

Low emissions measured on modern vehicles

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Association for Emissions Control by Catalyst (AECC AISBL)

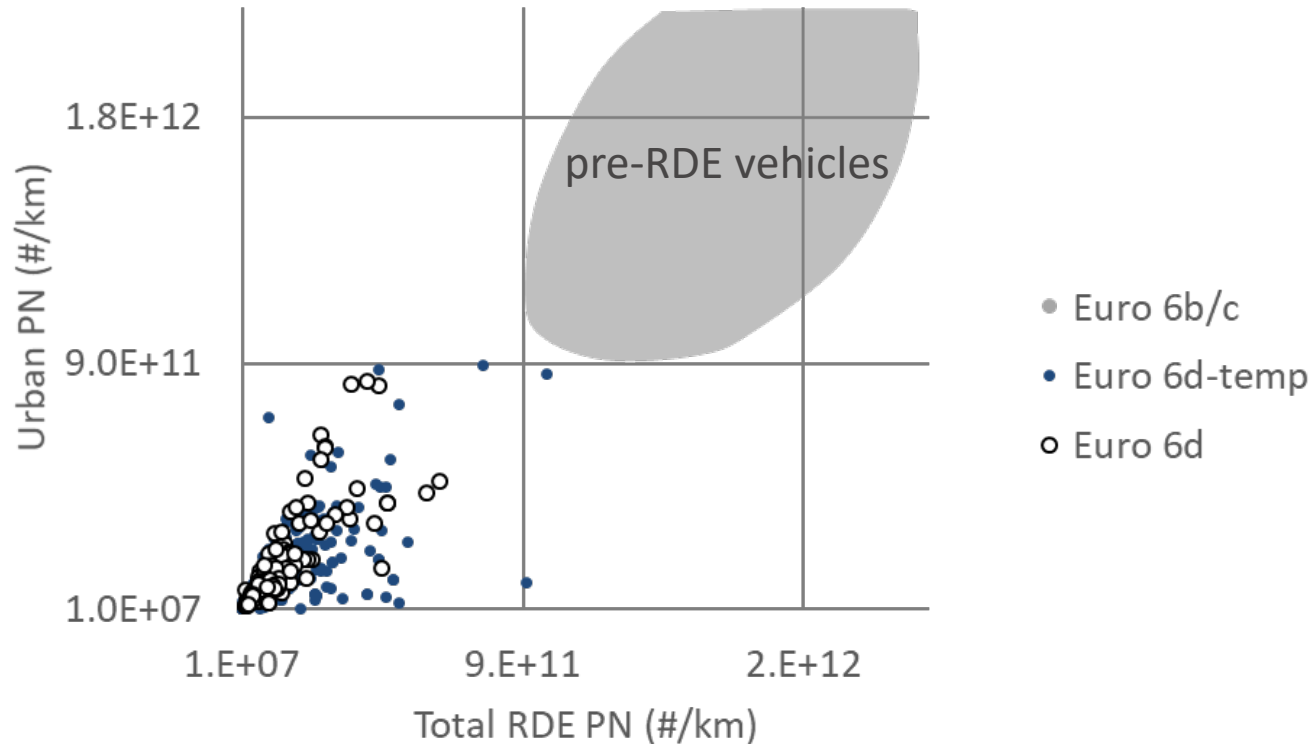
AECC members : European Emissions Control companies



