

POWERTRAINS, FUELS AND LUBRICANTS

SEPTEMBER 22-23, 2020
Online & On-Demand

Executive Leader: **BOSMAL** 

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Ultra-low heavy-duty Diesel NOx emissions in real world conditions

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AECC members : European Emissions Control companies



- Exhaust emissions control technologies for original equipment, retrofit and aftermarket for all new cars, commercial vehicles, motorcycles, and non-road mobile machinery
- AECC is # 78711786419-61 in EU Transparency Register and has consultative status with the UN Economic and Social Council (ECOSOC)



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 - Euro 7 confirmed in EU Green Deal communication
 - Technologies available to handle real-world operation emissions
- Heavy-duty Diesel
 - Real-world operation data of Euro VI vehicles
 - 2020 HD demonstrator project
- Summary and outlook



Euro 7 confirmed in EU Green Deal communication

For cars, vans, buses and trucks

- European Commission working group:
Advisory Group on Vehicle Emission Standards (AGVES)
- Studies by CLOVE consortium until Mid of 2021
- European Commission proposal expected in 2021 followed by
ordinary legislative procedure with European Parliament and Council



➤ Schedule

➤ CLOVE



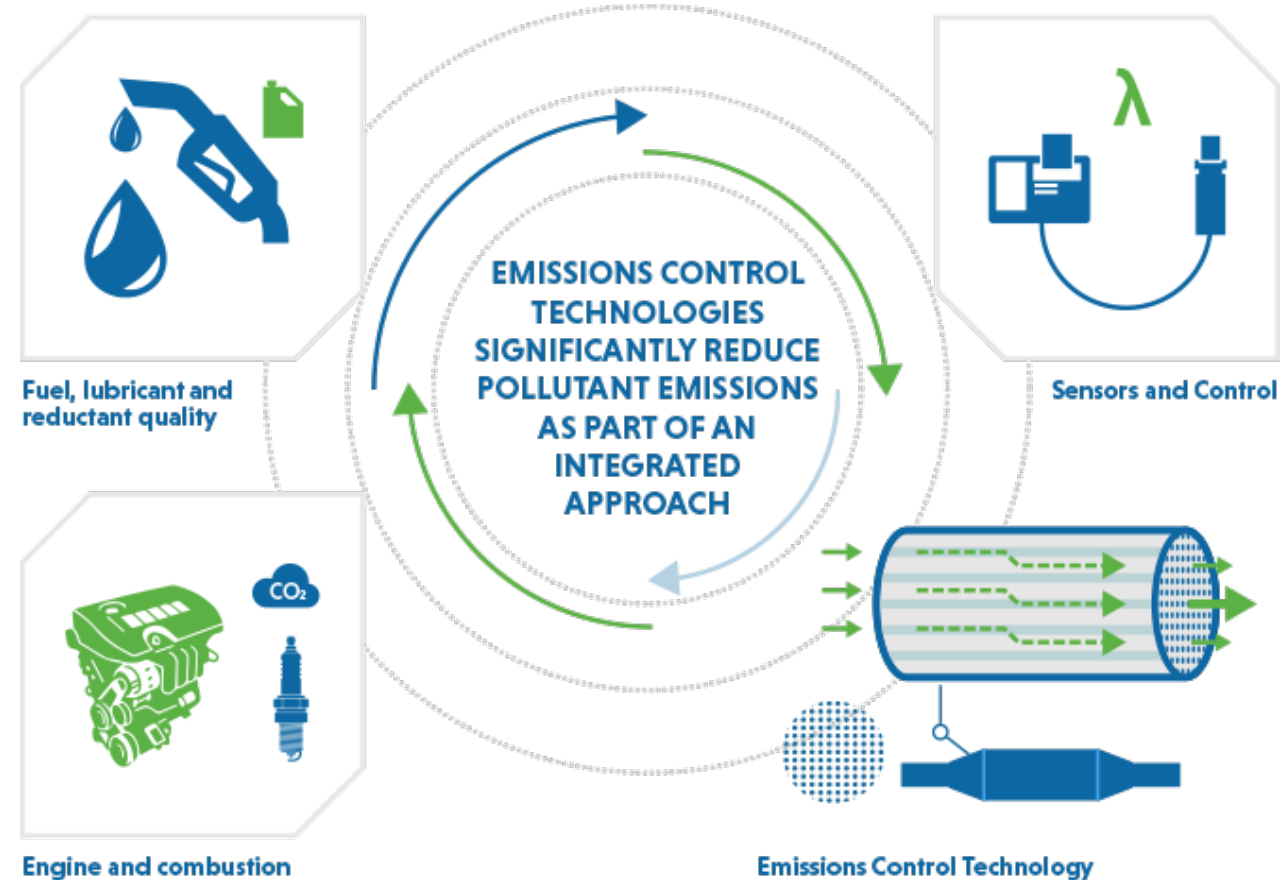
➤ EC/AGVES



Technologies available to handle real-world operation emissions

For light- and heavy-duty applications

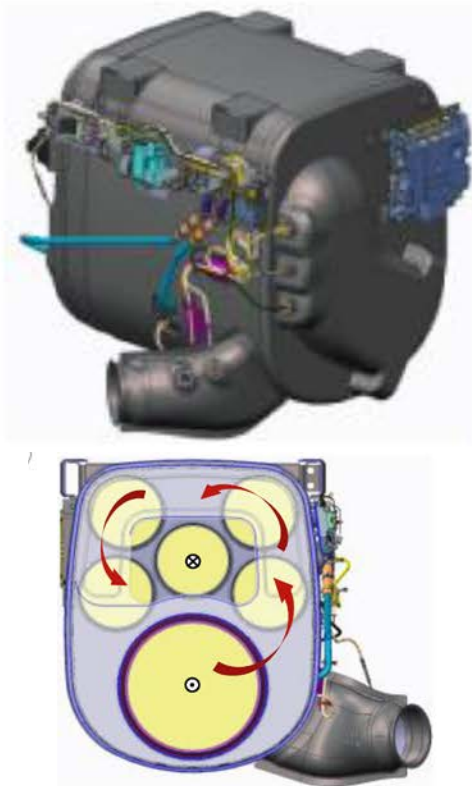
- Emissions control technologies significantly reduce pollutant emissions as part of an integrated approach
- Euro 7/VII will drive further innovation in
 - Catalyst and filter technology design
 - Emissions control system layout
 - System control
- Common system layout characteristics to handle real-world operation emissions
 - Close coupled and underfloor components to tackle emissions in all driving conditions
 - Total catalyst and filter volume to cope with peak engine pollutant flow



