AECC project results on Euro VI HDV real-world emissions

4th AGVES Meeting •
9 July 2020

ASSOCIATION FOR EMISSIONS CONTROL BY CATALYST

Association for Emissions Control by Catalyst (AECC AISBL)

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)

Content

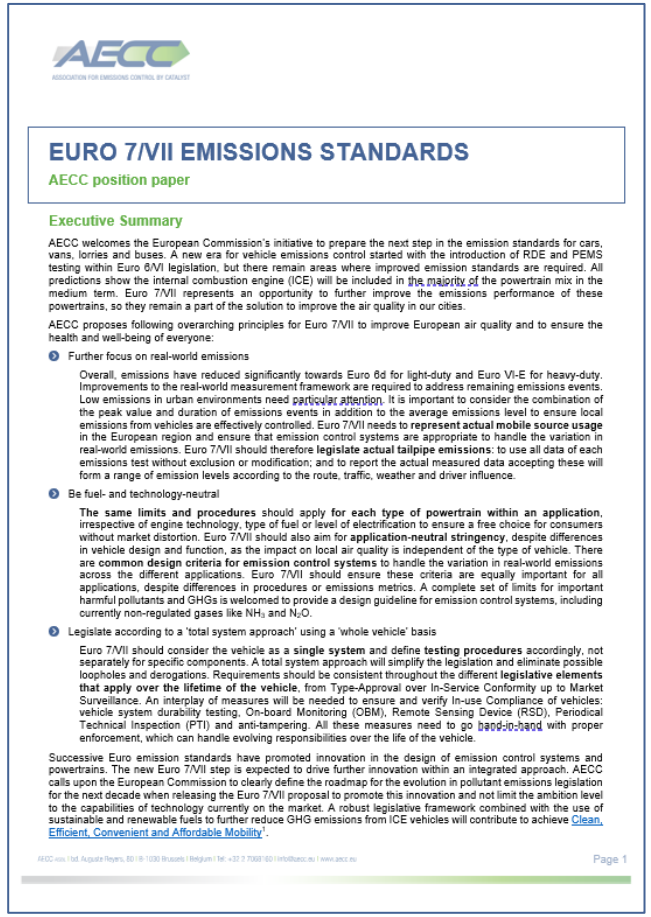
- Introduction
  - AECC Position Paper on Euro 7/VII Emissions Standards
  - Technologies available to handle real-world operation emissions
- Heavy-duty Diesel - Real-world operation data of Euro VI vehicles

- Summary

AECC Position Paper on Euro 7/VII Emissions Standards

Published on 09 July 2020

- Further focus on real-world emissions
  - Further improve air quality and ensure the health and well-being of everyone
  - Represent actual mobile source usage in the European region
  - Legislate actual tailpipe emissions
- Be fuel- and technology-neutral
  - Same limits and procedures for each type of powertrain within an application
  - Aim for application-neutral stringency
  - A complete set of limits for important harmful pollutants and GHGs is welcomed to provide a design guideline for emissions control systems
- Legislate according to a ‘total system approach’ using a ‘whole vehicle’ basis



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EURO 7/VII EMISSIONS STANDARDS

AECC position paper

Executive Summary

AECC welcomes the European Commission's initiative to prepare the next step in the emission standards for cars, vans, lorries and buses. A new era for vehicle emissions control started with the introduction of RDE and PEMS testing within Euro 6/VI legislation, but there remain areas where improved emission standards are required. All predictions show the internal combustion engine (ICE) will be included in the majority of the powertrain mix in the medium term. Euro 7/VII represents an opportunity to further improve the emissions performance of these powertrains, so they remain a part of the solution to improve the air quality in our cities.

AECC proposes following overarching principles for Euro 7/VII to improve European air quality and to ensure the health and well-being of everyone:

- Further focus on real-world emissions

  Overall, emissions have reduced significantly towards Euro 6d for light-duty and Euro VI-E for heavy-duty. Improvements to the real-world measurement framework are required to address remaining emissions events. Low emissions in urban environments need particular attention. It is important to consider the combination of the peak value and duration of emissions events in addition to the average emissions level to ensure local emissions from vehicles are effectively controlled. Euro 7/VII needs to **represent actual mobile source usage** in the European region and ensure that emission control systems are appropriate to handle the variation in real-world emissions. Euro 7/VII should therefore **legislate actual tailpipe emissions**: to use all data of each emissions test without exclusion or modification; and to report the actual measured data accepting these will form a range of emission levels according to the route, traffic, weather and driver influence.

- Be fuel- and technology-neutral

  The same limits and procedures should apply **for each type of powertrain within an application**, irrespective of engine technology, type of fuel or level of electrification to ensure a free choice for consumers without market distortion. Euro 7/VII should also aim for **application-neutral stringency**, despite differences in vehicle design and function, as the impact on local air quality is independent of the type of vehicle. There are **common design criteria for emission control systems** to handle the variation in real-world emissions across the different applications. Euro 7/VII should ensure these criteria are equally important for all applications, despite differences in procedures or emissions metrics. A complete set of limits for important harmful pollutants and GHGs is welcomed to provide a design guideline for emission control systems, including currently non-regulated gases like NH_3 and N_2O.

- Legislate according to a 'total system approach' using a 'whole vehicle' basis

  Euro 7/VII should consider the vehicle as a **single system** and define **testing procedures** accordingly, not separately for specific components. A total system approach will simplify the legislation and eliminate possible loopholes and derogations. Requirements should be consistent throughout the different **legislative elements that apply over the lifetime of the vehicle**, from Type-Approval over In-Service Conformity up to Market Surveillance. An interplay of measures will be needed to ensure and verify In-use Compliance of vehicles: vehicle system durability testing, On-board Monitoring (OBM), Remote Sensing Device (RSD), Periodical Technical Inspection (PTI) and anti-tampering. All these measures need to go hand-in-hand with proper enforcement, which can handle evolving responsibilities over the life of the vehicle.