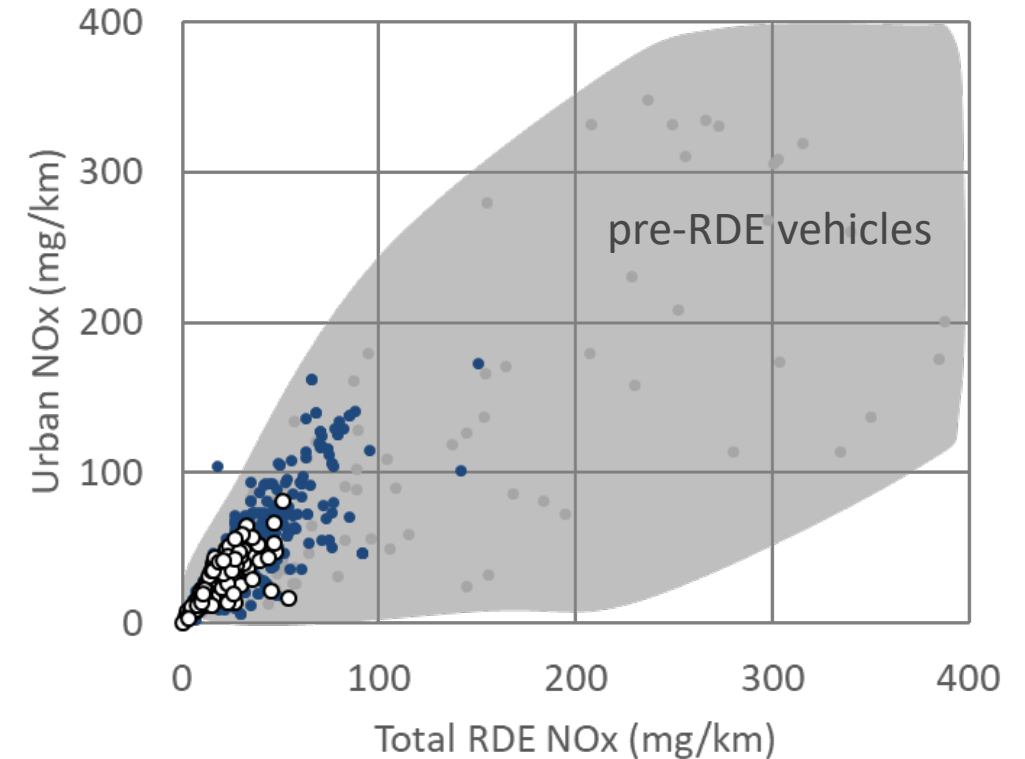
- Exhaust emissions control technologies for original equipment, retrofit and aftermarket for all new cars, commercial vehicles, motorcycles, and non-road mobile machinery
- AECC is # 78711786419-61 in EU Transparency Register and has consultative status with the UN Economic and Social Council (ECOSOC)

Pollutant emissions significantly reduced within Euro 6/VI

➤ Light-duty gasoline PN emissions



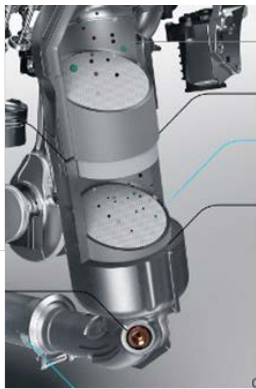
➤ Light-duty diesel NOx emissions



Sources: - ACEA/JAMA Euro 6d(-TEMP) PEMS data consulted 17 July 2020
- pre-RDE PN emissions factors from B. Giechaskiel, *Int. J. Environ. Res. Public Health*, 2018

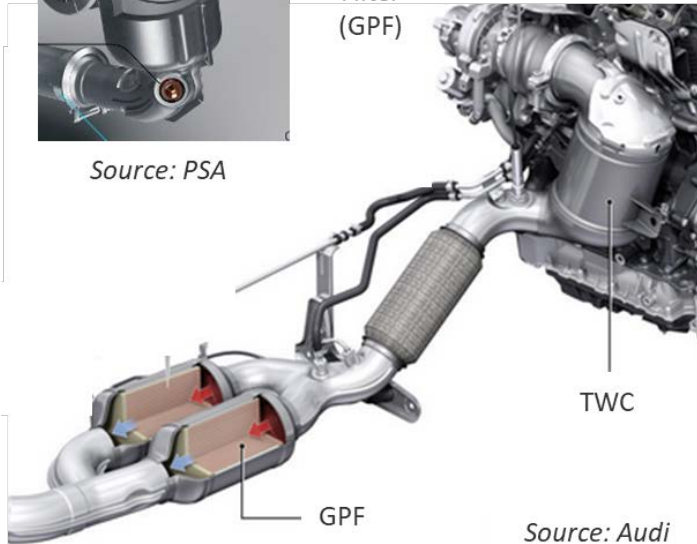
Advanced emission control systems for light- and heavy-duty

- LD Gasoline – introduction of Gasoline Particulate Filter



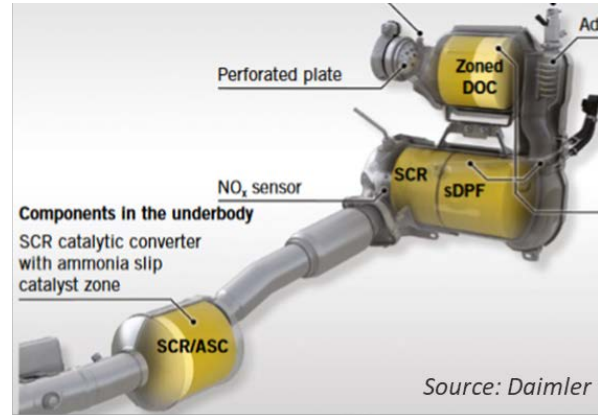
TWC
Gasoline
Particulate
Filter
(GPF)

