the new vehicles that they manufacture, which are sold, registered or enter into service in the Union, are type-approved in accordance with this Regulation. From the specific dates of application set out in this Regulation, manufacturers shall ensure that the new systems, components or separate technical units, including engines, traction batteries, brake systems, tyres and replacement pollution control systems requiring type-approval which they manufacture, and which are sold or enter into service in the Union are type-approved in accordance with this Regulation.

Manufacturers shall design, construct and assemble vehicles to comply with this Regulation, including complying with the emission limits set out in Annex I under the conditions set out in Annex III and respecting the values declared in the certificate of conformity and in the type-approval documentation for the lifetime of the vehicle, as set out in Table 1 of Annex IV.

EU7- Euro 7 Emission Type Approval Implementing Acts Assessment

	2018/858	EURO 7				
	Item	**Subject**	**Main additional or amended requirements**	**Source**		
	G	ENVIRONMENTAL PERFORMANCE AND EMISSIONS				
type 1 + ATCT + OBFCM	G2a	Determination of specific CO_2 emissions and fuel consumption of vehicle and device for monitoring on board the vehicle the consumption of fuel and/or electric energy +		UNR 154-02	**LDV CO2 & fuel consumption**	1
	G2	Tailpipe emissions of vehicle in lab	PN10 limit			
type 4	G7	Evaporative emissions	New SHED limit		**LDV pollutant emissions**	2
type 5	G5	Durability of tailpipe emissions	Concept of additional lifetime and durability multipliers			
	G9	On-board diagnostics (OBD)	No need for OBD demonstration at type-approval			
	G10	Absence of manipulation devices and absence of manipulation strategies	Guidance on the evaluation of Auxiliary Emission Strategies and the presence of Defeat Devices			
	G11					
	G12	Anti-tampering	Security and cybersecurity systems to be covered			
	--	Net power	Electrified vehicle power	UNR 85-00, GTR 21		
RDE	G4	Tailpipe emissions on the road	PN10 limit	UNR 168-00		
type 2	--	Idling emissions / smoke opacity		UNR 83-08		
type 3	G6	Crank case emissions				
type 6	G8	Low-temperature tailpipe emissions in lab				
	--	Replacement pollution control devices		UNR 103-00		
	--	**Range at low ambient temperature**		GTR 15	<TBC: in 1 or 2 ?>	
	--	**On-board monitoring (OBM) + Environmental Vehicle Passport (EVP)**	NEW <TBC: combining with G9 and G12>	--	**LDV OBM + EVP**	3
	--	**Brake particle emissions**	Brake particle emission limits <TBC: administrative provisions, COP and ISC>	GTR 24	**LDV Brake particle emissions**	4
	--	**In-vehicle battery durability**	Minimum Performance Requirements (MPR) <TBC: administrative provisions, COP and ISC>	GTR 22	**LDV Battery durability**	5
	--	**Tyre abrasion**	Tyre abrasion limits <TBC: administrative provisions, COP and ISC>	UNR 117-04	**Tyre abrasion C1 & C3**	6

New in EU7

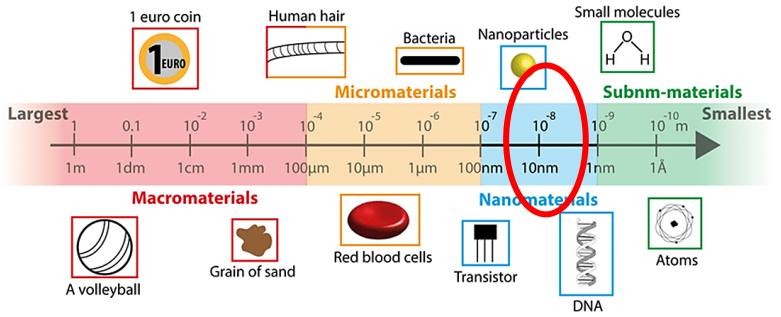
Euro 7 is Similar to Euro 6e in terms of Exhaust Emission Limits.

$PN_{(23)}$ ⇒ $PN_{(10)}$

- PN(10) instead of PN(23) .
- Not technology agnostic
- No NH_3
- Apply to all PI vehicles (not only DI-PI Vehicles)
- RED Test conditions for LDV remains the same as Council's General Approach of Eur06e (ECE-R168/R83-08) level.