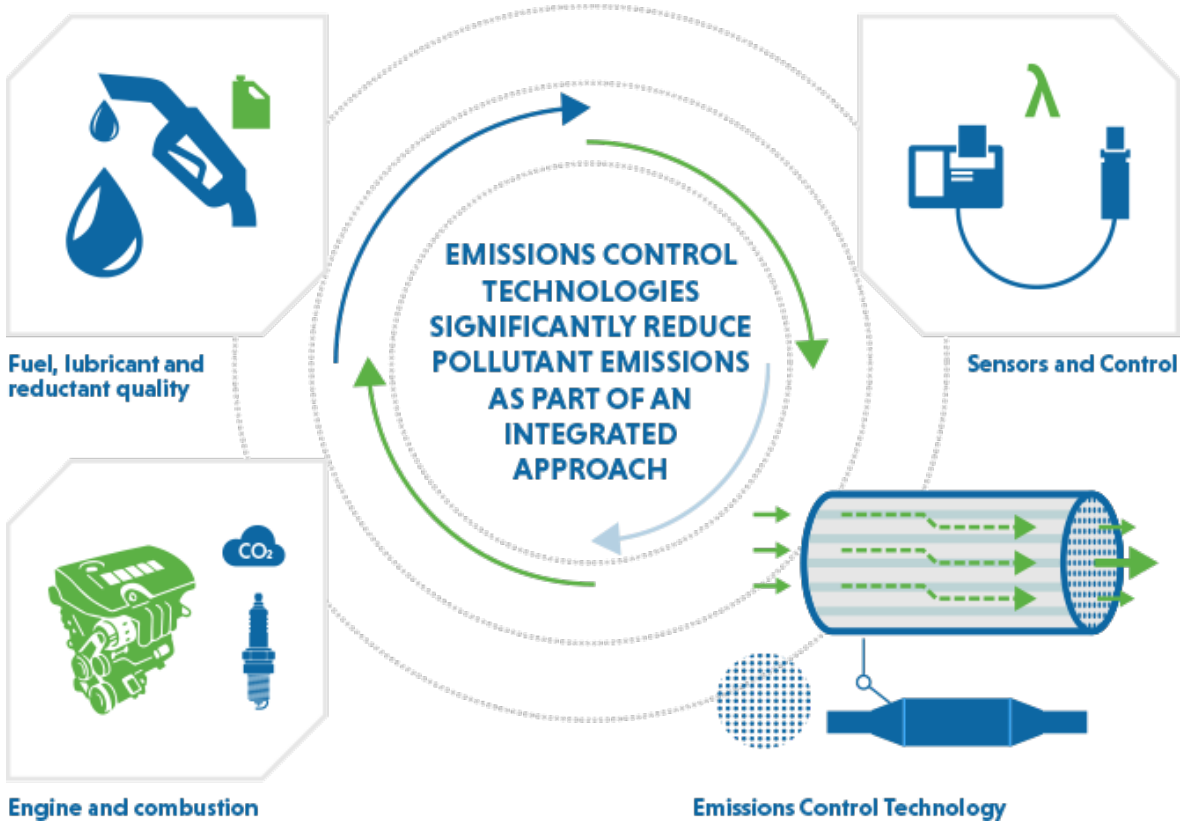
Successive Euro emission standards have promoted innovation in the design of emission control systems and powertrains. The new Euro 7/VII step is expected to drive further innovation within an integrated approach. AECC calls upon the European Commission to clearly define the roadmap for the evolution in pollutant emissions legislation for the next decade when releasing the Euro 7/VII proposal to promote this innovation and not limit the ambition level to the capabilities of technology currently on the market. A robust legislative framework combined with the use of sustainable and renewable fuels to further reduce GHG emissions from ICE vehicles will contribute to achieve Clean, Efficient, Convenient and Affordable Mobility[1].

Page 1

Technologies available to handle real-world operation emissions

For light- and heavy-duty applications

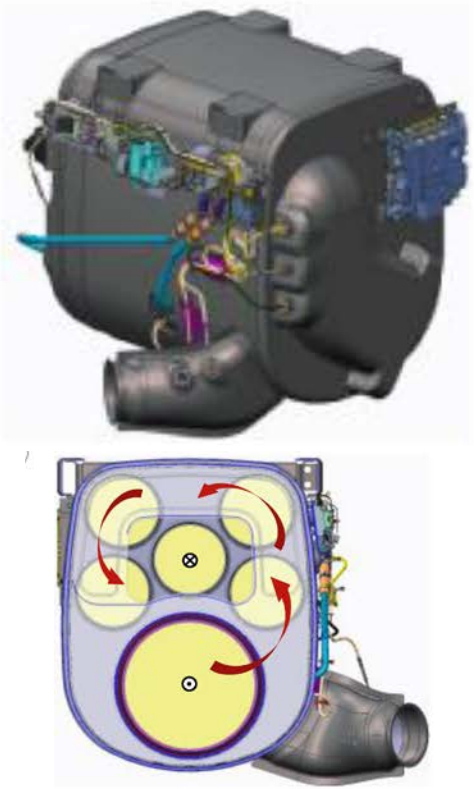
- Emissions control technologies significantly reduce pollutant emissions as part of an integrated approach
- Euro 7/VII will drive further innovation in
  - Catalyst and filter technology design
  - Emissions control system layout
  - System control
- Common system layout characteristics to handle real-world 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



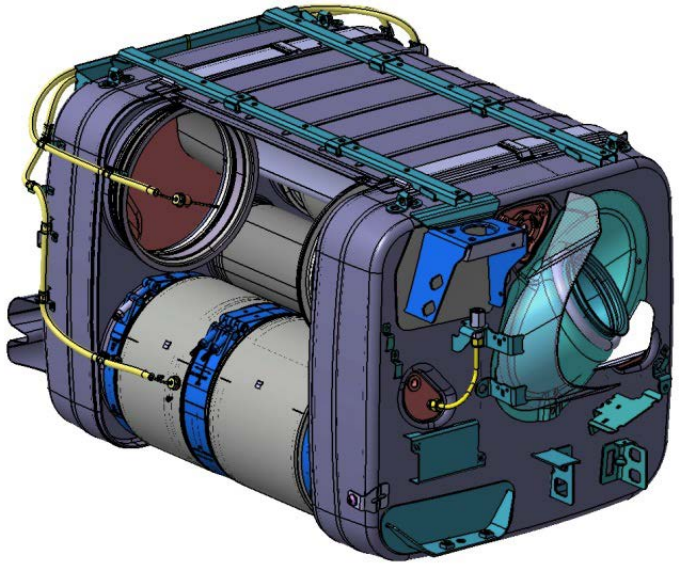
Technologies available to handle real-world operation emissions

