Euro 7 – Emissions & monitoring regulations - Future challenges

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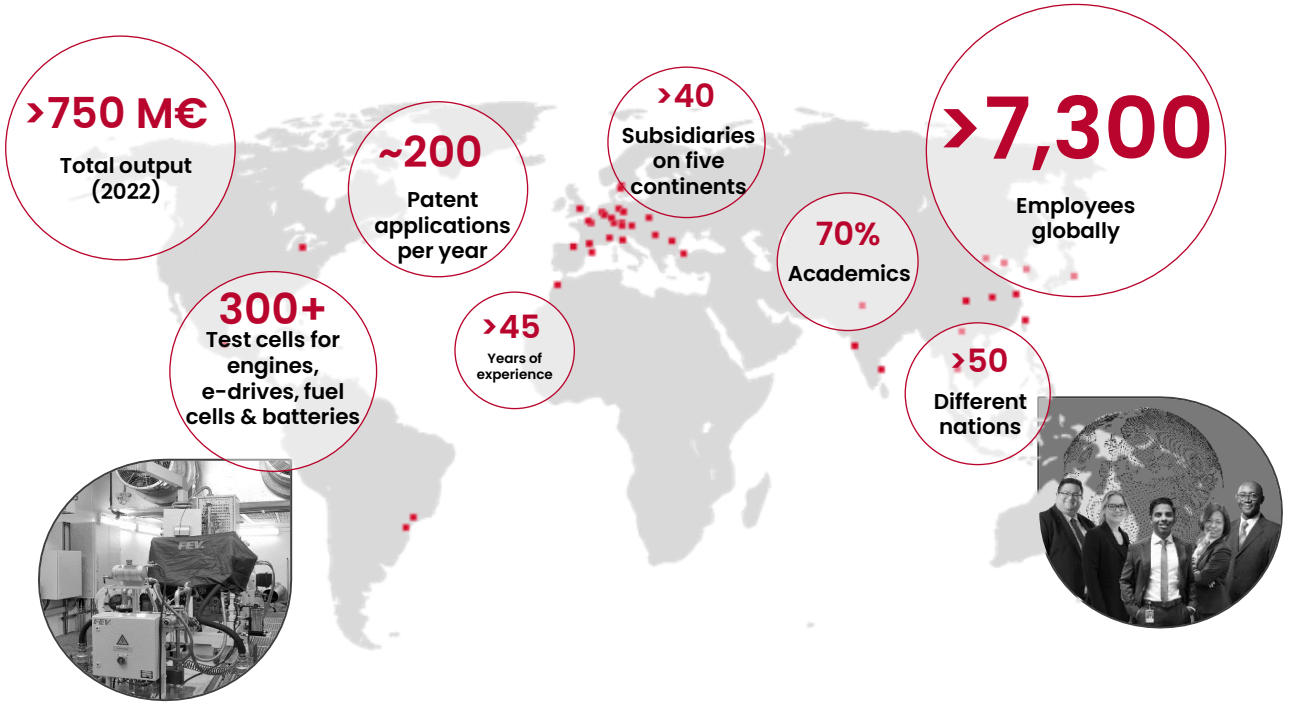
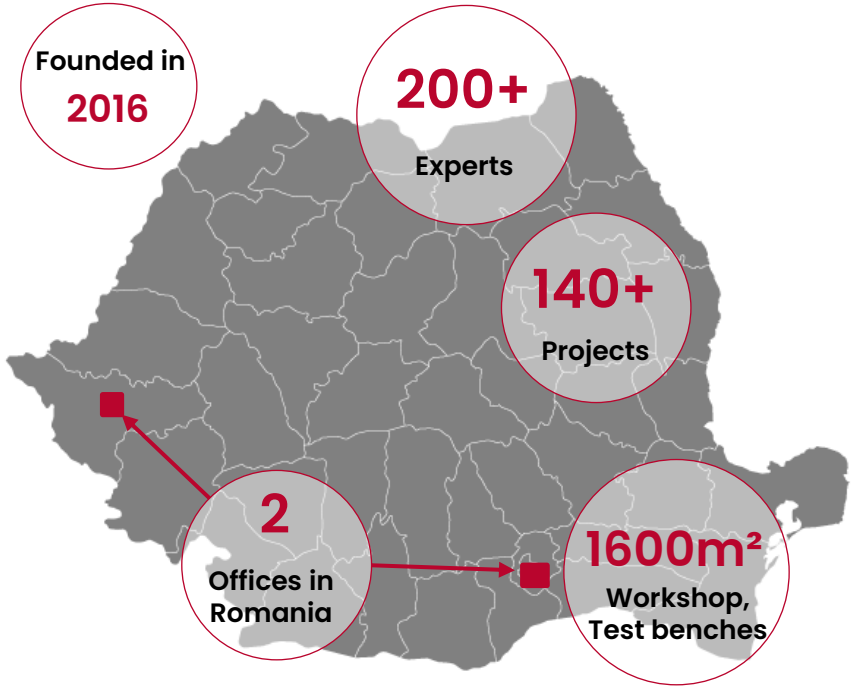
GLOBAL REACH – ONE FACE TO THE CUSTOMER