	Eu6e		Euro 7							
	Gasoline	Diesel	PI				CI			
			M1	N1 (Class I)	N1 (Class II)	N1 (Class III)	M1	N1 (Class I)	N1 (Class II)	N1 (Class III)
	WLTP RDE CF NOx: 1.1, PN: 1.34 only		Refer to **R168**: WLTP, RDE CF NOx: 1.1, PN: 1.34 only + CO and CO2 needs to be measured							
NOx [mg]	60	80	60	60	75	82	80	80	105	125
PM [mg]	4.5	4.5	4.5							
PN [#]	DI only PN23 : 6×10^{11}		PN10 : 6×10^{11}							
CO [mg]	1000	500	500	500	630	740	1000	1000	1810	2270
THC [mg]	100	HC+NOx: 170	100	100	130	160	HC+NOx: 170	HC+NOx: 170	HC+NOx: 195	HC+NOx: 215
NMHC [mg]	68	-	68	68	90	108	-	-	-	-
NH3 [mg]	-	-	-	-	-	-	-	-	-	-

New in EU7



PN10 means the total number of solid particles emitted from the tailpipe or the brakes that have a diameter larger or equal to 10 nm

EU7- CoP Test Required

ANNEX V / APPLICATION OF TEST REQUIREMENTS AND DECLARATIONS

Table 1: Application of test requirements and declarations

Test requirements	Tests and requirements for emission TA	Tests at CoP
Gaseous pollutants, PM, PN, CO2 emissions, fuel consumption (OBFCM), Electric energy Consumption and electric range (battery durability) (WLTP at 23 C)	Required test for all fuels for which the type-approval is granted	Required for exhaust emissions and OBFCM
Crankcase emissions	Declaration that a closed crankcase system or routing to the tailpipe is installed	Required
Evaporative emissions test	Required	Required

EU7- CoP Test of Brake Systems

Table 11: Application of test requirements for type-approval of brake systems for manufacturers

Test requirements	Tests and requirements for emission TA	Tests at CoP
Brake system emissions test in WLTP brake cycle	Required	Required

EU7- CoP Test Not Required

ANNEX V / APPLICATION OF TEST REQUIREMENTS AND DECLARATIONS

Table 1: Application of test requirements and declarations

Test requirements	Tests and requirements for emission TA	Tests at CoP
Gaseous pollutants and PN in road testing (RDE)	Required demonstration test for all fuels for which the type-approval is granted and declaration of compliance for all fuels, all payloads and all applicable vehicle types	Not required
CO2 ambient temperature correction(WLTP at 14 oC)	Declaration (*1)	Not required
Durability of emission control systems	Declaration	Not required
Correct operation of systems using a consumable reagent and pollution control systems	Declaration	Not required
Battery durability	Declaration	Not required
Laboratory test of low temperature for emissions	Required	Not required
Laboratory test of low temperature for electric range	Required	Not required
On-board diagnostics	Declaration	Not required
On-Board Monitoring (OBM)	Declaration and demonstration	Not required
Power determination	Required	Not required
Anti-tampering, security and cybersecurity	Declaration and documentation	Not required
Geofencing technologies (where applicable)	Declaration and demonstration	Not required

EU7- Test of Pollution Control Systems

Table 9: Application of test requirements and declarations for type-approval of pollution control systems for manufacturers

Test requirements	Tests and requirements for emission TA	Tests at CoP
Demonstration of performance and durability with aged parts	Required/Declaration	Not required
Durability requirement check in real world (RDE test with aged vehicles)	Declaration	Not required