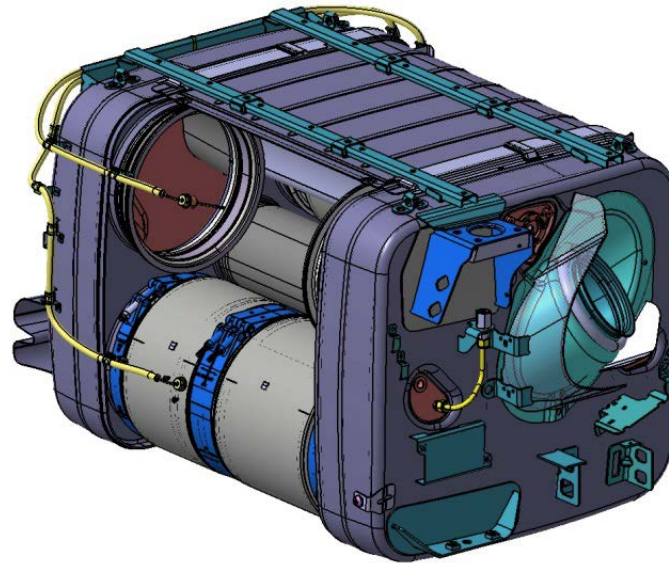
Technologies available to handle real-world operation emissions

For heavy-duty applications

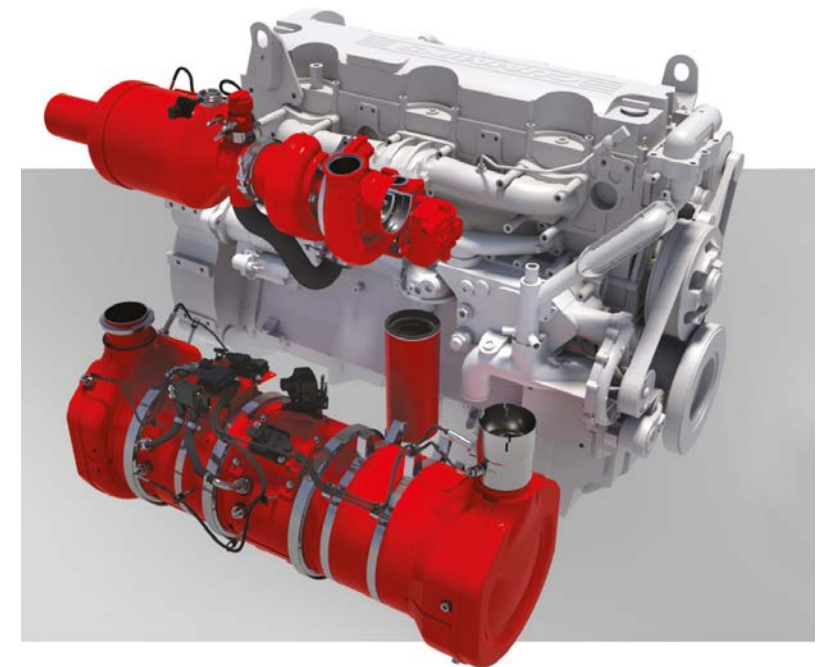
- Examples of available systems for heavy-duty diesel
- Example of announced system with close-coupled components for heavy-duty diesel



Source: DAF



Source: Daimler



Source: Cummins

Objective & scope of Heavy-duty test programmes

- Identify real-world emissions of Euro VI vehicles for broad range of applications
- Investigate
 - Impact of Euro VI-D/E
 - Actual real-world operation vs. Euro VI In-Service Conformity
 - Actual real-world value (=raw data integrated over test) vs. ISC data evaluation
- Available data for the study
 - Existing real-world operation database of 23 vehicles (Euro VI-A to VI-C)
 - Real-world operation data measured on 3 vehicles (Euro VI-D)
 - Detailed testing on 1 vehicle (N3 Euro VI-C distribution truck)
 - Euro VI ISC route
 - Actual real-world operation



Objective & scope of Heavy-duty test programmes

➤ Vehicles

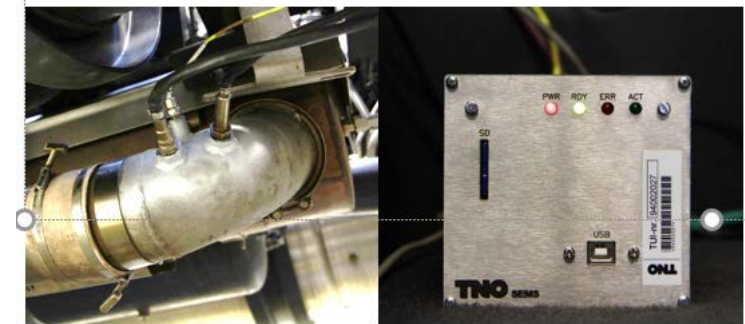
- Normal usage of vehicles in the ranged from urban and regional delivery, to sand haulage trucks, standard and articulated buses.

➤ Methodology

- On-road test were carried out with Smart Emissions Measurement System (SEMS) during normal operation
- Vehicles were instrumented by the contractor and then left with the SEMS for about 1 or 2 weeks, after which, the data was retrieved
- Data analysis was executed, applying the formal PEMS evaluation rules to the real world data.