Source: PSA

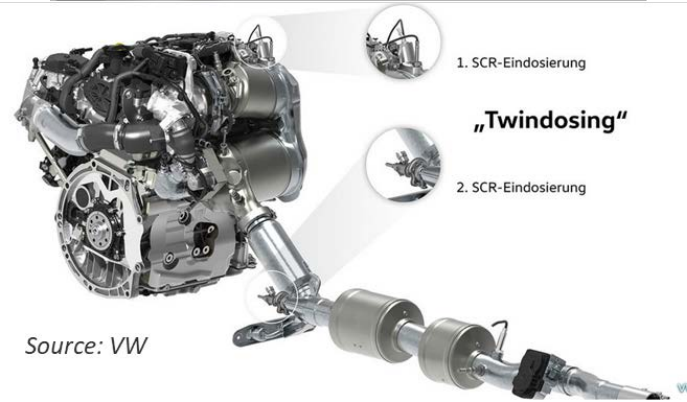


Source: Audi

- LD Diesel – combination of deNOx technologies

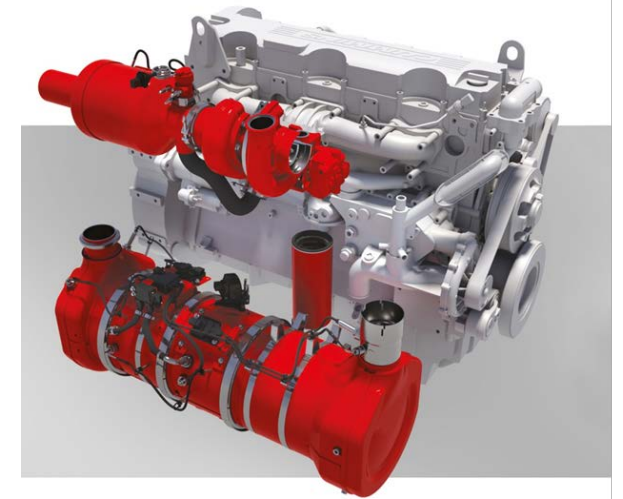


Source: Daimler



Source: VW

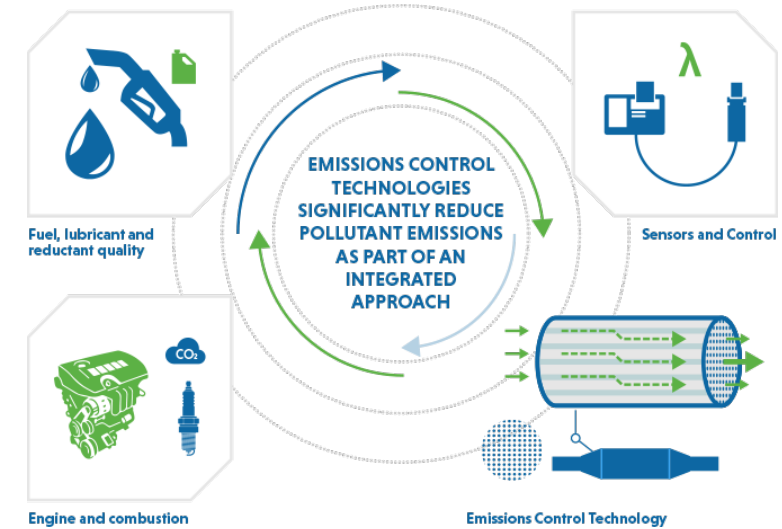
- HD diesel – announcement of system with close-coupled components



Source: Cummins

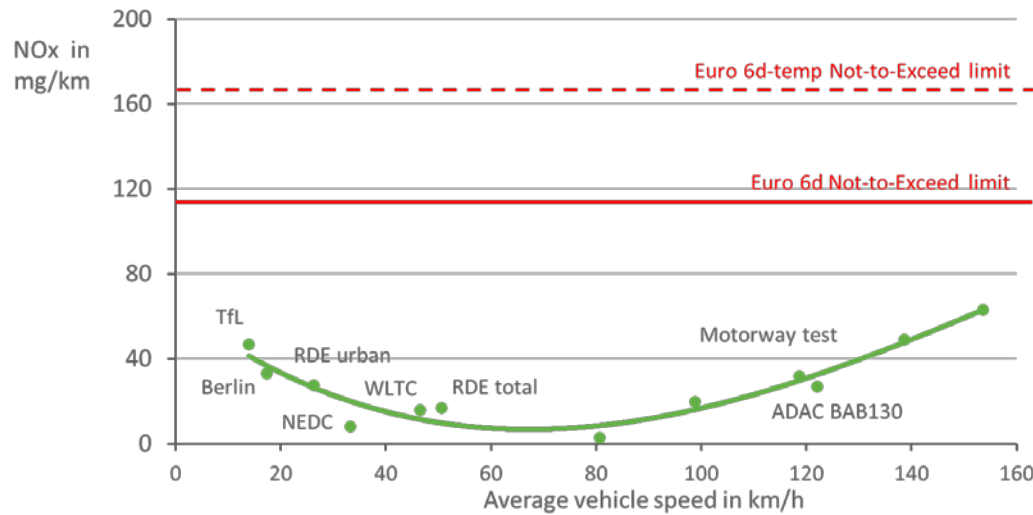
Euro 7/VII will drive further innovation