EU7 Summary of Test Burden Compared to EU6e

Approval Effort: less | same | on request TAA (more) | more

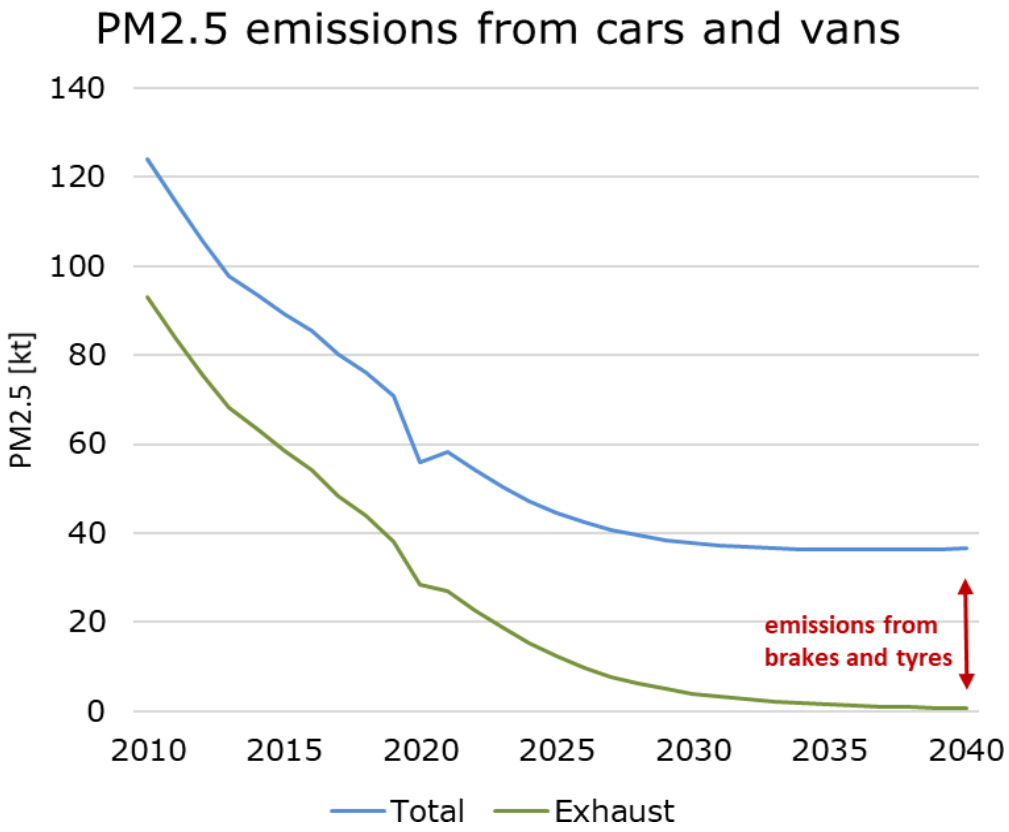
Test set	Type approval	COP	ISC
Brake emission	New. Additional burden.	New. Additional burden.	New. Additional burden. How should that work?
WLTP-Type 1	Same as EU6e.	Same as EU6e.(PN10)	Same as EU6e if CO2 is not considered. Otherwise increased.
Crankcase – Type 3	Optional declaration replaces a testperiod of a few minutes if TAA accepts.	New. Additional burden.	None.
EVAP – Type 4	Same as EU6e.	Same as EU6e(1.5 g/test)	Optional increase if requested by TAA.
Emission Durability	Burden almost equal due to validation for declaration.	None.	None.
Battery Durability	New. Additional burden due to validation for declaration.	None.	None.
OBD	Amount of validation test scenarios due to more sensors is increased. Burden almost equal for declaration.	None.	Optional increase if requested by TAA.
OBM	New. Additional burden due to required demonstration in addition to declaration.	None.	New. Additional burden.
Engine power	Same as EU6e.	Same as EU6e.	None.
Anti-tampering, security and cybersecurity	Additional documentation burden due to extended anti-tampering and cybersecurity.	None.	None.
EU7A	New. Additional burden.	None.	None.
EU7G	New. Additional burden.	None.	None.

Brake and Tyre Wear Particles

- The contribution of brake and tyres to PM 2.5 will soon be higher than from exhaust sources.
- Tyres are the biggest source of unintentional release of microplastics in the environment (heavier particles to water and soil).
- Brake dust measurement method developed for cars and vans (GTR 24 on brakes) and is currently under development on HDV.
- Tyre abrasion test methods have been in development in GRBP/GRPE TF/TA.

- Brake particle emissions (PM10) for Pure Electric Vehicle (PEV) : 3 mg/km
- All other powertrain technologies : : 7 mg/km

  (Limits to be reviewed in 2027 for 2030-2035)
- All powertrain from 01-JAN-2035 : 3mg/km