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Why Euro 7? Why CLOVE?

EMISSIONS REGULATIONS OBJECTIVES

NGOs

EU Member States

EU Policy makers

OEMs

CLOVE CONSORTIUM FOR ULTRA LOW VEHICLE EMISSIONS

§ Euro 7 **Euro 7 Draft by EU Commission** (November 2022)

Euro 7 faces heavy criticism from industry & member states. 8 member states (Romania Included) are planning to block Euro 7 in EU Council as it was initially defined.

CLOVE CONSORTIUM FOR ULTRA LOW VEHICLE EMISSIONS

European Commission

TNO innovation for life · FEV · IAV RICARDO · VTT · LAT · emisia · TU Graz

CLOVE (supporting Euro 7 development)

- Consulting EU commission based on a contract
- Answering questions & providing data / expert knowledge / suggestions / concerns
- Performing impact assessment. Cost benefit: Reduced health cost minus cost for Euro 7

CLOVE aims for emissions reduction mainly in urban areas

- Improving of air quality, with focus on urban areas
- Making sure that ICE vehicles can be considered as clean as all other alternatives (no banning required)

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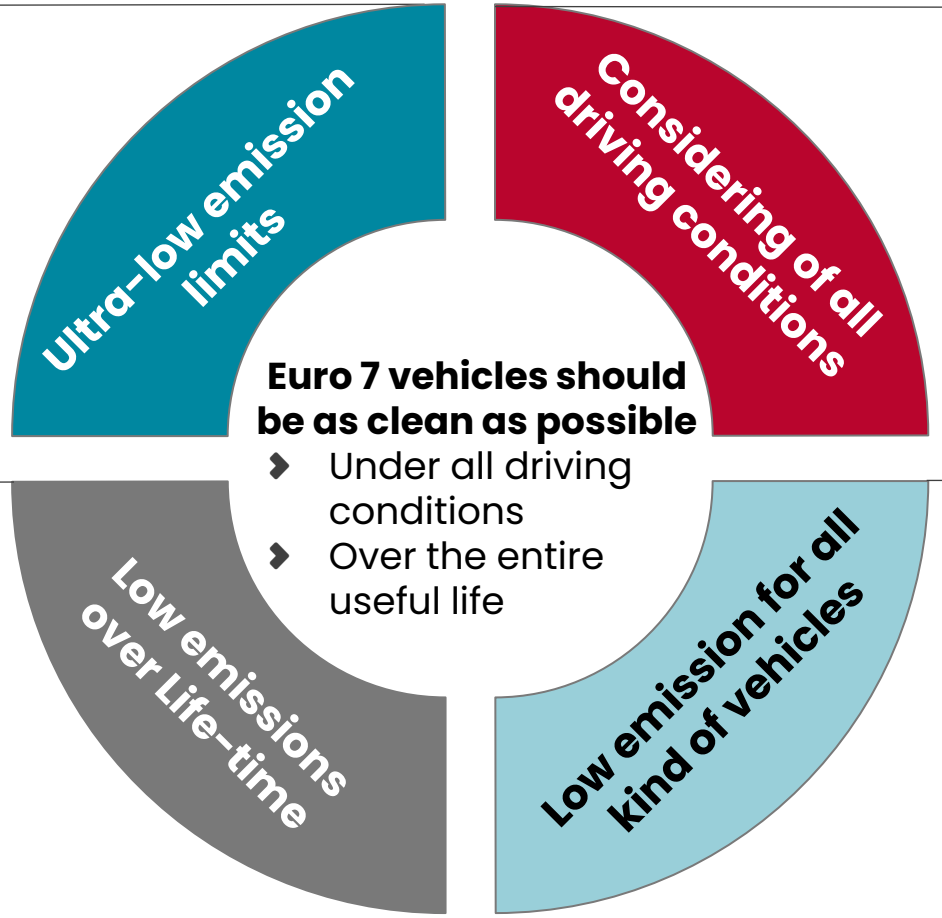
Main facts of the Euro 7 legislation as suggested by EU Commission