Normal operation of a Euro VI D vehicle



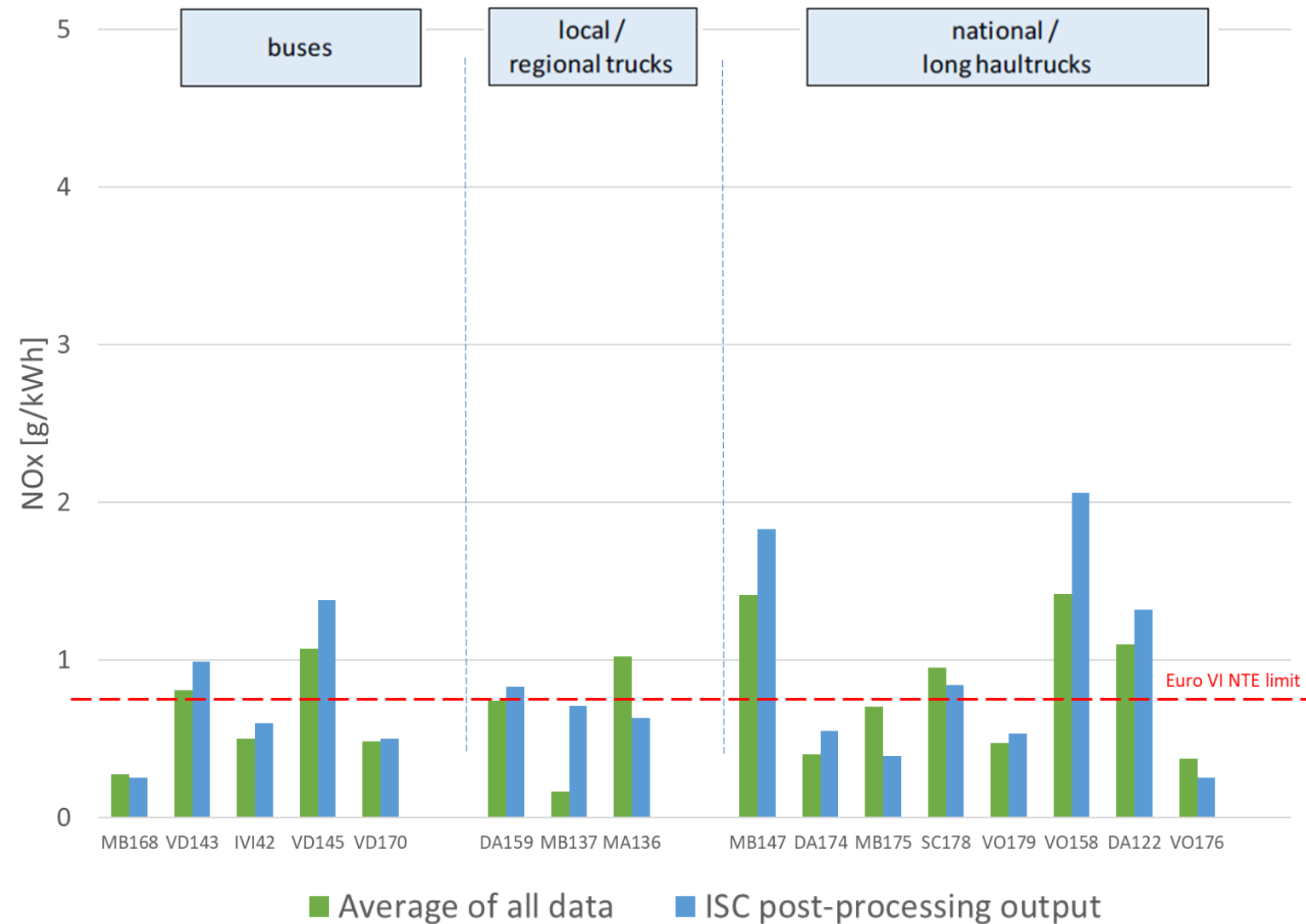
SEMS installation



Data confirms low emissions of Euro VI vehicles on average

- Most vehicles in database have low emissions in real-world operation according to

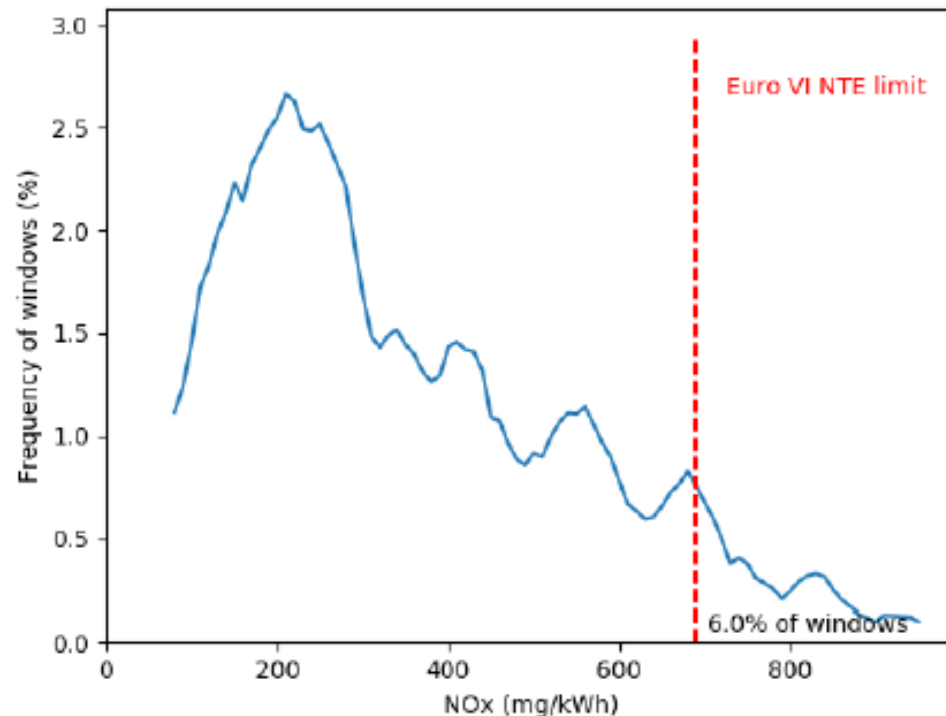
- Average of all data
- ISC data post-processing



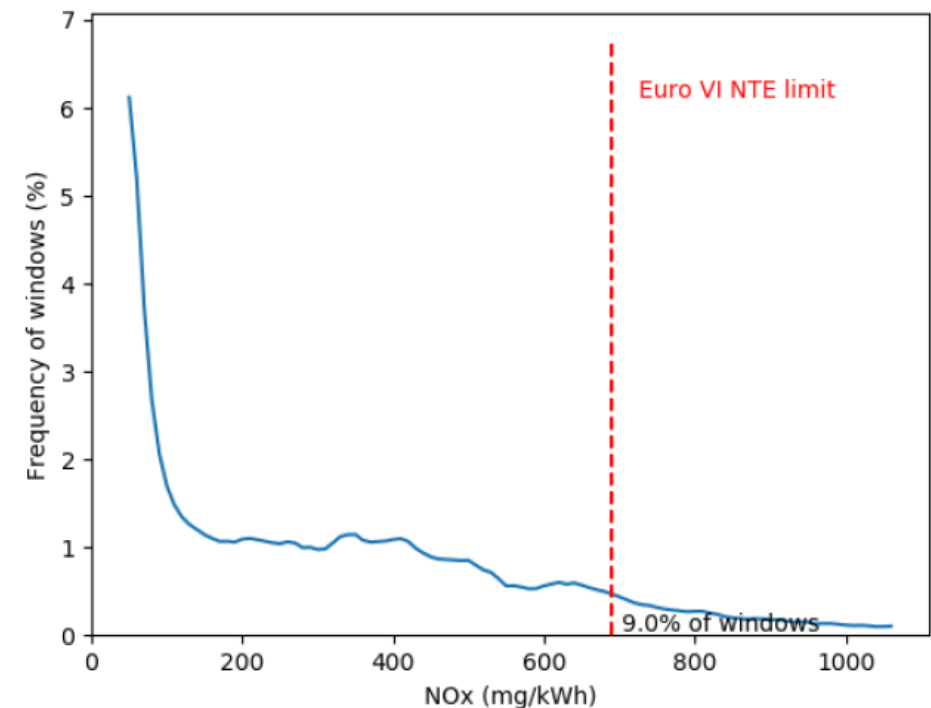
Data confirms low emissions of Euro VI vehicles on average