For heavy-duty applications

- Examples of available systems

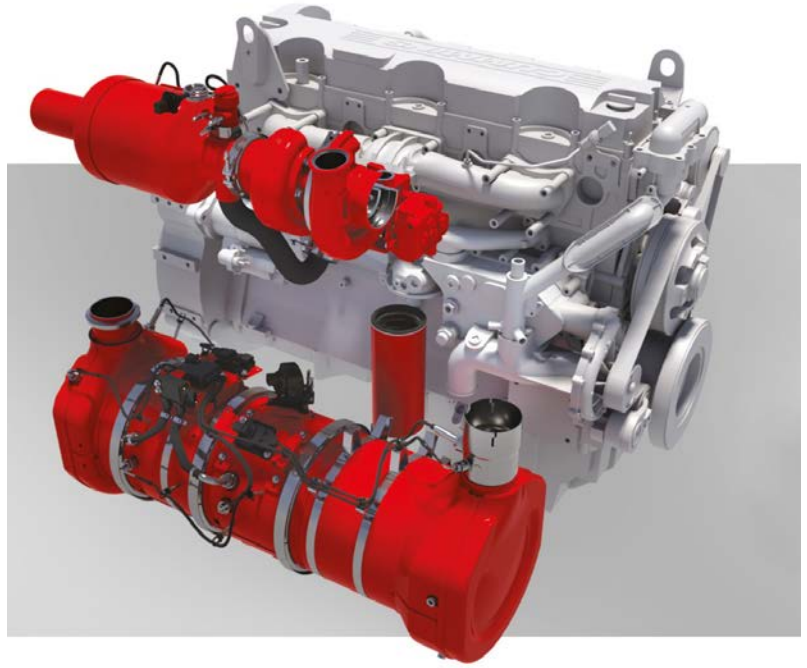


Source: DAF



Source: Daimler

- Example of announced system with close-coupled components



Source: Cummins

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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 data post processing
  - 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

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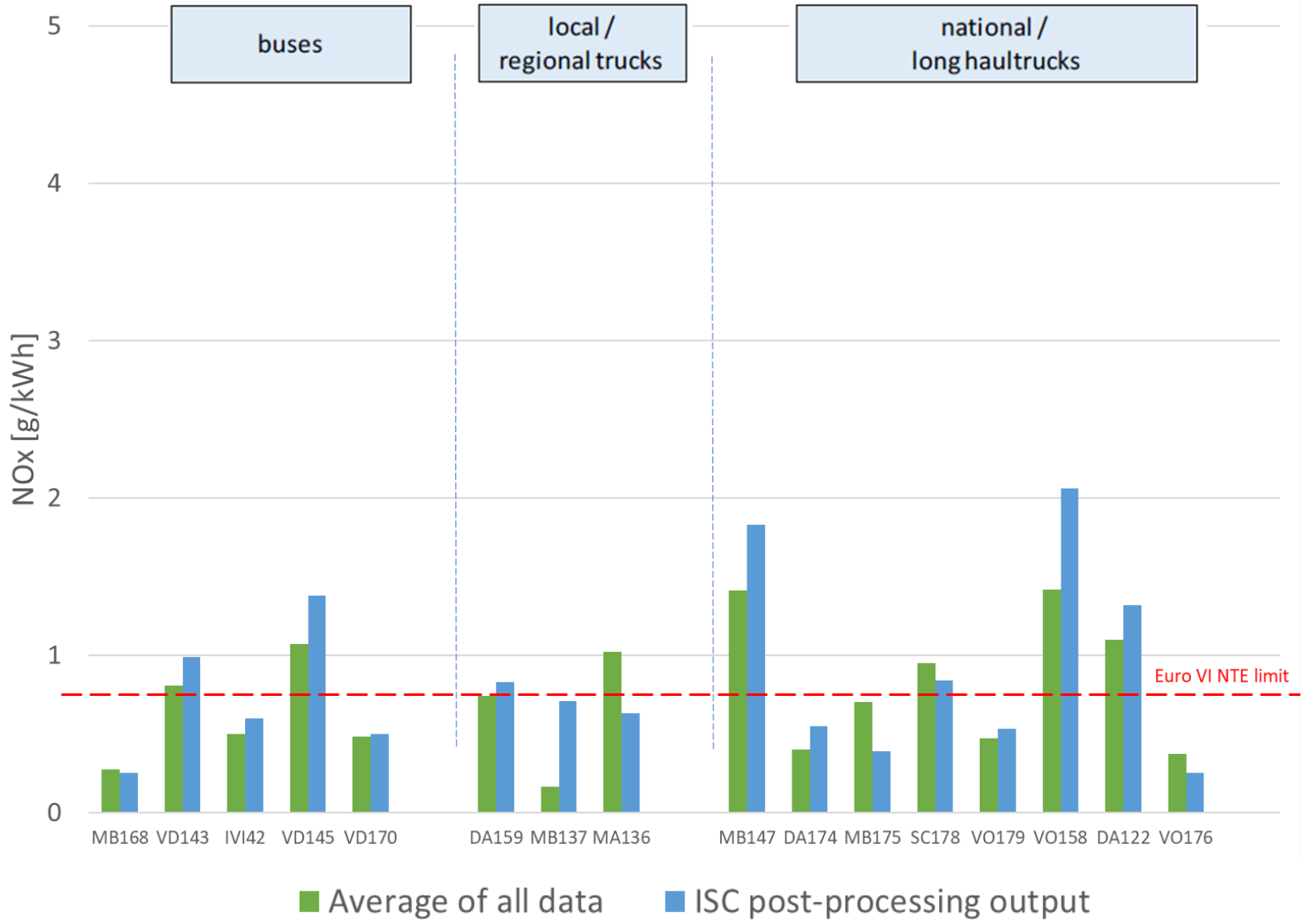
Data confirms low emissions of Euro VI vehicles on average

- Most vehicles in database have low emissions in real-world operation according to
  - Average of all data
  - ISC data post-processing