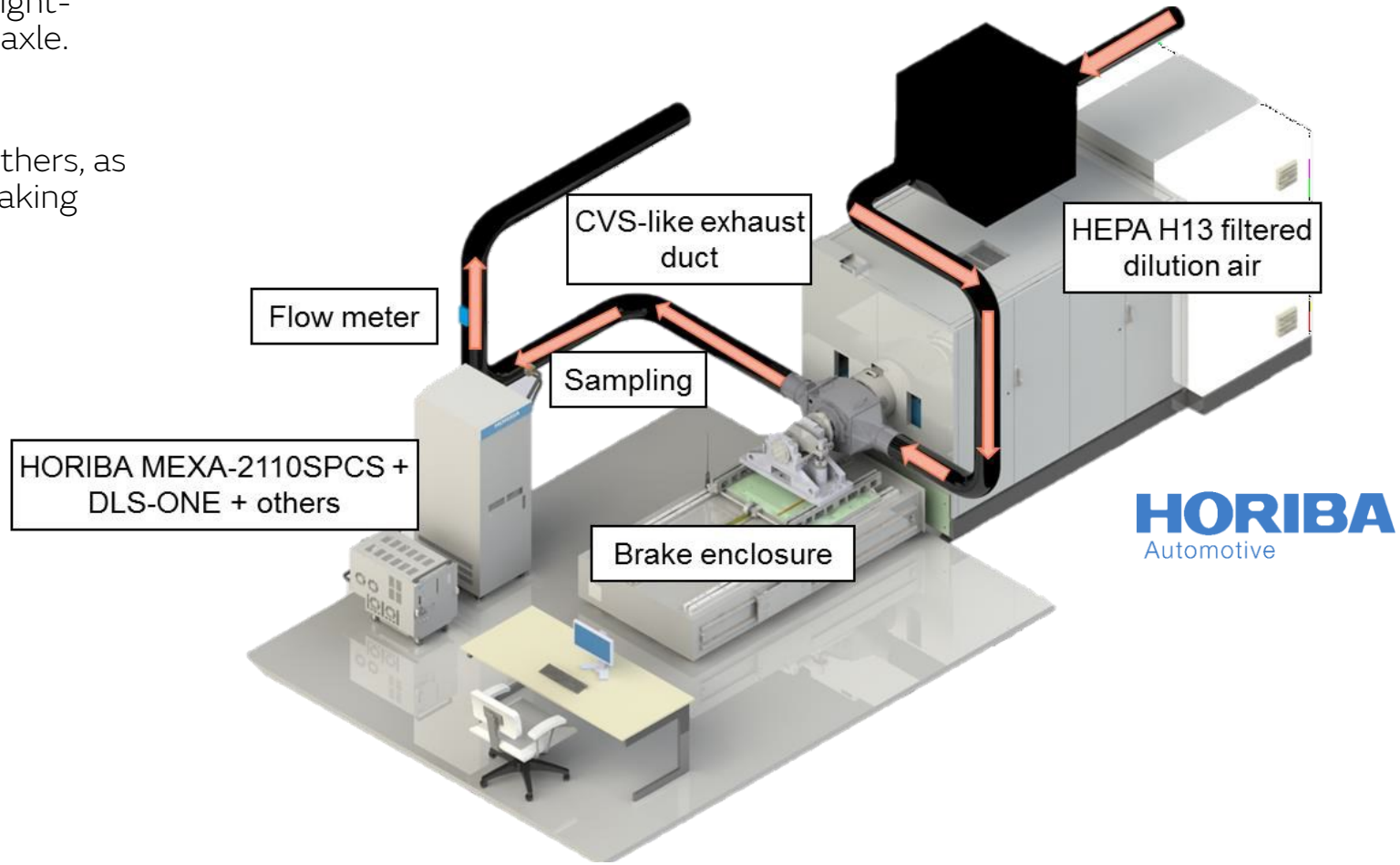


Non-Exhaust Emissions Measurement- Brake Dust

- Brake dust requirements are a new requirement that was not included in EU6e.

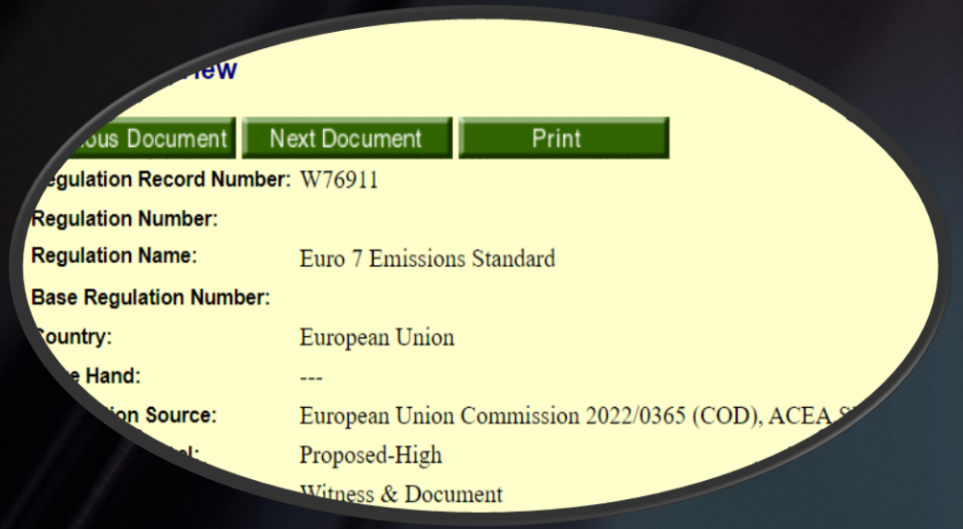
- **The EU7 requirements** measure particle emissions based on GTR 24 – Laboratory Measurement of Brake Emissions for Light-Duty Vehicles, on a bench simulating the weight of the axle.

- There is potentially differentiation between BEVs and others, as BEVs are heavier but favoured by more regenerative braking (less friction, so less dust).