➤ Several vehicles stay below Euro VI NTE limit during most of real-world operation

➤ Euro VI-A regional bus

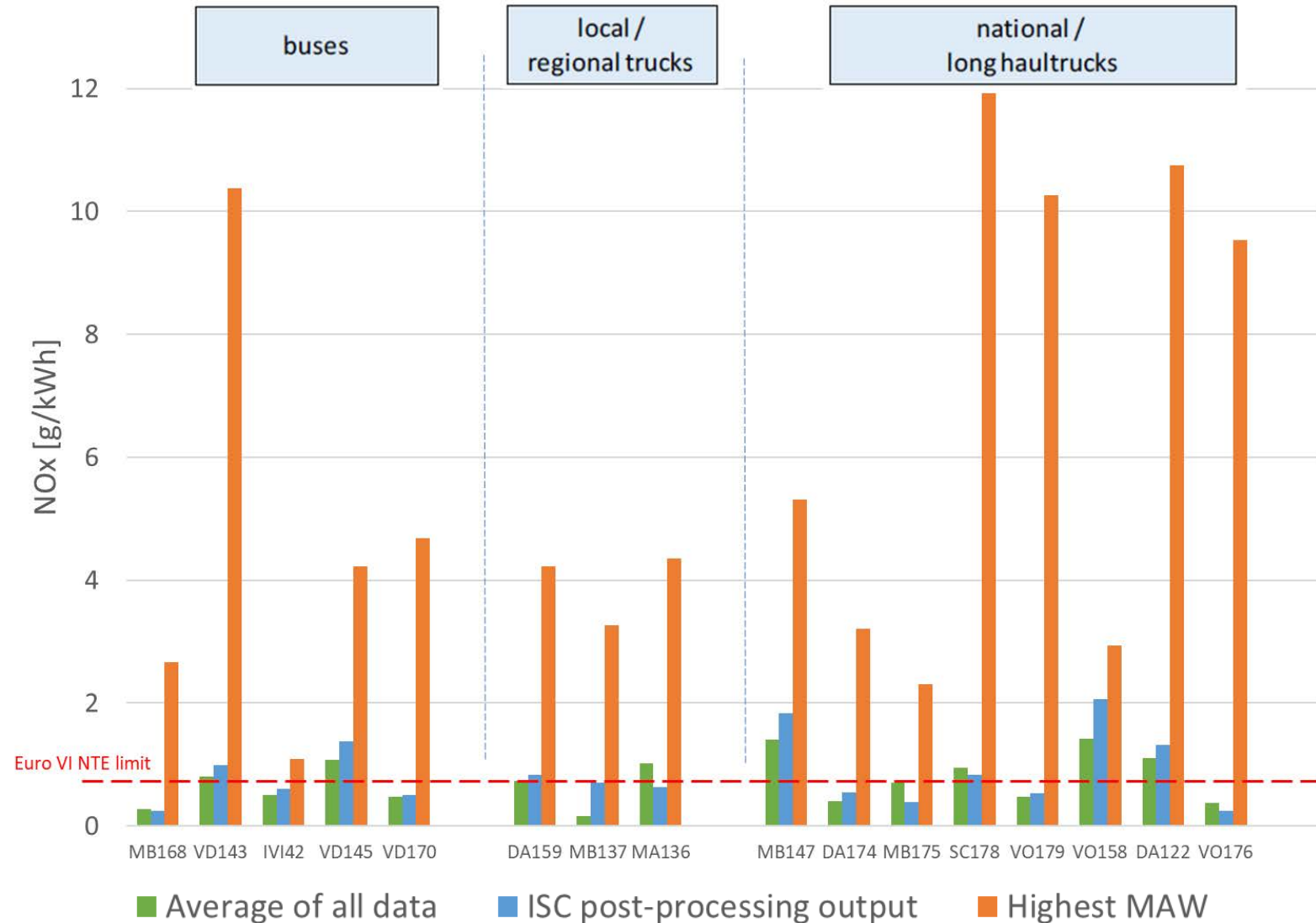


➤ Euro VI-C national distribution truck



ISC post-processing has significant impact

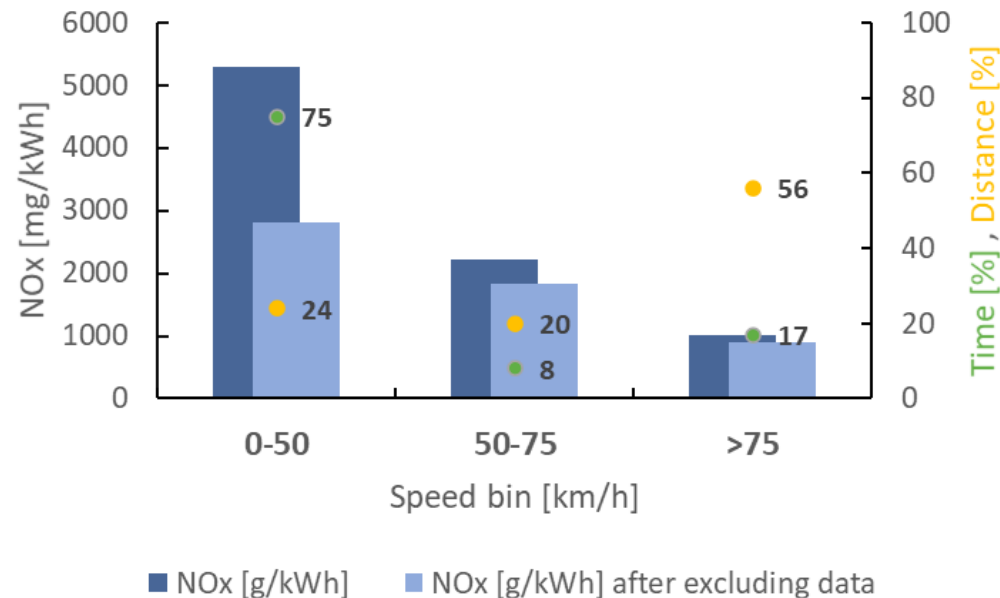
- Most vehicles in database have low emissions in real-world operation according to
 - Average of all data
 - ISC data post-processing
- Highest Moving Average Window in real-world operation can be factor of 5-10 higher
- Investigated next
 - Effect of data exclusions
 - Frequency of high emissions