EU COMMISSION / CLOVE TARGETS

- **Lowest Euro 6 emission limits, unified from Gasoline & Diesel**
- PN counting capabilities as low as 10nm
- NH3 emission limit (20mg/km)



- **Focus on real driving emissions**
  - No predefined test conditions
  - PEMS testing instead of static driving cycles
- Wider driving conditions
- Wider ambient conditions

- Extending vehicle full useful life to 200.000 km and 10 years
- **On-board monitoring (OBM)** should ensure emissions conformity over vehicle lifetime
- Extensive independent vehicle testing (Market Surveillance)

- One regulation framework for Light-Duty & Heavy-Duty vehicles
- Fuel and engine technology independent regulation

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EU COMMISSION / CLOVE TARGETS

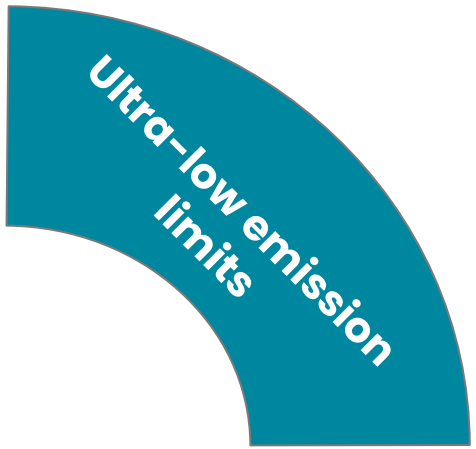
EU Commission targeted engine technology neutrality with respect to emissions limits, generating important engineering development challenges

	NO_x [mg/km]	PN* [#/km]	PM [mg/km]	CO [mg/km]	NH_3* [mg/km]	THC [mg/km]	NMHC [mg/km]
Light Duty Vehicle (> 35kW/t)	**60**	**$6x10^{11}$**	**4.5**	**500**	**20**	**100**	**68**
Engineering effort - gasoline engine	●	●	●	●	●	●	●
Engineering effort - Diesel engine	●	●	●	●	●	●	●

● Very challenging: Strong impact on engine & EATS

● Challenging: Moderate impact on EATS layout

● Manageable or no impact compared with current Euro 6 layout



* PN counting sensitivity for emissions measurement systems increased from 23 nm to 10 nm regarding particle dimension
* NH_3 limit carried over from HD to LD included in EU Commission's draft, as responsible for heavy smog around cities

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EU COMMISSION / CLOVE TARGETS

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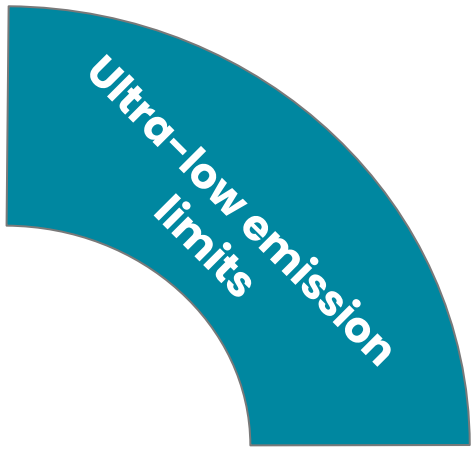