- Within an integrated approach of
 - Emission control technology
 - Engine and combustion
 - Fuel, lubricant and reductant quality
 - Sensors and controls
- AECC demonstrator test programmes
 - Light-duty diesel
 - Light-duty gasoline
 - Heavy-duty diesel

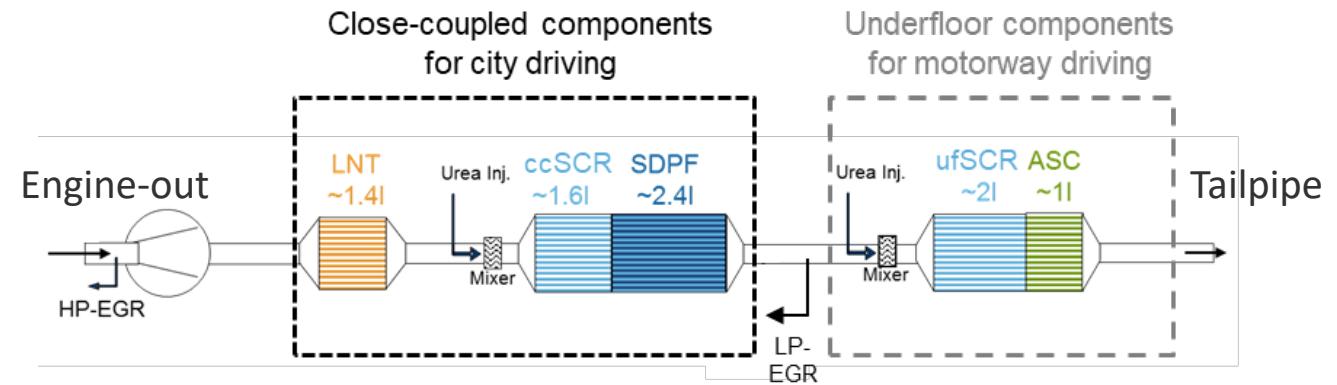


Ultra-low emissions diesel demonstrator

➤ Objective is to demonstrate ultra-low NO_x emissions over wide range of driving conditions for various fuels



➤ Emission control system based on combination of available components LNT + dual-SCR supported by 48V mild-hybrid system



Note: hydrothermal aged components used targeting 160k km

- 1) J. Demuyne, et al.; "Integrated Diesel System Achieving Ultra-Low Urban and Motorway NO_x Emissions on the Road", 40th Vienna Motor Symposium, 2019
<https://www.aecc.eu/wp-content/uploads/2019/04/190516-AECC-IAV-IPA-Integrated-Diesel-System-achieving-Ultra-Low-NOx-on-the-road-Vienna-Symposium.pdf>
- 2) Joint MTZ publication with Bosch, Vitesco, FEV and IAV <https://www.aecc.eu/wp-content/uploads/2020/09/200901-modern-diesel-MTZ.pdf>
- 3) Videos of instantaneous conversion performance available at www.youtube.com/channel/UCbPS9op5ztLqrv6zIMH_IcQ