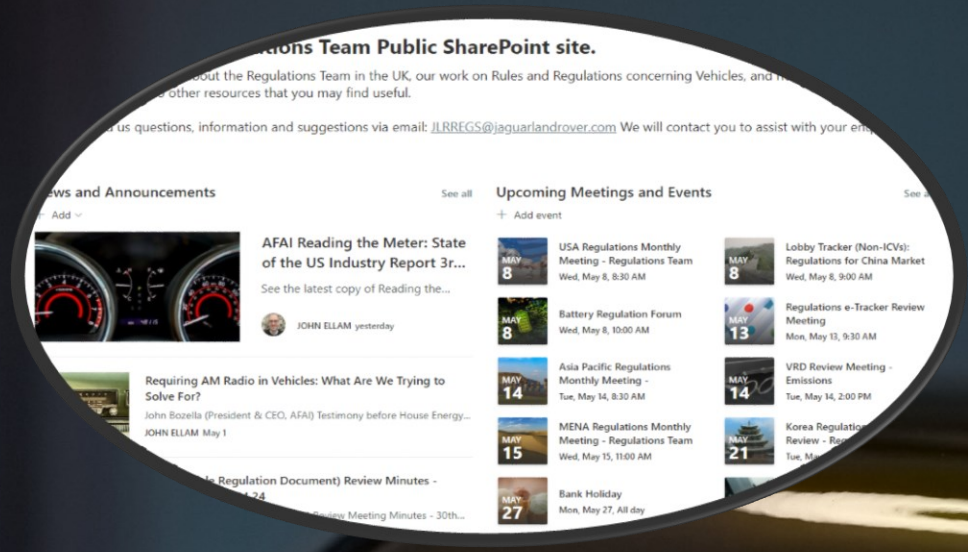


• Thank you for your time.
• Any questions?

For further details on EU7, please refer to the Regulation Record in GRID -https://www.grid.jlrint.com/grid/?REGID=W76911



For further detail on AQ13 activities, please refer to our SharePoint site - Product Compliance - Advanced Regulations and Rulemaking Public_GRP - Home (sharepoint.com)



THANKS

Chassis Dyno Operations

EO10 – Test Operations
In separate file

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RDE Testing

EP – Powertrain Engineering

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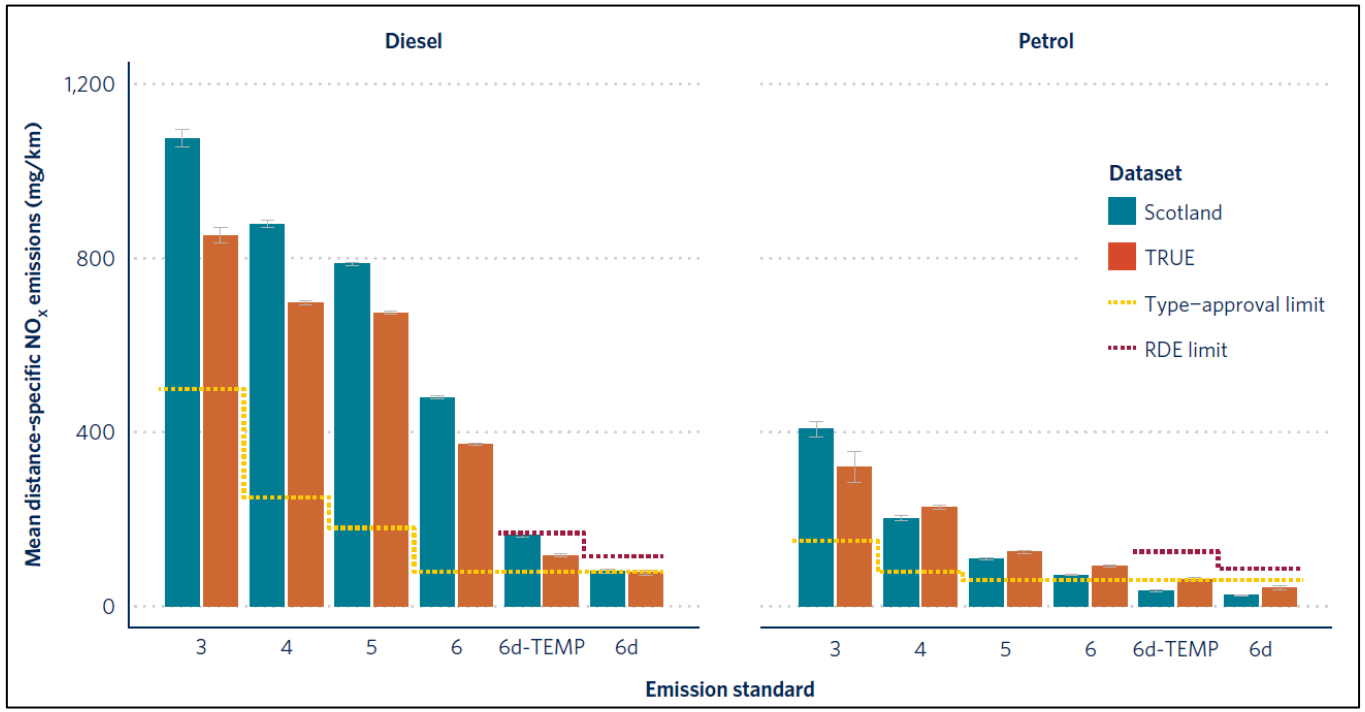
RDE regulation has been a success

- RDE regulations were introduced into Europe from 2018. EU6d_temp
- Overtime the regulation has evolved to reduce the measurement uncertainty factors.
- Roadside air quality measurements have shown that the legislation has significantly reduced the real world pollutant emissions generated from each vehicle.
- From this legislation we have seen improvements for Gasoline and diesel tailpipe emissions.