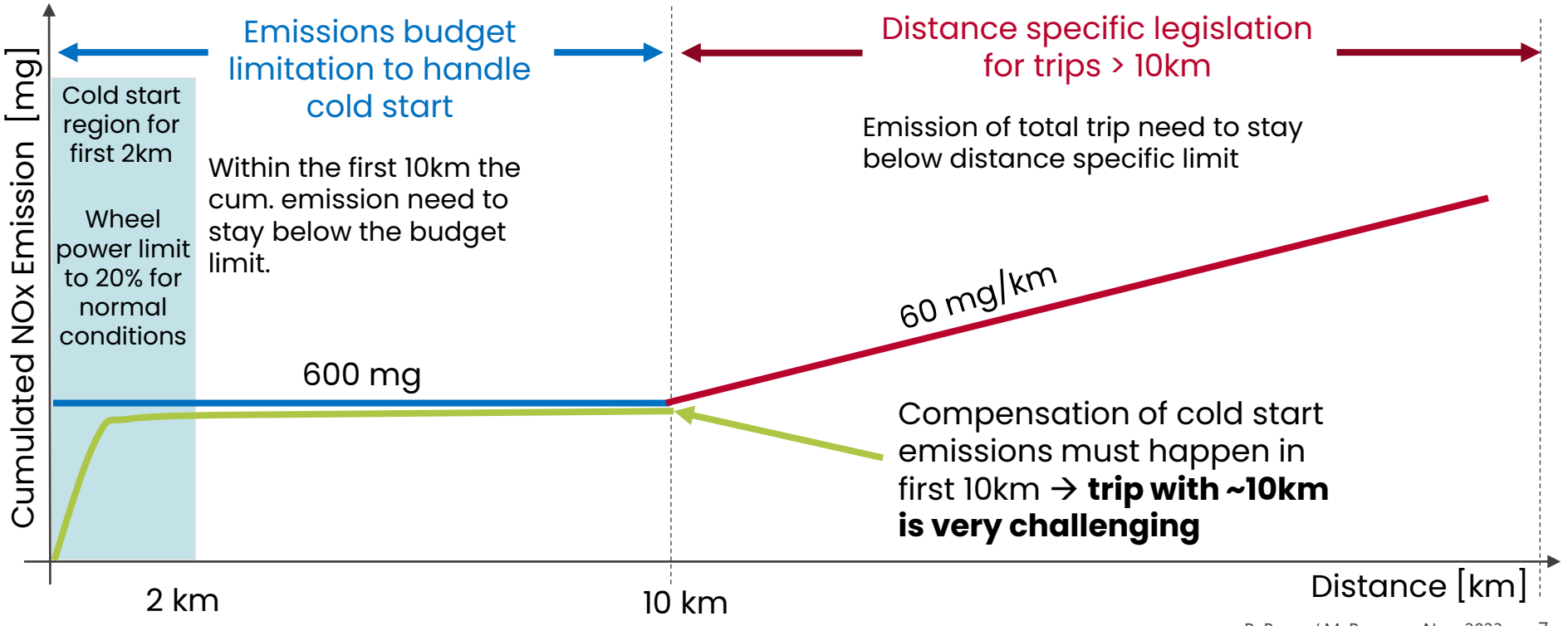

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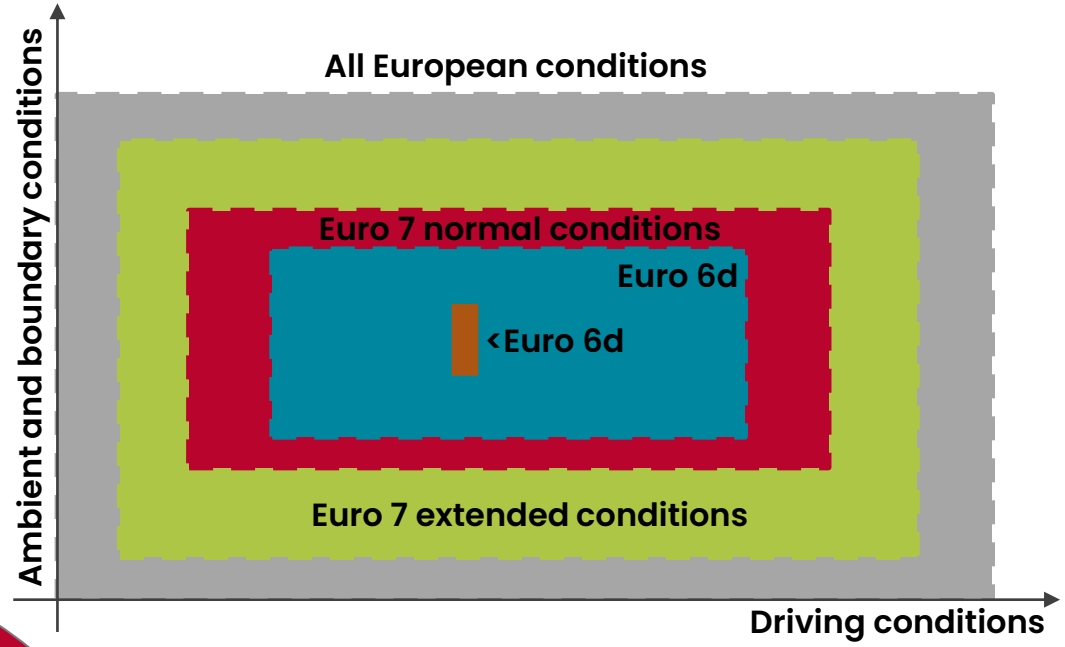
Main facts of the Euro 7 legislation as suggested by EU Commission