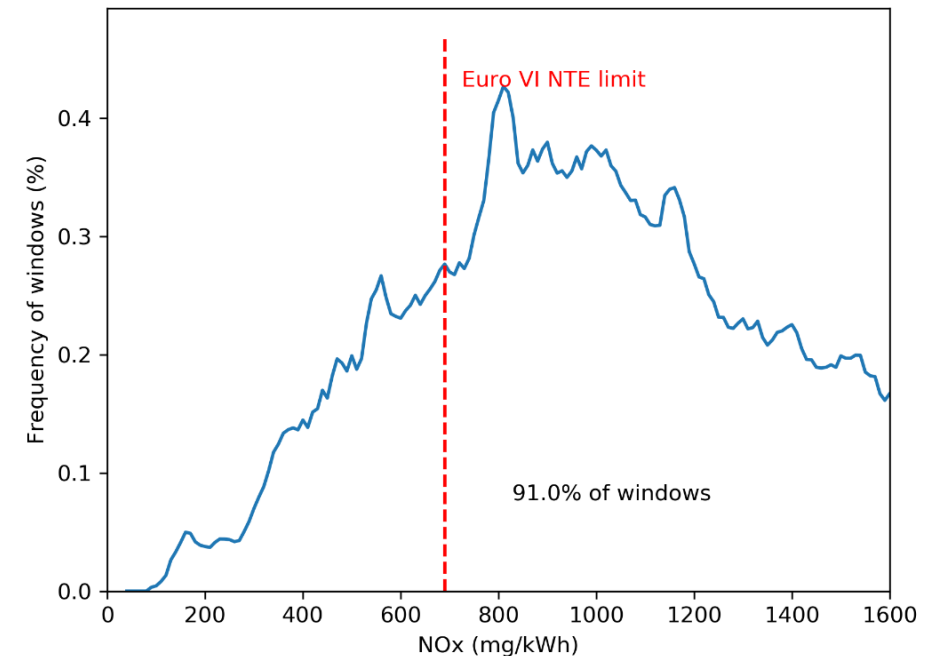
Data exclusions affect urban report value for Euro VI-A to VI-C

➤ Euro VI-A N3 vocational truck

- Urban operation: 75% of the total trip, maximum averaged emissions 11 times the current NOx limit



- 91% of MAW above Euro VI NTE limit

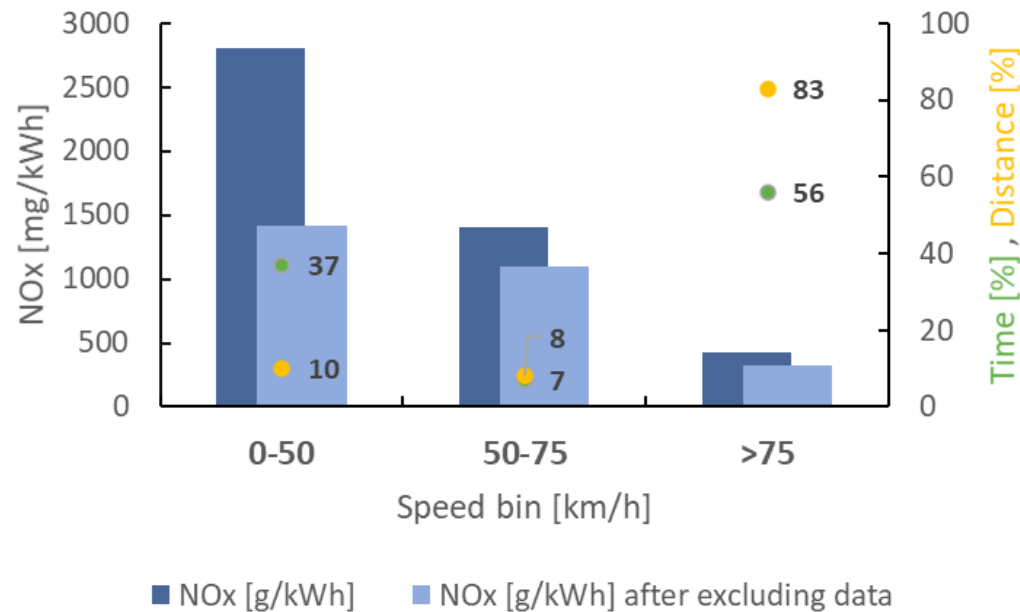


Data excluded: cold start, 20%PT, 90th cumulative percentile.

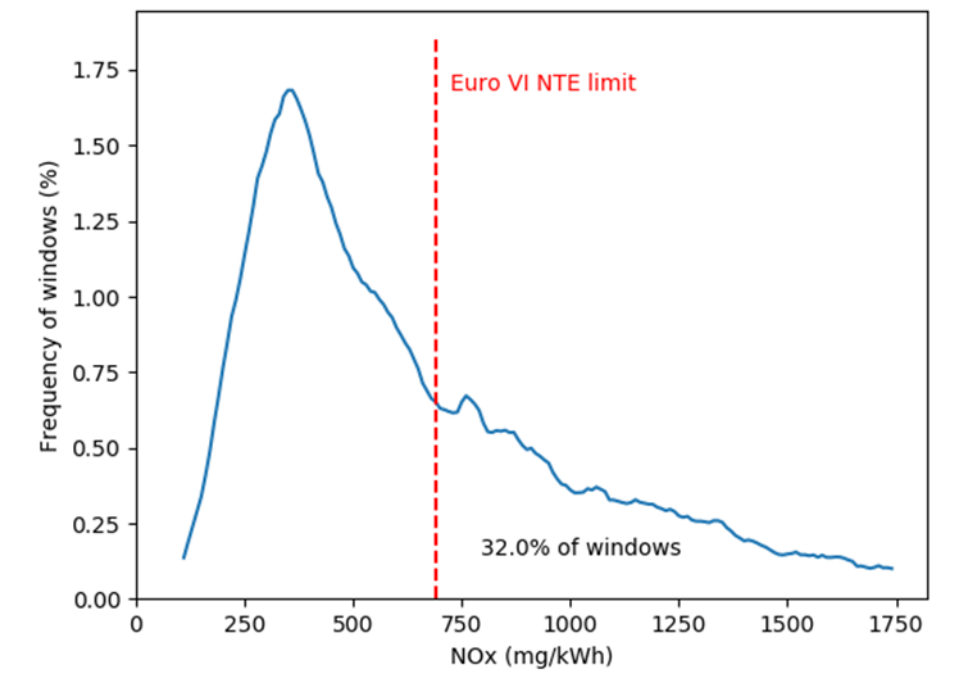
Data exclusions affect urban report value for Euro VI-A to VI-C