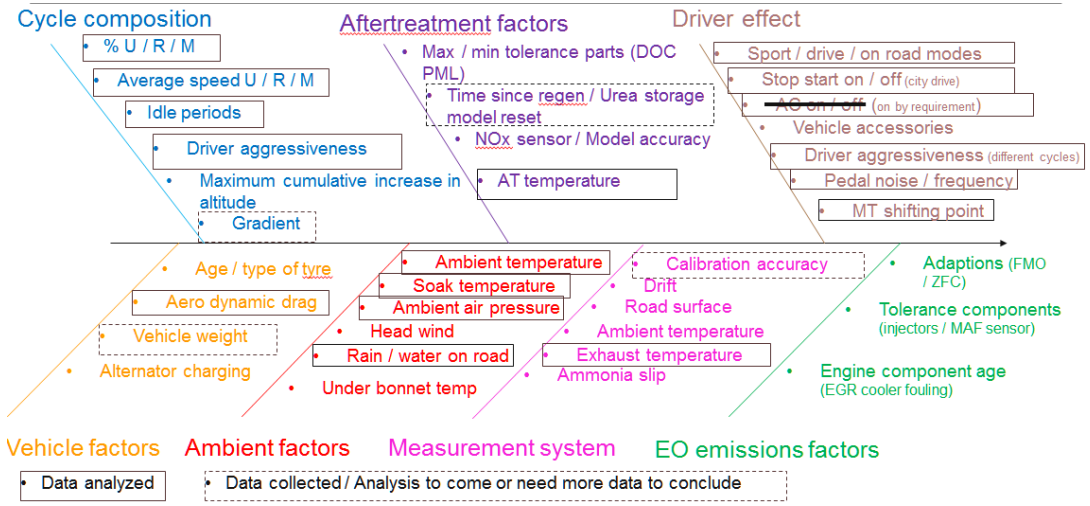
	EU6c	EU6d-temp	EU6d	EU6e
All vehicles date	01/09/2018	01/09/2019	01/01/2021	01/09/2024
NOx CF	Monitoring	2.1	1.43	1.1
Pn CF	Monitoring	1.5	1.5	1.34

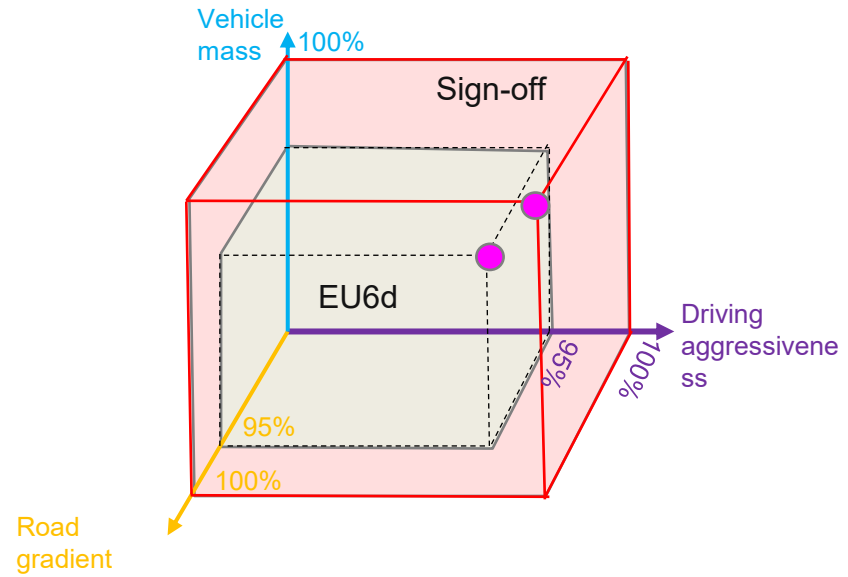


RDE legislation has successfully reduced tailpipe emissions

Developing products which are RDE capable

- RDE introduced many new noise factors into the sign-off and robustness testing for our vehicles.
- In order to fully validate all the possible combinations of test conditions it would drive an additional 10,000 test types per vehicle variant.
- In order to manage the additional test burden OEMs sign-off to conditions beyond RDE to reduce the number of tests to a manageable level.
- Additionally, it has driven 100's hours of additional of lab validation. Requiring both altitude and climatic simulation capabilities.
- And additional hours of on road and climatic validation, which need support from facilities team / hotels / and dealerships to ensure that each test is a success.