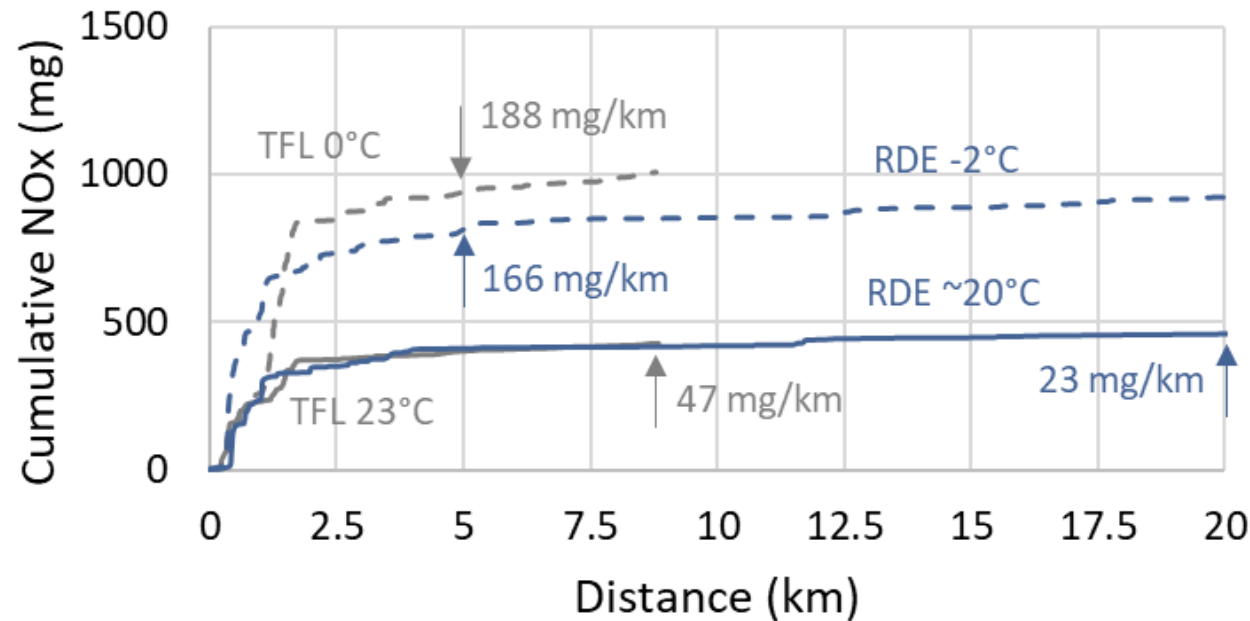
Engine load: 11% Vehicle speed: 0 km/h

More videos available on YouTube (AECC eu):
https://www.youtube.com/channel/UCbPS9op5ztLqrv6zlMH_IcQ



Ultra-low emissions diesel demonstrator

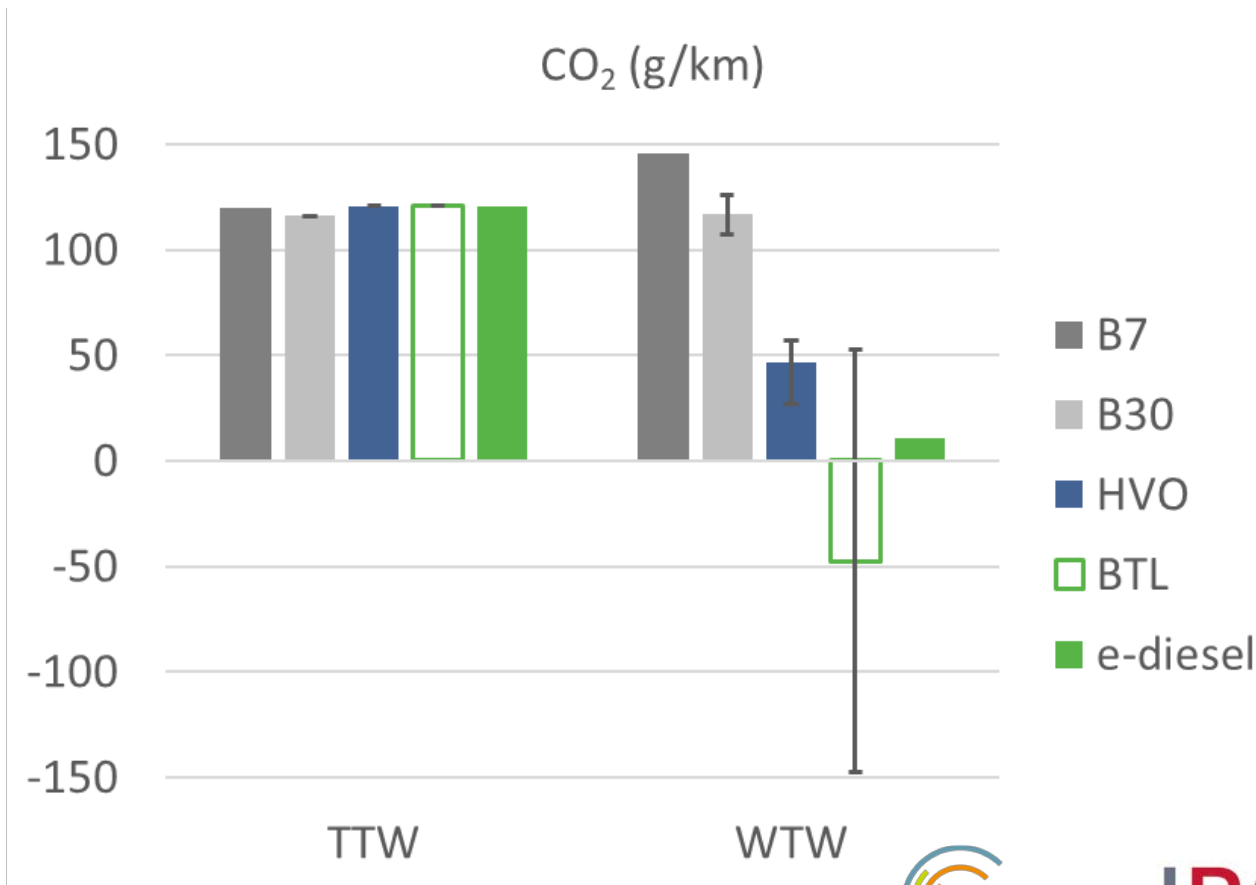
- Analysis of combination of boundary conditions: low-load and ambient temperature
- Near-zero NOx emissions achieved after cold-start phase for range of ambient temperatures tested
- Initial cold-start NOx peak is impacted by ambient temperature
- Reported mg/km significantly depends on minimum trip distance definition