➤ Euro VI-C N3 long-haul truck

- Urban operation: 37% of the total trip, maximum averaged emissions 6 times the current NOx limit



- 32% of MAW above Euro VI NTE limit



Data excluded: cold start, 20%PT, 90th cumulative percentile.

Data exclusions affect urban report value for Euro VI-A to VI-C

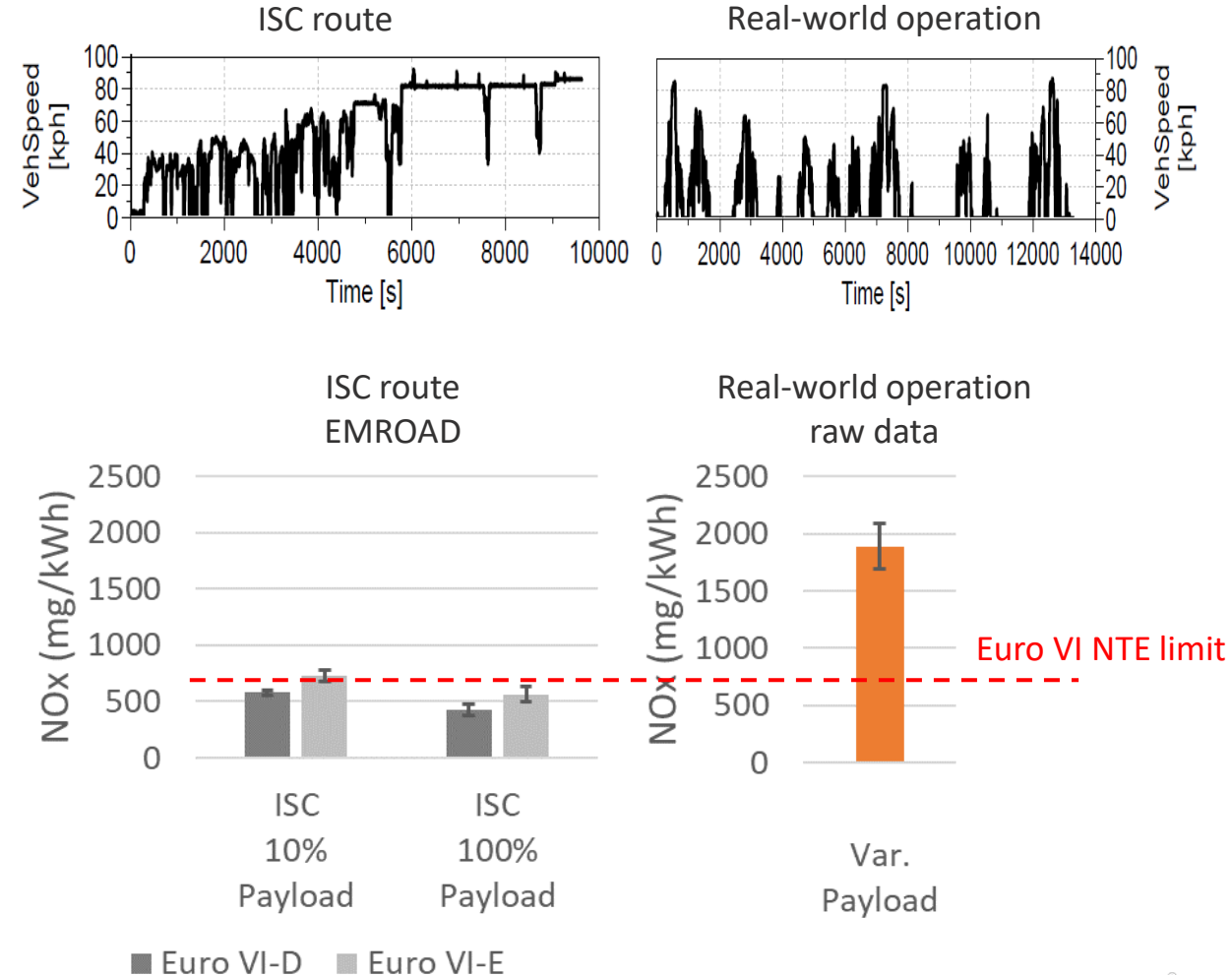
➤ Example of Euro VI-C distribution truck

➤ ISC route

- Stringency increases from Euro VI-D to VI-E
- Truck would comply up to Euro VI-D