Robust development for RDE drives significant amounts of additional lab and on road validation

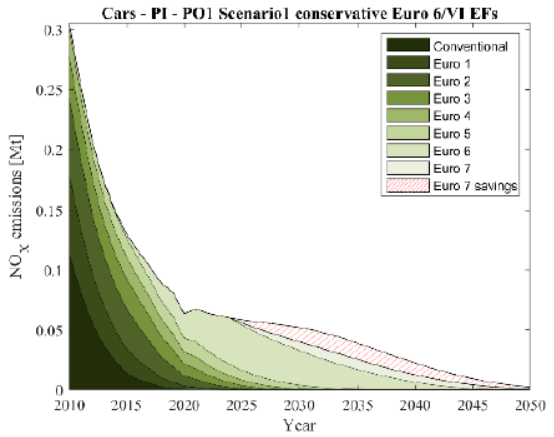
EU7 RDE legislation journey

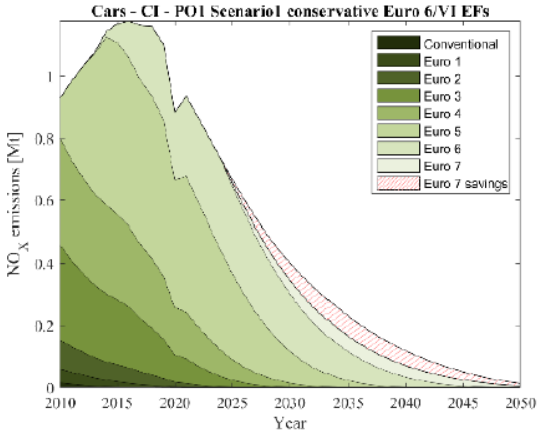
- During EU7 legislation development an impact study was commissioned.
  - It showed because of the progress already made by EU6d RDE legislation
  - that even a significant tightening of EU7 RDE limits would not significantly improve air quality in Europe.
  - Instead fleet renewal of EU4 and EU5 vehicle and the transition to BEV technologies were a much stronger method to improve air quality.

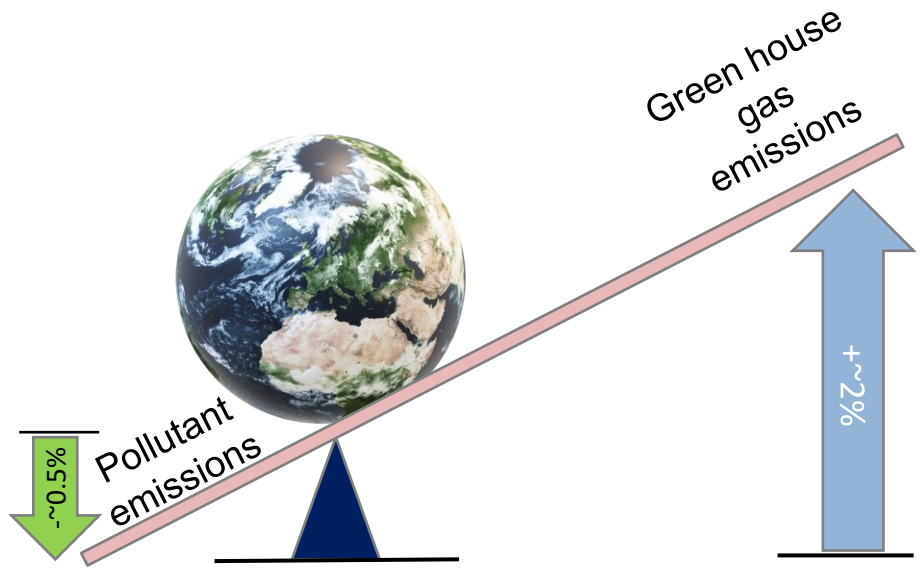
- Additionally, the proposals would have degraded CO2 for all drivers to ensure that the <1% of drivers who were higher polluting (100%ile customers) would comply.

- The Parliament and council decided that For EU7 it would be better improve the anti-tampering and the in market compliance elements of the regulation and left the RDE test conditions and normalisation unchanged from EU6e.

- The only change which has been made from EU6e is the Change from 23nm Pn to 10nm Pn.







EU7 RDE is carry over EU6e with the inclusion of Pn 10

RDE adoption outside of Europe

- RDE has been adopted outside of Europe as well.
- Initially in Japan (Diesel only), India and China
- But now also in Brazil and with the Reg83-08 and UNR-168 more widely around the world.
- Most markets have broadly aligned to the UNR-168 definition of driving boundaries and post processing.
- However, there are some market to market specifics:
    - China – cold start excluded and upper altitude 2,400m
    - Brazil – minimum altitude gain (600m/100km) and measurement of HC

RDE adopting is continuing outside of Europe - Markets aligning to Reg 168

Challenges of RDE testing

- When first starting developing our RDE routes we found it hard to ensure that all test would be successful due to traffic conditions, or road works.
- Over time we have developed our routes to make them more reliable and we are constantly monitoring road works and adapting the routes when needed.
- We understand from other markets that a particular challenge is to achieve a valid RDE test, due to higher traffic densities and driving styles.
- A move we have seen more recently is the move to completing RDE testing in the lab – but this can introduce new challenges.
    - It is easy in the lab to generate test conditions which would not be seen in the real world.
        - (i.e. 20% gradient for 2hours at motorway speed)
    - In the lab it is challenging to achieve representative airflow around and through the car.
    - In the lab it is easy to apply the target acceleration profile from one vehicle to another even though that vehicle may not be able to achieve it.
- Therefore, we would advise only playing back RDE traces in the lab which have been generated on the specific vehicle type.
    - This approach is preferred by the European commission as well.