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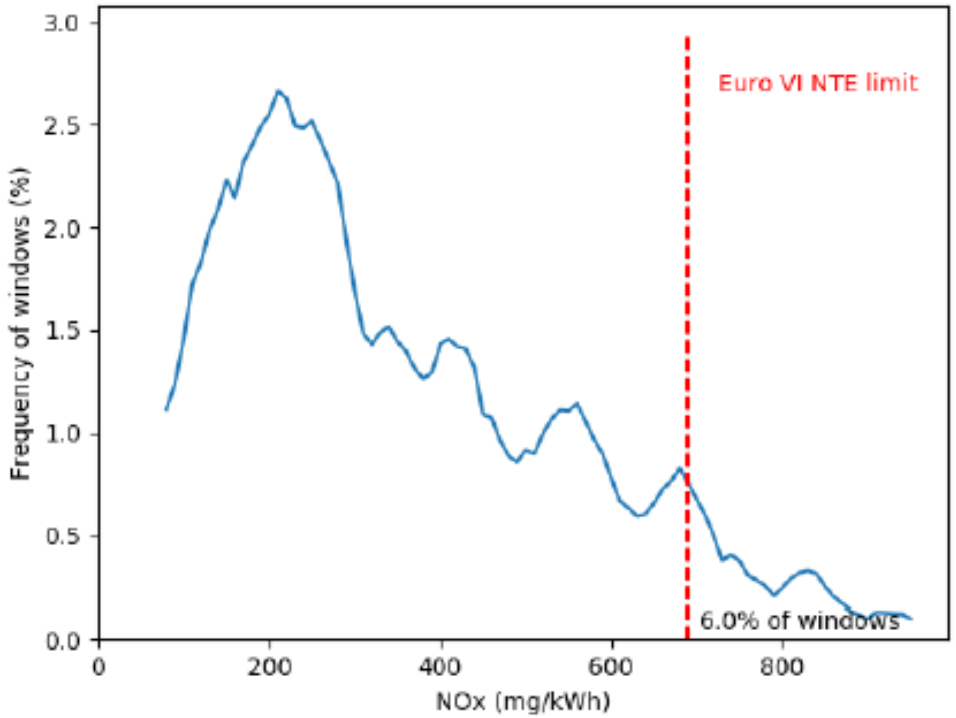
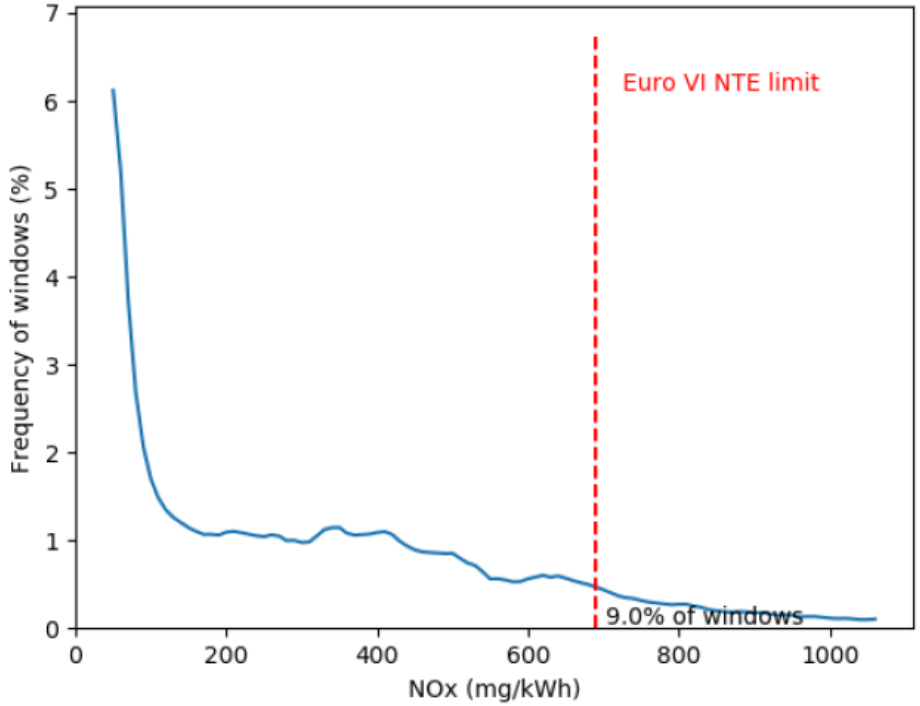
Data confirms low emissions of Euro VI vehicles on average

- 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



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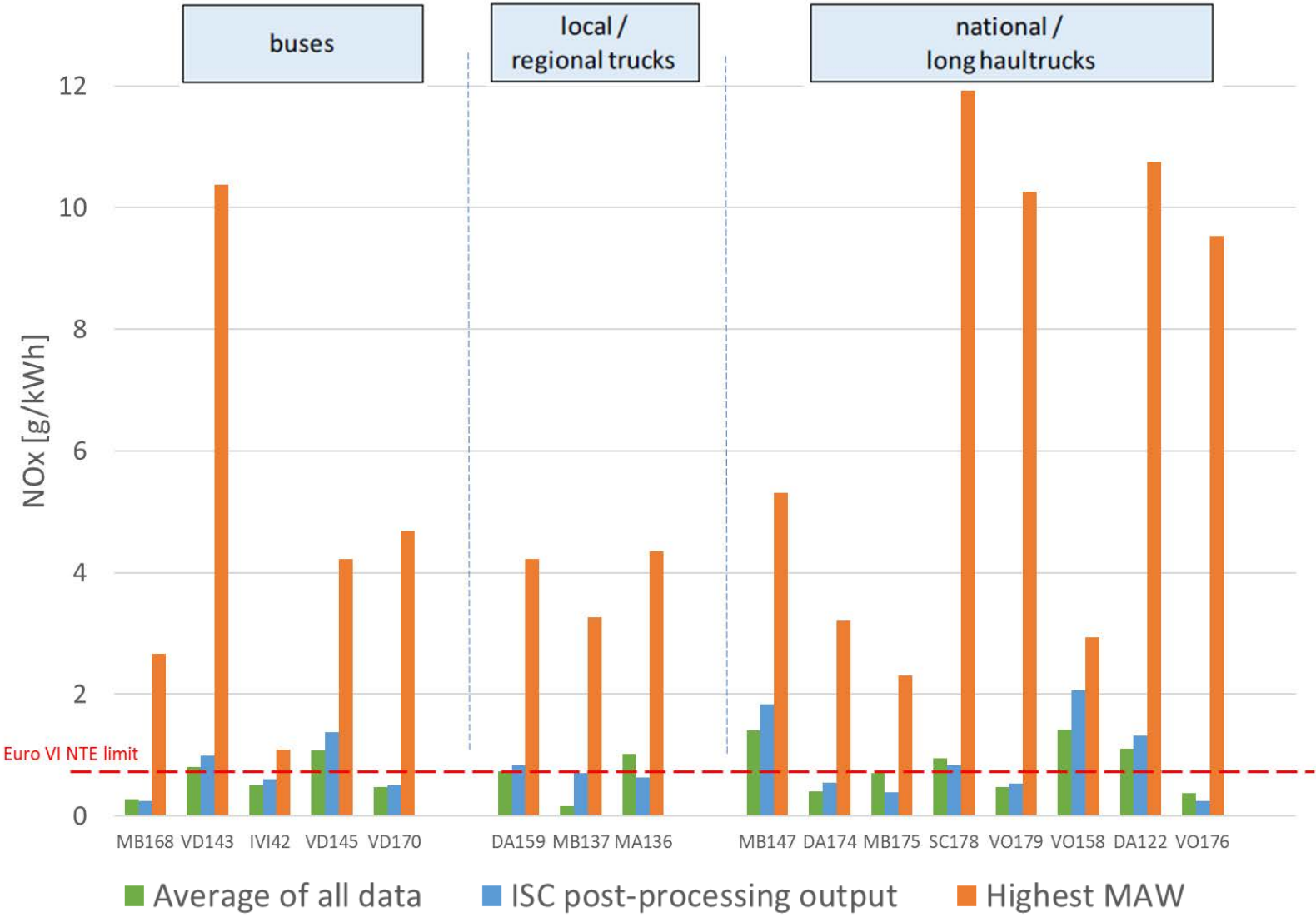
ISC post-processing has significant impact