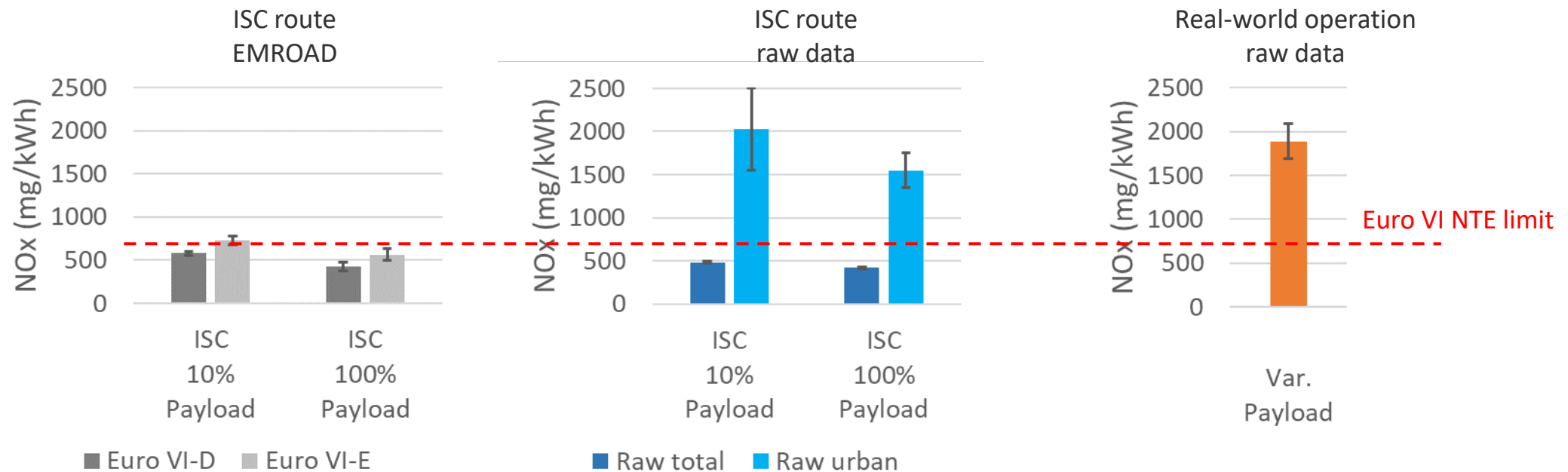
➤ Actual real-world operation

- 100% of time below 10% power threshold
→ Not covered by ISC up to Euro VI-E
- Raw data integrated over test is factor 4-5 higher



Data exclusions affect urban report value for Euro VI-A to VI-C

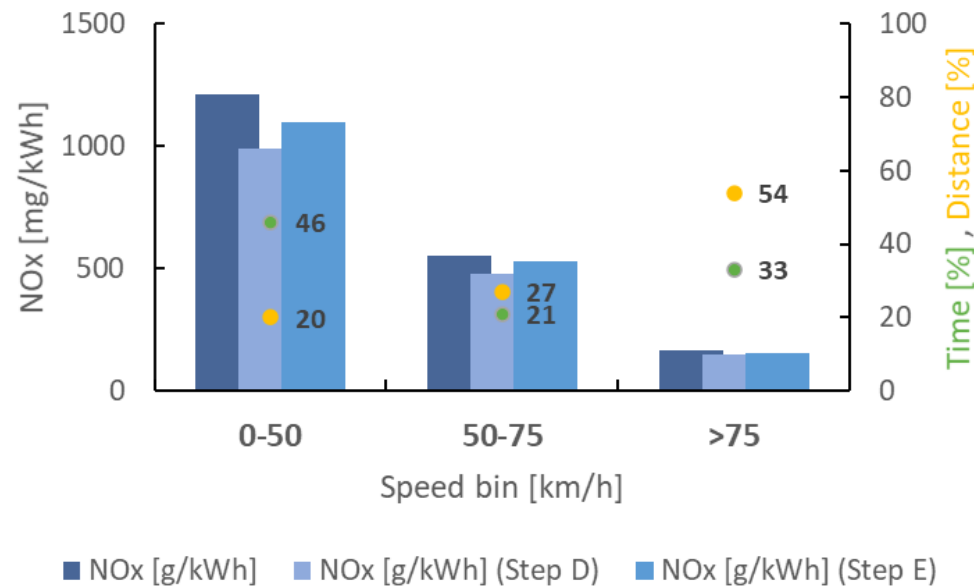
- Example of Euro VI-C distribution truck
 - Urban part of the ISC route reflects actual real-world emissions



Improvements for Euro VI-D, but high emission events still occur

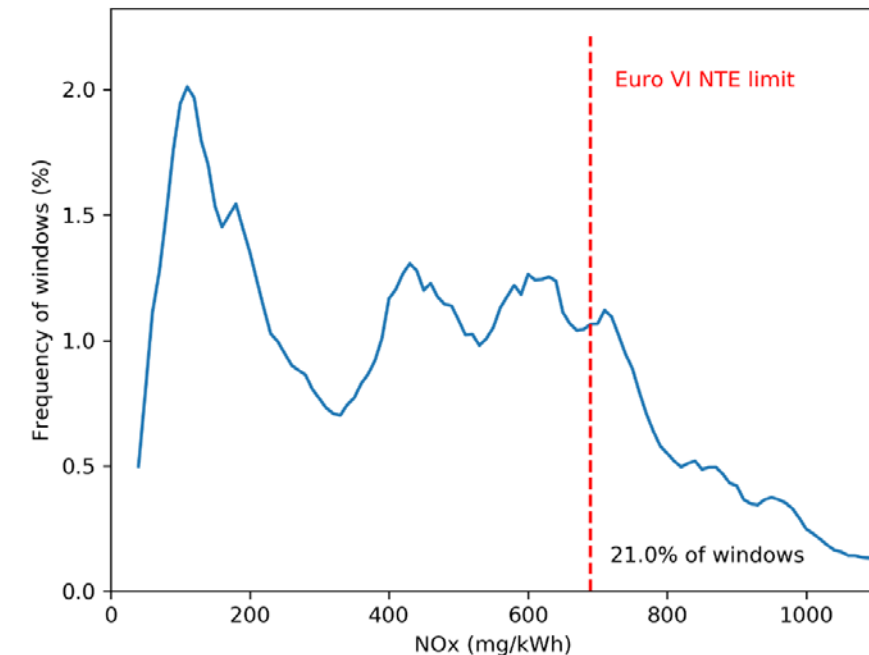
➤ Euro VI-D N2 rigid truck

- Urban operation: 46% of the total trip, maximum averaged emissions 3 times the current NOx limit



Data excluded: as per Step D or E exclusions.