Generating valid testing can be challenging;
Testing in the lab should be used with caution

Ethanol Content in Fuel

EP – Powertrain Engineering

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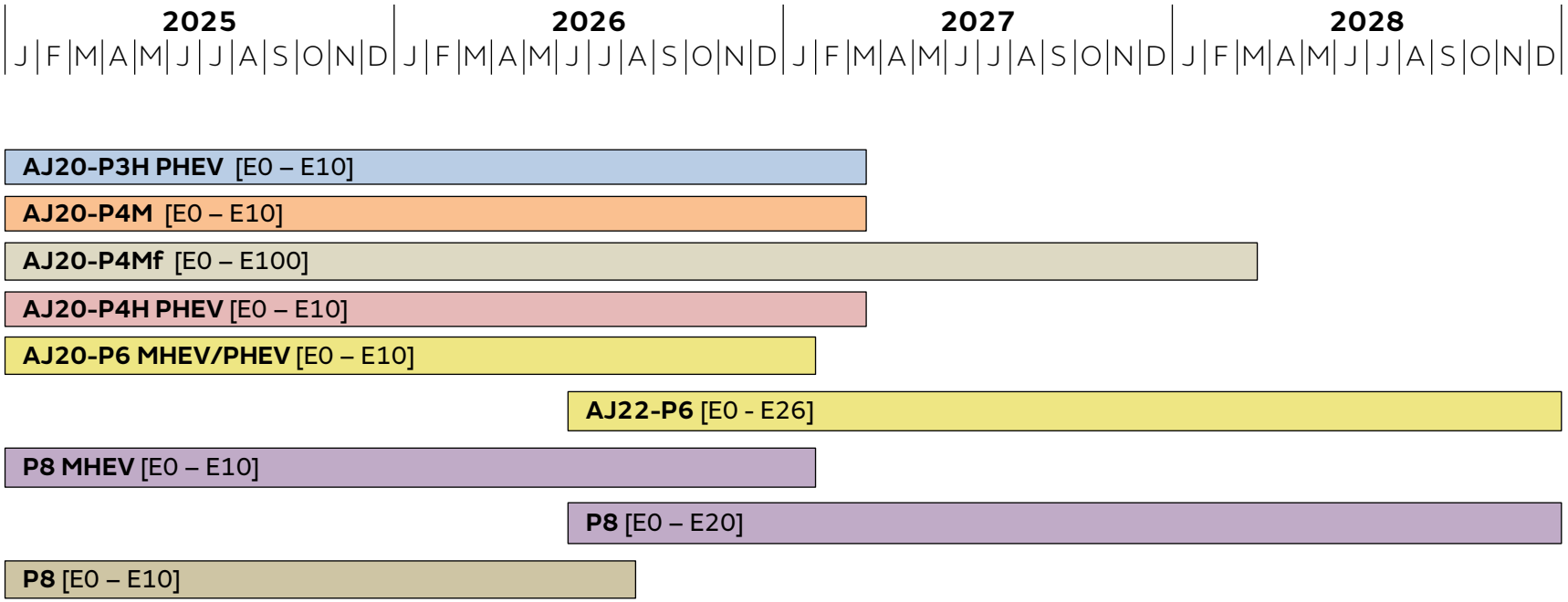

- Run-out and introduction time varies with platform, timings shown are based on last available or first intro
- Ethanol capabilities for EU products are currently signed off to E10 although in some cases hardware and calibration may permit higher usage levels

Current ethanol capability extensively tested up to E10. Future model years have minimum E20 capability

Net Zero Carbon Emissions Policy

Sustainability Operation

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TO REIMAGINE MEANS TO RETHINK EVERYTHING WE DO

OUR REIMAGINE STRATEGY HAS SET US ON AN EXCEPTIONAL JOURNEY OF TRANSFORMATION. IT LAYS OUT A CLEAR VISION TO BECOME PROUD CREATORS OF MODERN LUXURY AND BE A CARBON NET ZERO BUSINESS BY 2039. DESIGNED TO CREATE A NEW BENCHMARK IN ENVIRONMENTAL, SOCIETAL AND COMMUNITY IMPACT FOR LUXURY BUSINESS.

2030

All name plates available in BEV

Scope 1, 2 & 3 Emission reduction through Science Based Targets

2036

Global Zero tailpipe emissions by 2036

2039

Our aim is to achieve net zero carbon emissions across our supply chain, products and operations by 2039

- UK ZEV Mandate, EU Green Deal – All new cars zero emission by 2035
- UK Net Zero and EU carbon neutral by 2050
- Industry trade associations – SMMT (UK), ACEA (EU), AIA (USA) influencing positions on climate legislation
- Legislation engagement – CO2, charging infrastructure, End of Life vehicles, batteries legislation, ETS, CBAM, taxonomy, corporate reporting and due diligence