- 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



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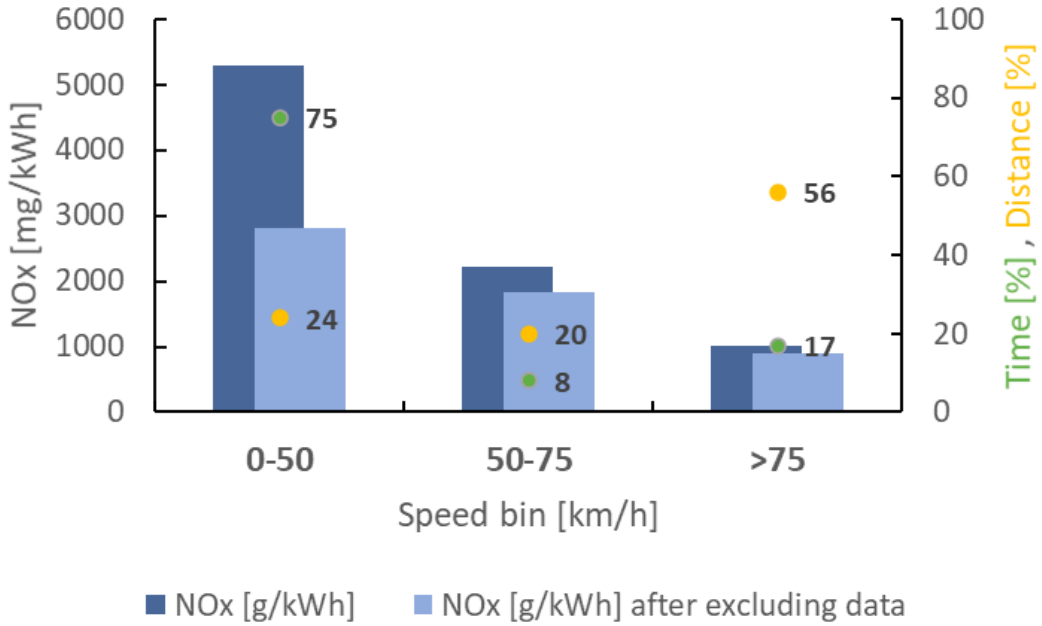
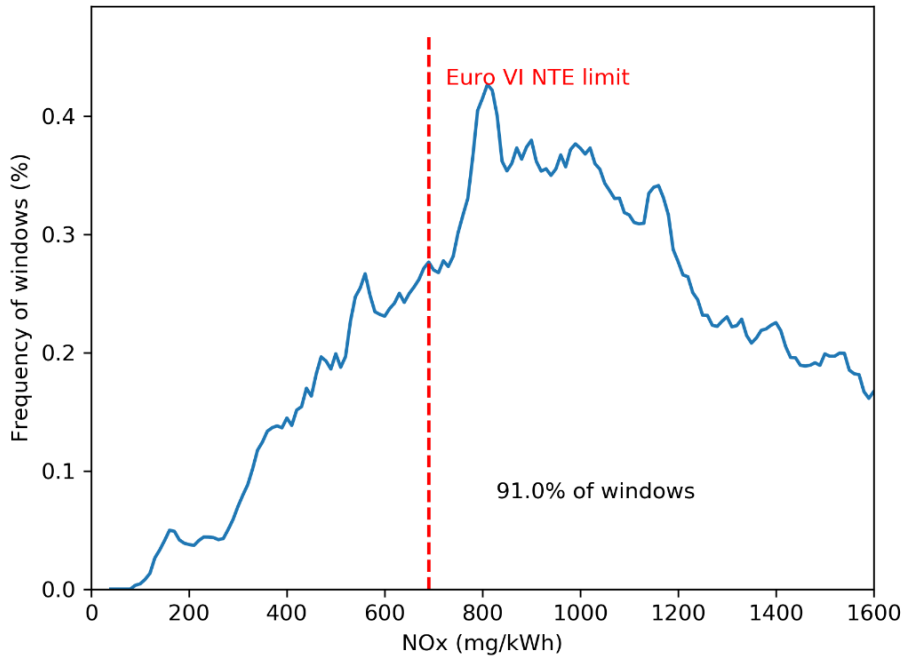
Data exclusions affect urban report value for Euro VI-A to VI-C

- Euro VI-A N3 vocational truck
  - Urban operation: 75% or 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.