Note: a minimum trip length of 5 km applied according to CLOVE scenario 27/10/20

Reduction in WtW CO₂ emissions with low carbon fuels

- Tank-to-Wheel (tailpipe) measurements show similar results for the different fuels
- Well-to-Wheel evaluation versus B7 reference depending on production pathway
 - B30: -14 to -26%
 - HVO: -60 to -82%
 - BTL: -64% to -200%
 - E-fuel: -93%



LD gasoline demonstrator concept

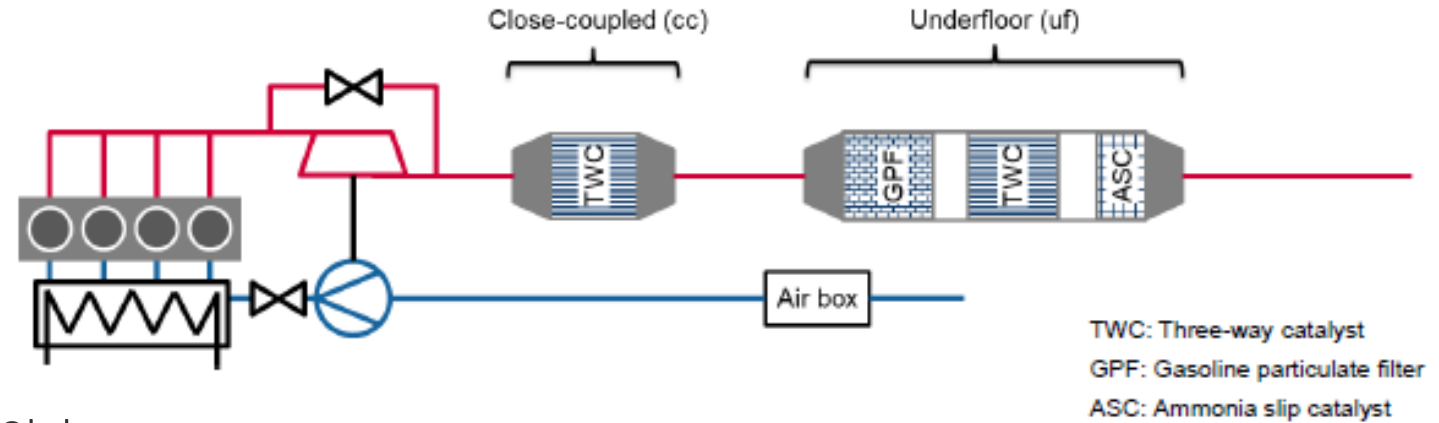
➤ Demonstrator concept

- Euro 6d C-segment base vehicle
- 4 cyl GDI with 48V mild-hybrid
- ccTWC, ufGPF+TWC+ASC¹

¹ ASC operation strategy for gasoline under investigation in addition to improved lambda control