EU COMMISSION / CLOVE TARGETS



Considering of all driving conditions

Euro 7 - normal conditions of use

- Ambient 0°C to 35 °C; < 700 m; no trailer; max. speed < 145 km/h
- Smooth driving in cold start area (<20% wheel power)
- 10.000 km de-greening of EATS (favorable for PM filtration)

Euro 7 - extended condition of use → emissions are divided by 1.6

- Applicable only if a single condition is present
- Ambient -10 °C to 45 °C; < 1800 m; with trailer; max. speed < 160 km/h
- Used wheel power > 20% in cold start area
- 3.000 to 10.000 km de-greening of EATS

Double extended or outside extended condition of use → emission multiplication with 0 (invalid trip)

- For more than one extended condition at the same time
- Outside extended conditions

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Main facts of the Euro 7 legislation as suggested by EU Comission

EU COMMISSION / CLOVE TARGETS

For BEV & PHEV

- Battery durability requirements

For ICE vehicles

- Fuel- and technology-neutral emission limits
- Regulating additional pollutants (N_2O, NH_3, HCHO)
- On-road tests with broader range of driving conditions

For all cars, vans, trucks and buses

- Limits for emissions from brakes
- Compliance with emissions rules for longer vehicle usage periods
- Rules on micro-plastic pollution from tires
- Better market surveillance tests
- More effective emissions tests
- Digital monitoring of compliance

Low emission for all kind of vehicles

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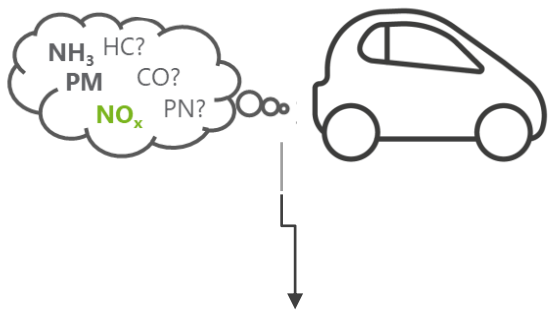
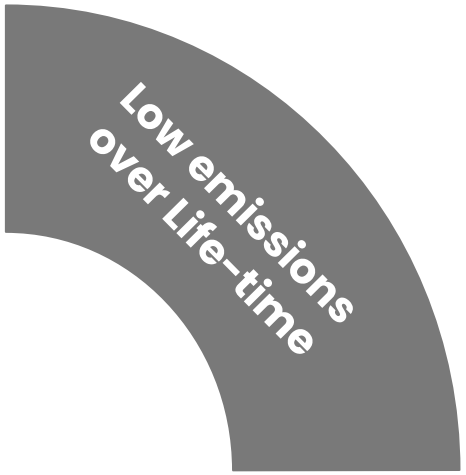
Main facts of the Euro 7 legislation as suggested by EU Commission

EU COMMISSION / CLOVE TARGETS





- Increase of maximum mileage for In-Service Conformity (ISC) / Market Surveillance (MaS) PEMS tests to:
  - 160.000 km and 8 years vehicle age with normal emissions limits
  - 200.000 km and 10 years with 20% higher emissions limits

- On-Board Monitoring system is introduced to monitor the tailpipe emissions of every single vehicle.
  - OBM system need to be demonstrated during Type Approval and Market Surveillance
  - OBM system need to stay active till vehicle leaves the street