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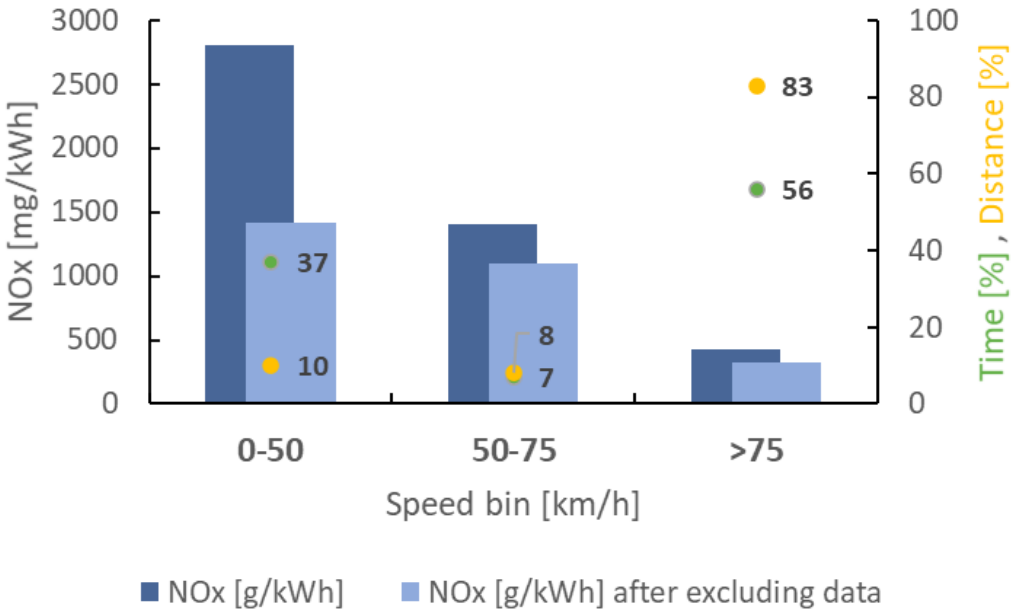
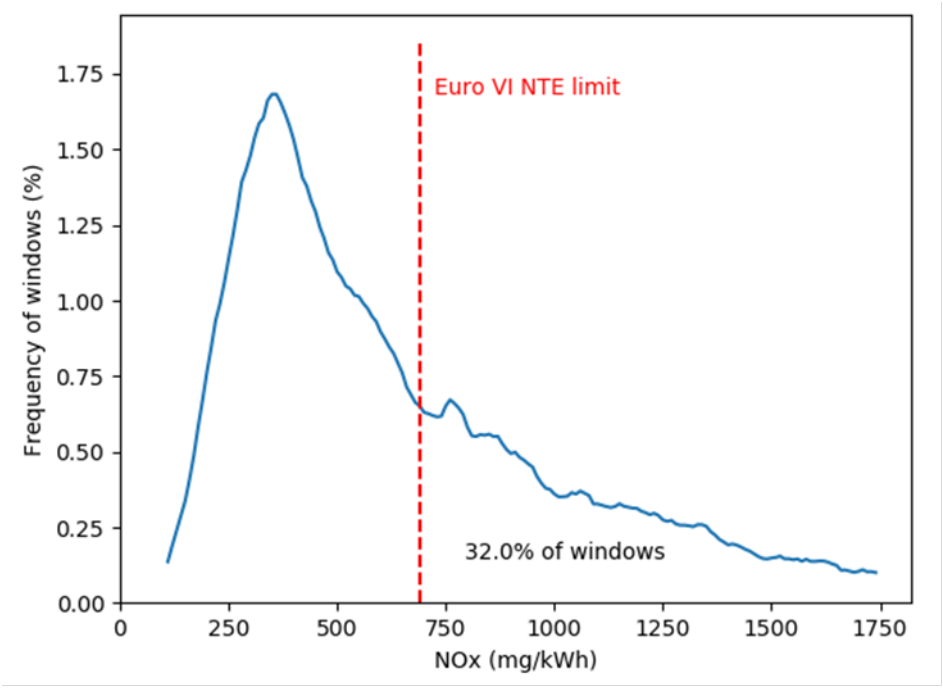
Data exclusions affect urban report value for Euro VI-A to VI-C

- Euro VI-C N3 long-haul truck
  - Urban operation: 37% or 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.