- 21% of MAW above Euro VI NTE limit

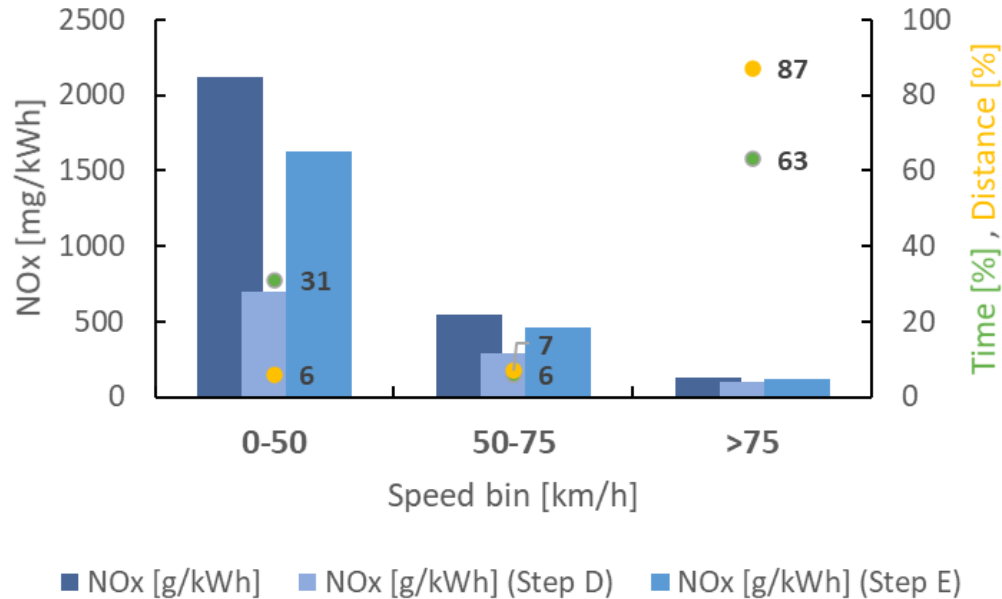


Improvements for Euro VI-D, but high emission events still occur

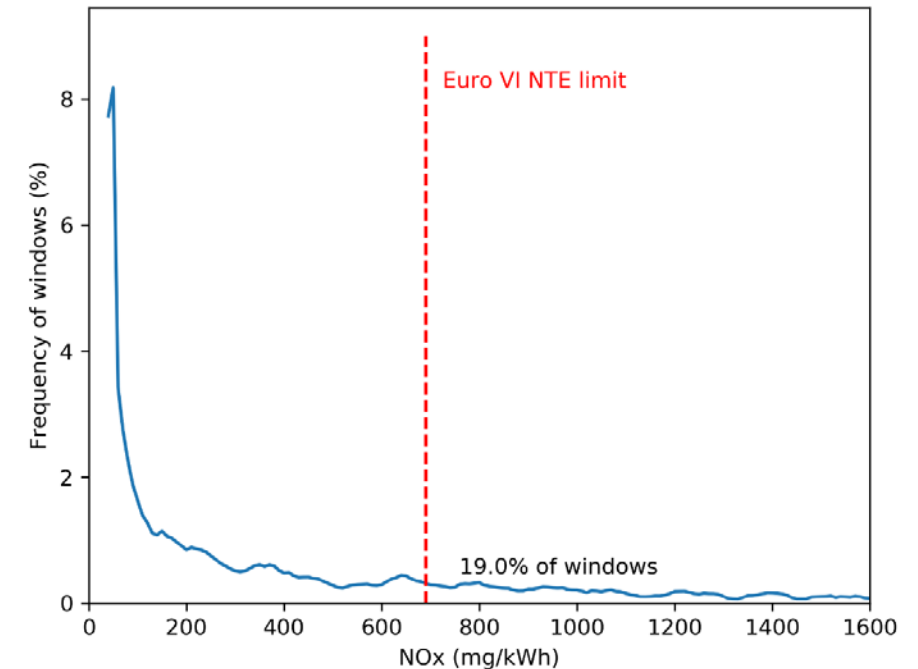
➤ Euro VI-D N3 tractor tanker semi-trailer

- Urban operation: 31% of the total trip, maximum averaged emissions 5 times the current NOx limit

- 19% of MAW above Euro VI NTE limit



Data excluded: as per Step D or E exclusions.



Objective and scope of 2020 AECC HD demonstrator project

- Objective: demonstrate improved urban performance with minimal impact on CO₂
 - Implementation of Emissions control technology to address critical high emissions operation: cold start, city start & delivery operation
 - Total catalyst and filter volume of appropriate size to cope with peak engine pollutant emissions flow
- Focus on on-road measurements
 - All calibration will be performed on the road, and PEMS testing will be used to verify and complement results
 - Tests will be run using an In-service conformity designed route
 - Real world operation trips will also be conducted
 - Different payloads will be considered
 - Critical conditions will be studied
 - Both regulated and unregulated pollutants will be measured (N₂O, NH₃ and PN₁₀)

2020 AECC HD demonstrator concept

- Base vehicle description
 - 4x2 tractor
 - Newest Euro VI powertrain
 - Engine characteristics
 - EGR
 - 13 litres
 - 390hp
- Project partners

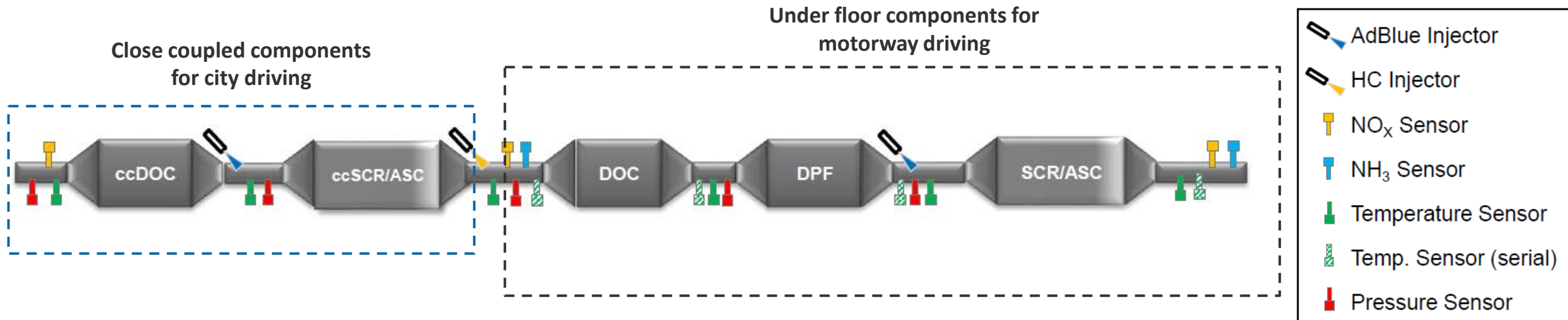


Automotive Grade Urea Sector Group



2020 AECC HD demonstrator concept

- Advanced emissions control system and control software



Summary and outlook

- AECC test programmes data presented
 - Heavy-duty ISC post-processing has significant impact on report value for urban operation
- AECC welcomes the EU Commission's legislative initiative to prepare Euro 7/VII
 - All predictions show the ICE will be included in the majority of the (electrified) powertrain mix in the medium term
 - There remain areas where improvements to the emission standards are required
 - Real-world emissions measurement framework
 - Setting emissions limits to ensure the health and well-being of everyone
- AECC will continue to demonstrate that technologies are available today to effectively control emissions from ICE under real-world operation towards near zero-impact on air quality

THANK YOU !

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