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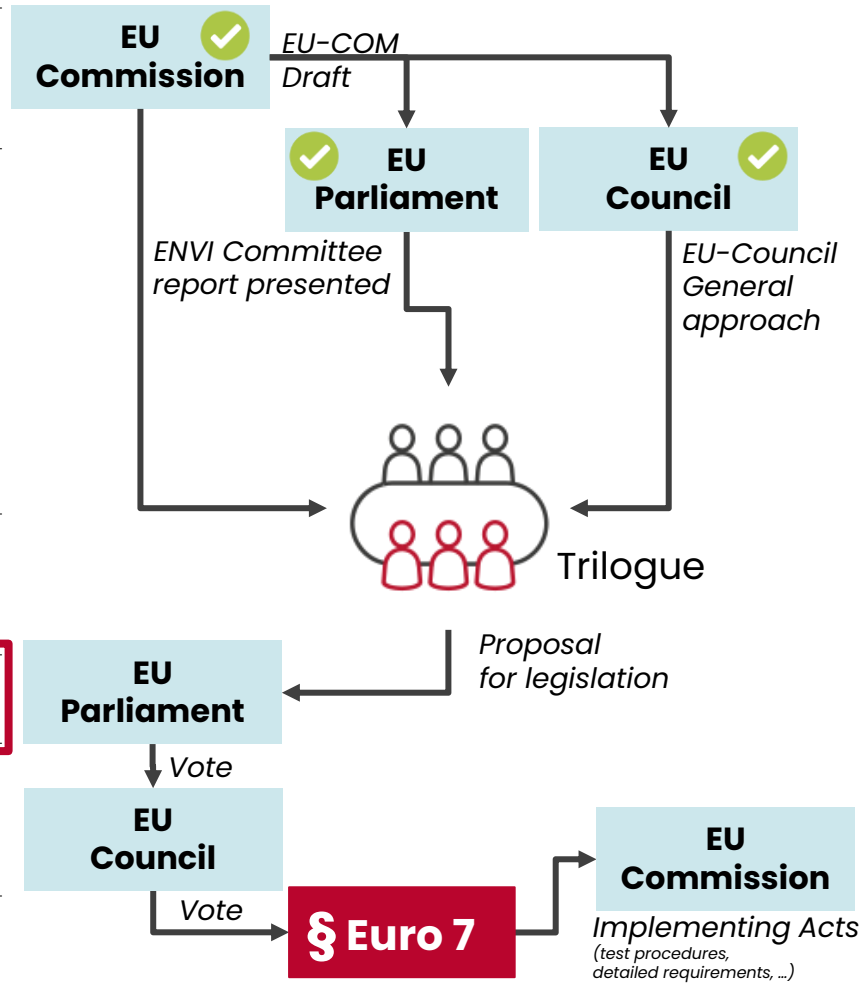
Comparison of Trilogue positions for Light Duty Euro 7 legislation

STATUS: RELEASED ON 19.10.2023

		EU-Commission (Nov. '22)	**EU-Parliament** (Oct. '23)	**EU-Council** (Sep. '23)
1	Emissions Limits	Euro 7, Gasoline = Diesel	- Euro 7, Gasoline = Diesel (incl. NH3, incl. PN10)	Euro 6 (Diesel 80mg/km NOx, no NH3, no PN10, no PM/PN for PFI, …)
2	Boundaries	Any trip, budget for 1st 10km, dynamic limit in cold start	- Boundary extended conditions slightly lighter than EU-COM **(e.g. -7°C to 38°C + <1300m)** - Trip dynamics similar Euro 6 - Trip composition „Any as per normal use" (with new 30% wheel power limit for extended, rare + biased driving excluded.)	As EU6, RDE + WLTP (=valid trip at least 48km)
3	Introduction date TA/NR[2)]	TA+NR 07/25	TA:+24M, NR:+36M After entry into force date base and (!) implementing legislation[1)]	TA:+30M, NR:+42M After entry into force date base legislation[1)]
4	OBM	Yes	Yes	Yes
5	Brake + Tire emissions, Battery durability	Yes	Yes + Battery durability increased e.g. 75%@10Y/200tkm)	Yes
6	Increased lifetime	Yes	Increased, e.g to 12Y/240tkm	Yes



1) Assumed earliest entry into force for base legislation Q2/24, for implementing legislation Q3/24

2) TA= new Type Approvals, NR= New vehicle Registrations

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What is OBM?