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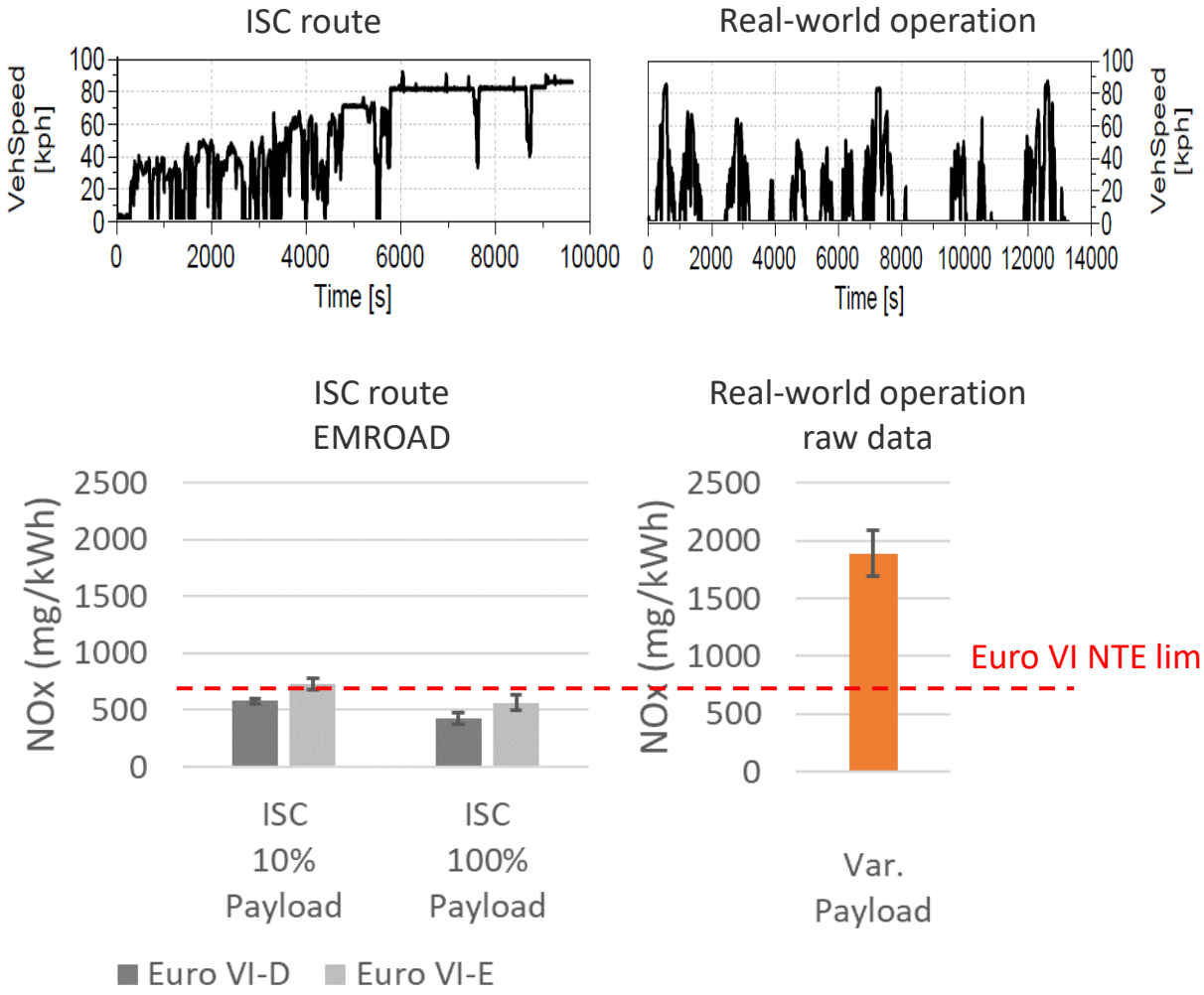
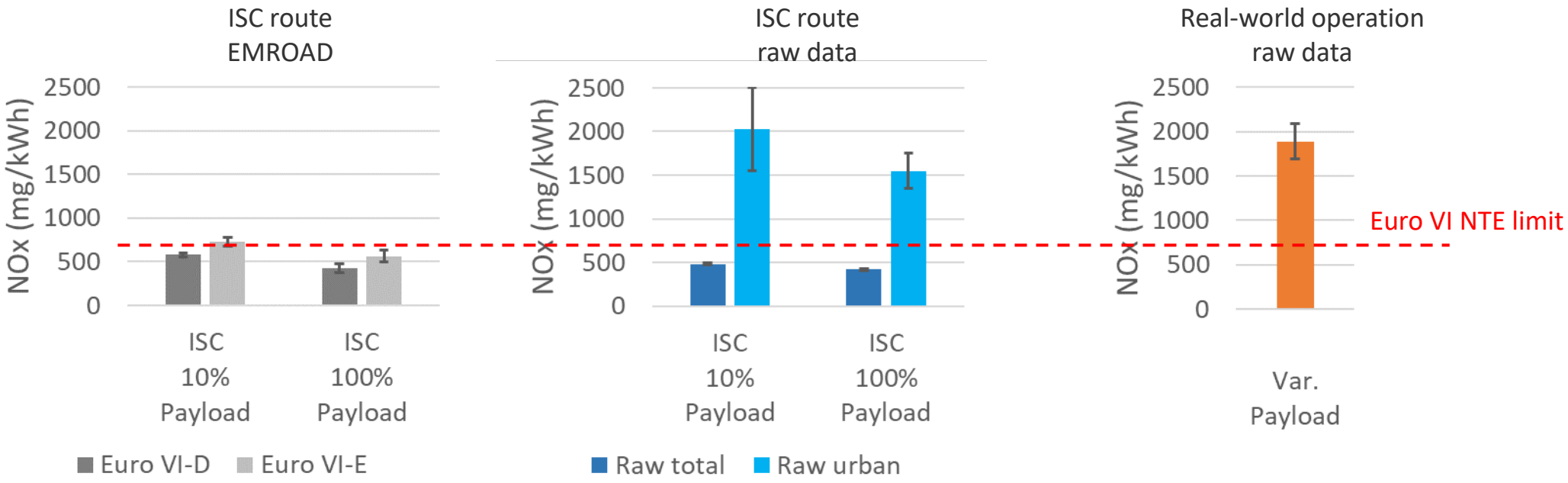
Data exclusions affect urban report value for Euro VI-A to VI-C

- 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



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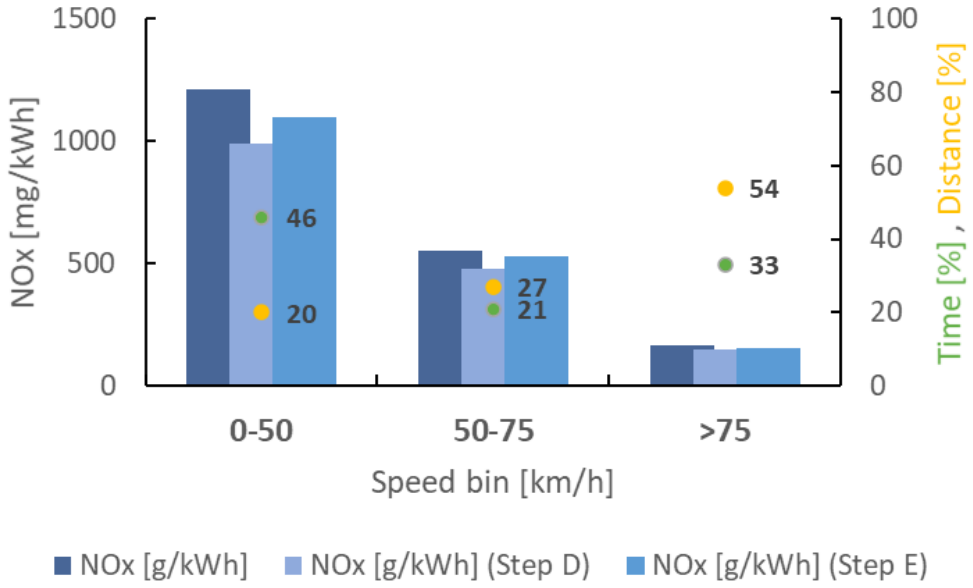
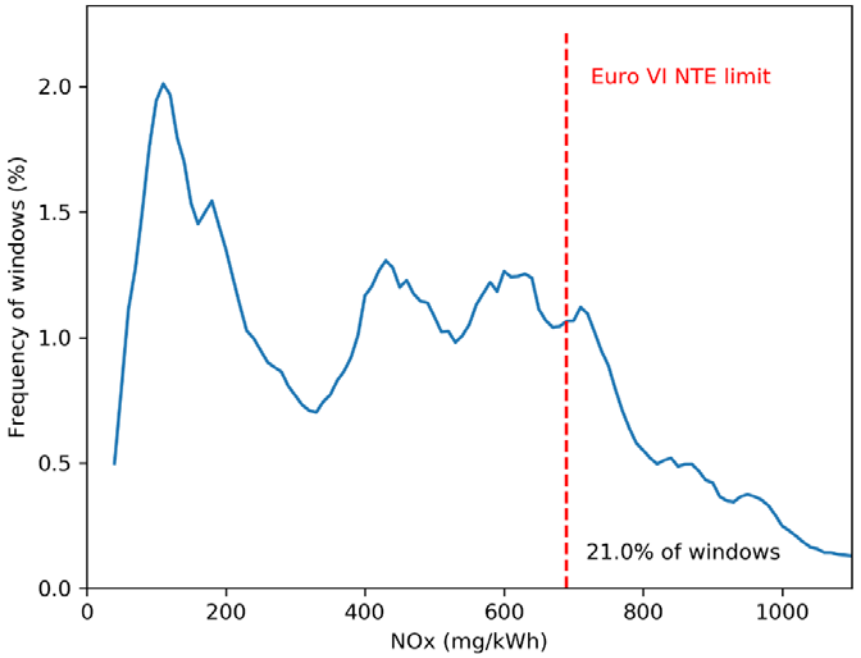
Improvements for Euro VI-D, but high emission events still occur