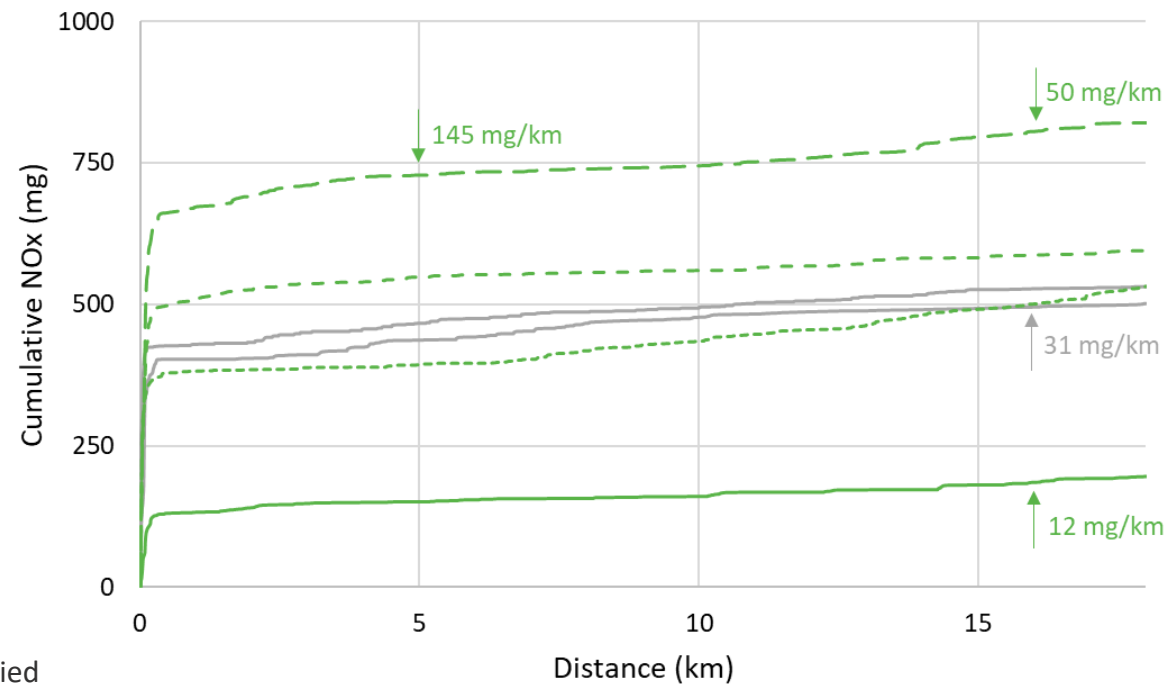
- Bench aged components targeting 160k km
- Advanced lambda sensors and control

➤ Project partners



LD gasoline demonstrator initial check of AECC ECT

- Low NO_x emissions of Euro 6d-TEMP data confirmed under moderate RDE conditions
- Challenges remain towards combination of boundary conditions
- Minimum trip definition impacts report value in mg/km

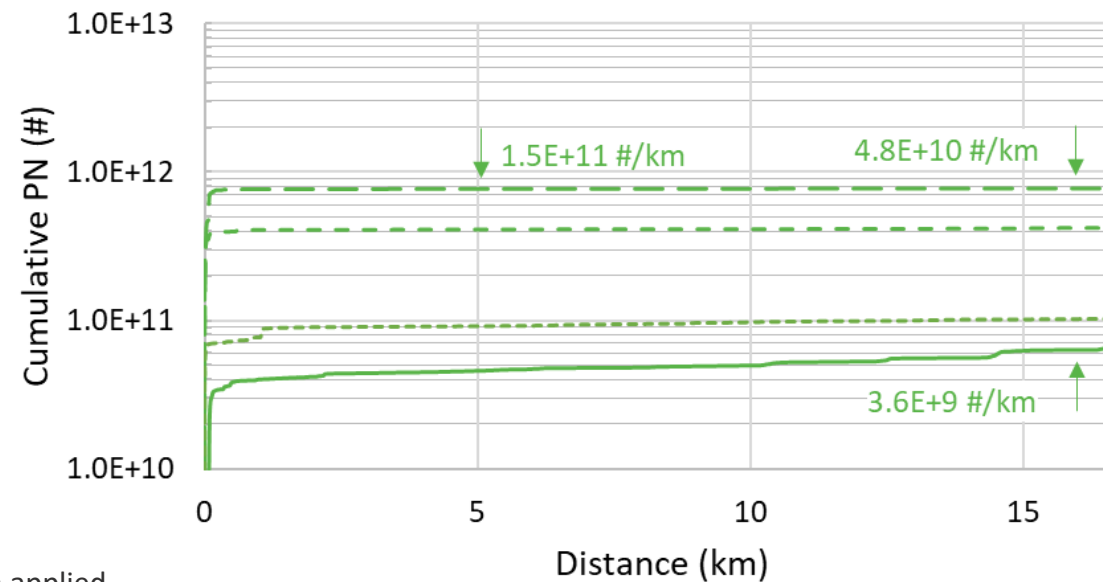


¹ Minimum trip length of 5 and 16 km applied

² The results are reported as measured under the specified test routes and conditions

LD gasoline demonstrator initial check of AECC ECT

- Low PN emissions of Euro 6d-TEMP data confirmed under moderate RDE conditions
- Soot and ash accumulation during ageing of parts supports filtration efficiency
- Challenges remain towards combination of boundary conditions
- Minimum trip definition impacts report value in #/km