EU COMMISSION APPROACH

BACKGROUND

Article 3 –Definitions

(38) 'on-board monitoring system' or 'OBM' means a system on board a vehicle that is capable of detecting either emission exceedances or when a vehicle is in zero-emission mode if applicable, and capable of indicating the occurrence of such exceedances by means of information stored in the vehicle, and of communicating that information via the OBD port and over the air'

SCOPE

- OBM is designed as a faithful representation of emissions
- Technology-neutral
- All Euro 7 vehicles
- Both for LDV and HDV (but development of concept has started by LDV)
- Same application calendar as the rest of the standard

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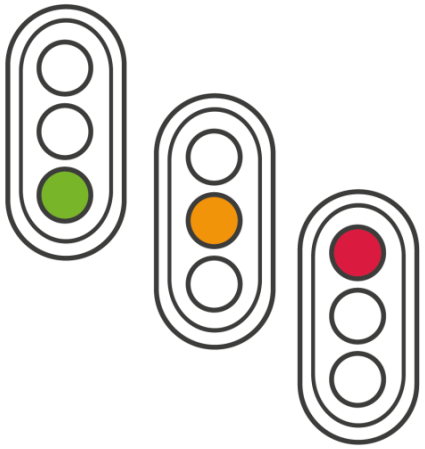
Euro 7 – OBM

OBM APPROACH

1 OBM

2 TRIP EMISSIONS

3 EEDWS



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Euro 7 – OBM

OBM BASIC PRINCIPLES

- Emissions to be monitored even beyond full useful life thresholds
- The OBM pollutants traced are the following:
  - NO_x [mg/s]
  - NH_3 [mg/s]
  - PM [mg/s]
- The key monitoring OBM emissions will be measured per trip:
  - Time resolved signals to be available from OBD port (1Hz for NO_x and NH_3 , as no readily available technology yet for PM)
  - Emissions are monitored throughout the whole duration of the trip
  - Additional signals are also monitored and used as metadata for further analysis

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Euro 7 – OBM

CALCULATION OF OBM TRIP EMISSIONS

- Emissions can be supported by models (expected for cold start due to present sensor limitations)
- Emissions data are ‘RDE processed’ in vehicle
- The vehicle processes the emissions data using ‘data flags’ associated to multipliers consistent with the data evaluation method for RDE trips
- In-vehicle processing of ‘unprocessed’ [g/s] emissions (trip conditions evaluated by the vehicle):
  - Emissions in normal conditions are normally counted
  - Emissions in extended conditions get a 1.6 divider
  - Emissions in double extended conditions get a 0 multiplier (invalid)
  - Emissions in ‘inducement’ condition get a 0 multiplier (invalid)
  - Emissions for trips <10km are calculated as if trip distance = 10 km

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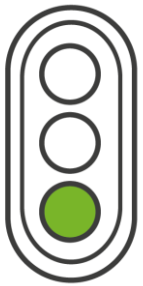
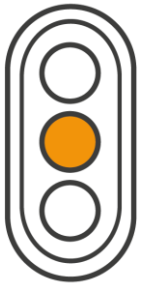
Euro 7 – OBM

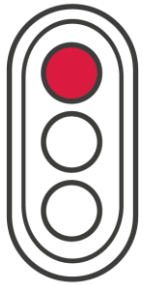
EXCESS EMISSIONS DRIVER WARNING SYSTEM (EEDWS)



- **GREEN** (NORMAL MONITORING)
  - Emissions OK (vehicle is not a high emitter, monitoring is normal)
  - Vehicle may be selected for ISC (other ISC vehicle selection criteria continue to apply; normal accuracy criteria apply to OBM ISC test)
  - Vehicle may produce an indication of green status upon engine start



- **AMBER** (INCONCLUSIVE MONITORING)
  - Emissions probably OK (vehicle is not a high emitter, but OBM monitoring is inconclusive)
  - Vehicle may be selected for ISC (other ISC vehicle selection criteria continue to apply; less strict accuracy criteria apply to OBM ISC test)
  - Vehicle must produce an indication of amber status upon engine start (no driver action required)



- **RED** (POSSIBLE LARGE EMISSIONS EXCEEDANCE)
  - Emissions probably not OK (possible large emissions exceedance, or OBM is faulty)
  - Vehicle is not fit for ISC (it may still be tested, but result do not lead to ISC fails)
  - Inducement must be triggered (inducement starts with a soft warning; the inducement level can escalate or self-heal)

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Euro 7 – Upcoming engineering challenges