- Euro VI-D N2 rigid truck
  - Urban operation: 46% or the total trip, maximum averaged emissions 3 times the current NOx limit



- 21% of MAW above Euro VI NTE limit



Data excluded: as per Step D or E exclusions.

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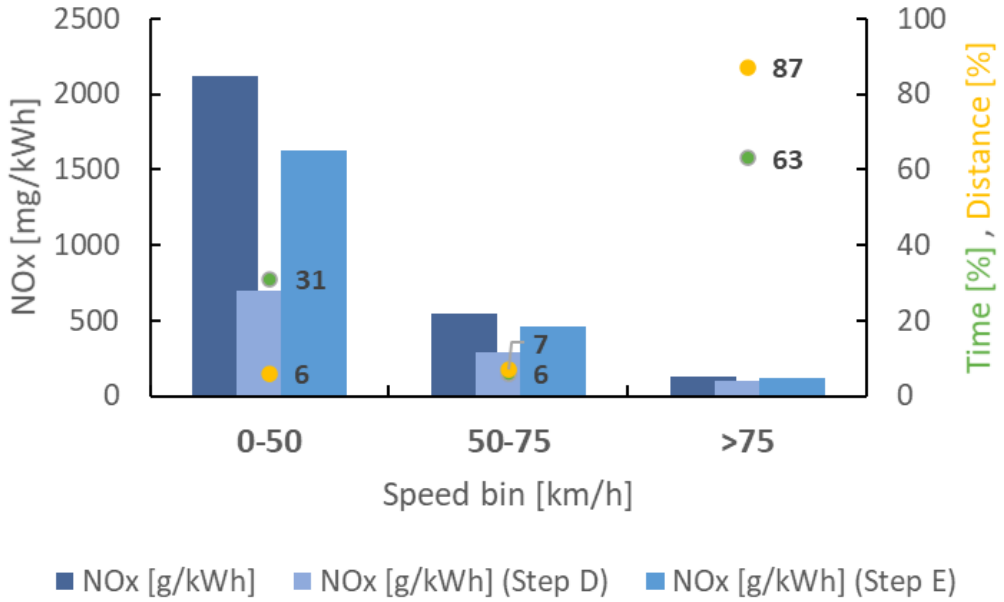
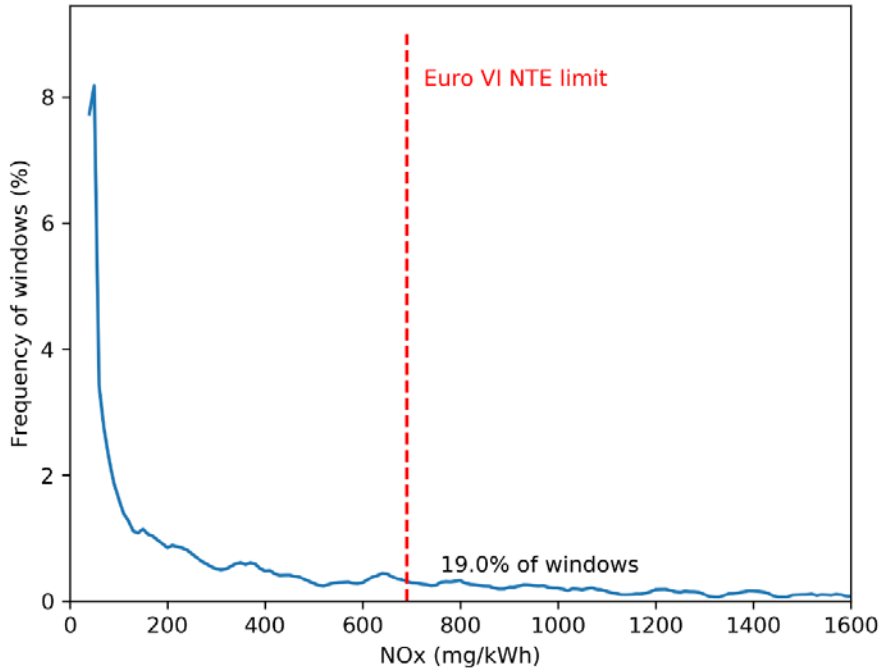
Improvements for Euro VI-D, but high emission events still occur

- Euro VI-D N3 tractor tanker semi-trailer
  - Urban operation: 31% or the total trip, maximum averaged emissions 5 times the current NOx limit



Data excluded: as per Step D or E exclusions.

- 19% of MAW above Euro VI NTE limit



Summary

- Heavy-duty vehicle real-world operation data was presented
  - All vehicles compliant to the type-approval emission level (Euro VI A-C and D) under ISC testing
  - High emission events are still occurring
    - Highest MAWs reach 5-10 times the NTE limits
    - These events mainly occur in the 0-50 km/h speed bin (mainly urban operation)
    - Data from 28 vehicles shows up to 91% of MAWs can be above the NTE limit
  - Heavy-duty ISC post-processing has significant impact on the report value for urban operation
  - HD Euro VI Step D and Step E post processing boundary conditions still exclude critical data
- Technologies are available today to appropriately handle real-world operation emissions
- 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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