OBD - OBM APPROACH

- Shared hardware elements (e.g. sensors, OBD port)
- OBD can support OBM (and vice-versa)
- No hierarchy, no functional dependencies, the systems run in parallel (OBD cannot override OBD)
- OBD will have to pinpoint a fault at the time Inducement is triggered by EEDWS. Alternatively, off-board diagnostics methods can be employed

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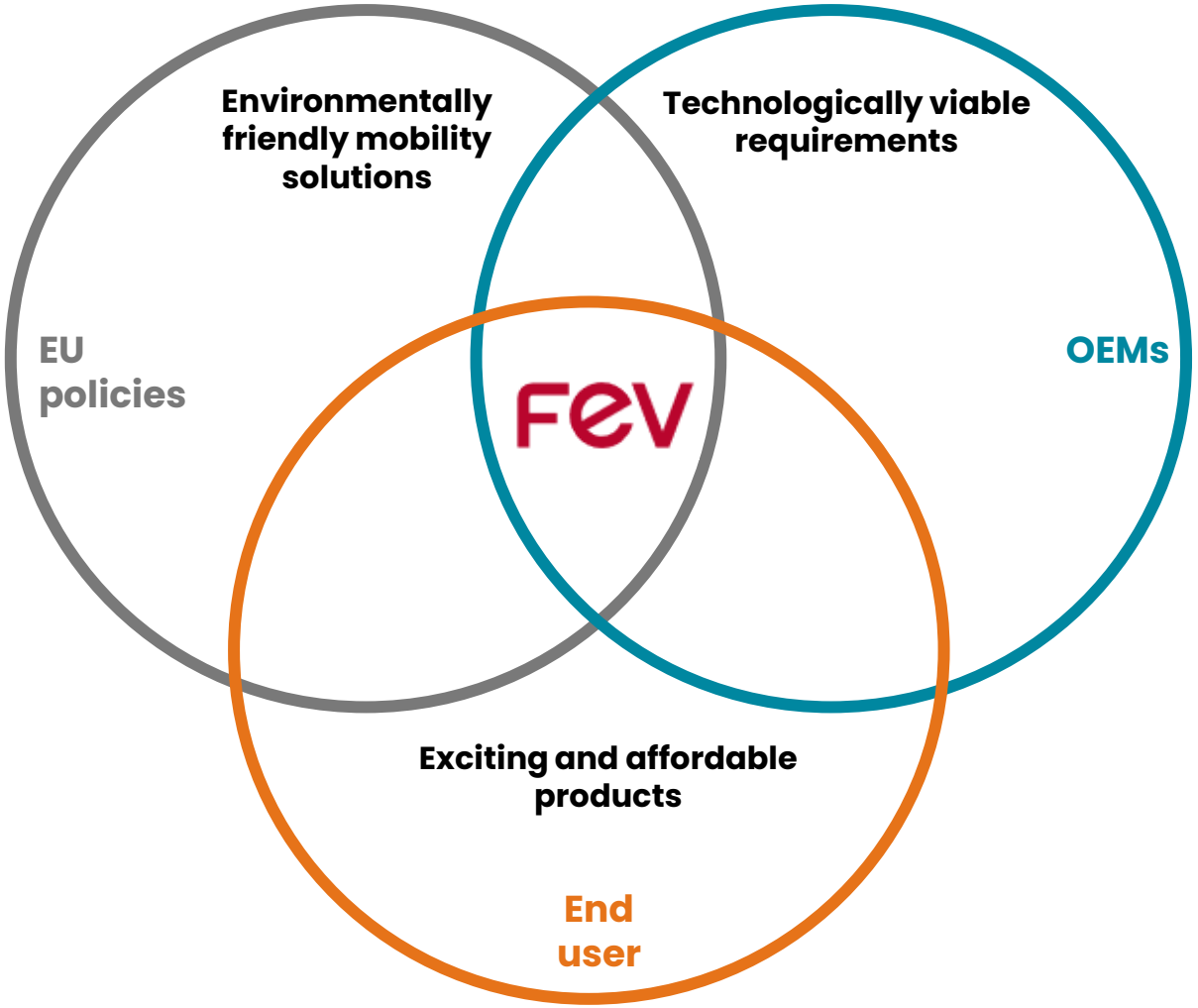
Euro 7 – Upcoming engineering challenges

TAKEAWAYS



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