AECC RDE normal -5°C (MHEV)
 AECC Calib Test aggressive 2°C (MHEV)
 AECC RDE aggressive 23°C (MHEV)
 AECC Calib Test normal 23°C (MHEV)

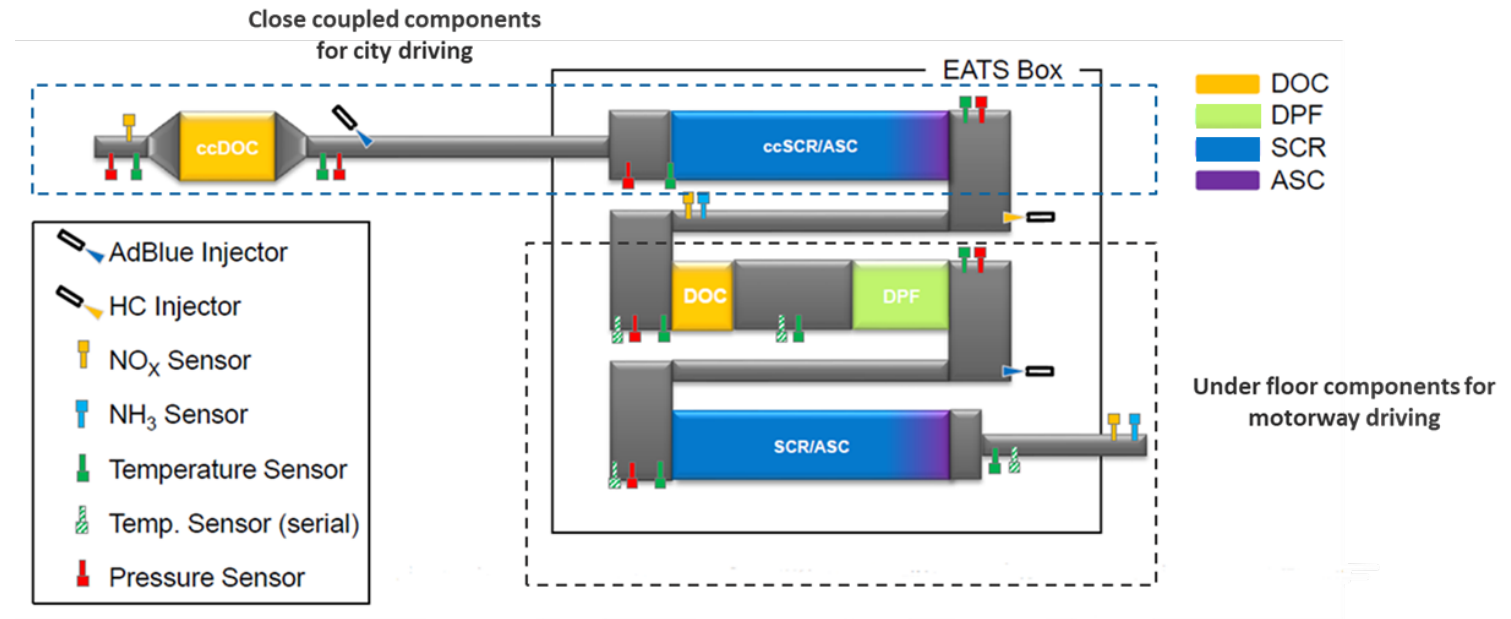
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HD diesel demonstrator project

➤ Demonstrator concept

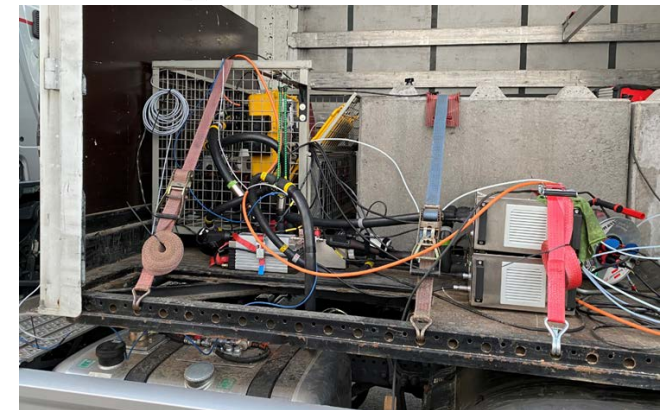
- MB Actros 1845 LS 4x2
- Euro VI C, 12.8 l, 6 cyl, HP EGR
- ccDOC+ccSCR/ASC, ufDOC+cDPF+SCR/ASC
- Hydrothermal aged components targeting 500k km



➤ Project partners

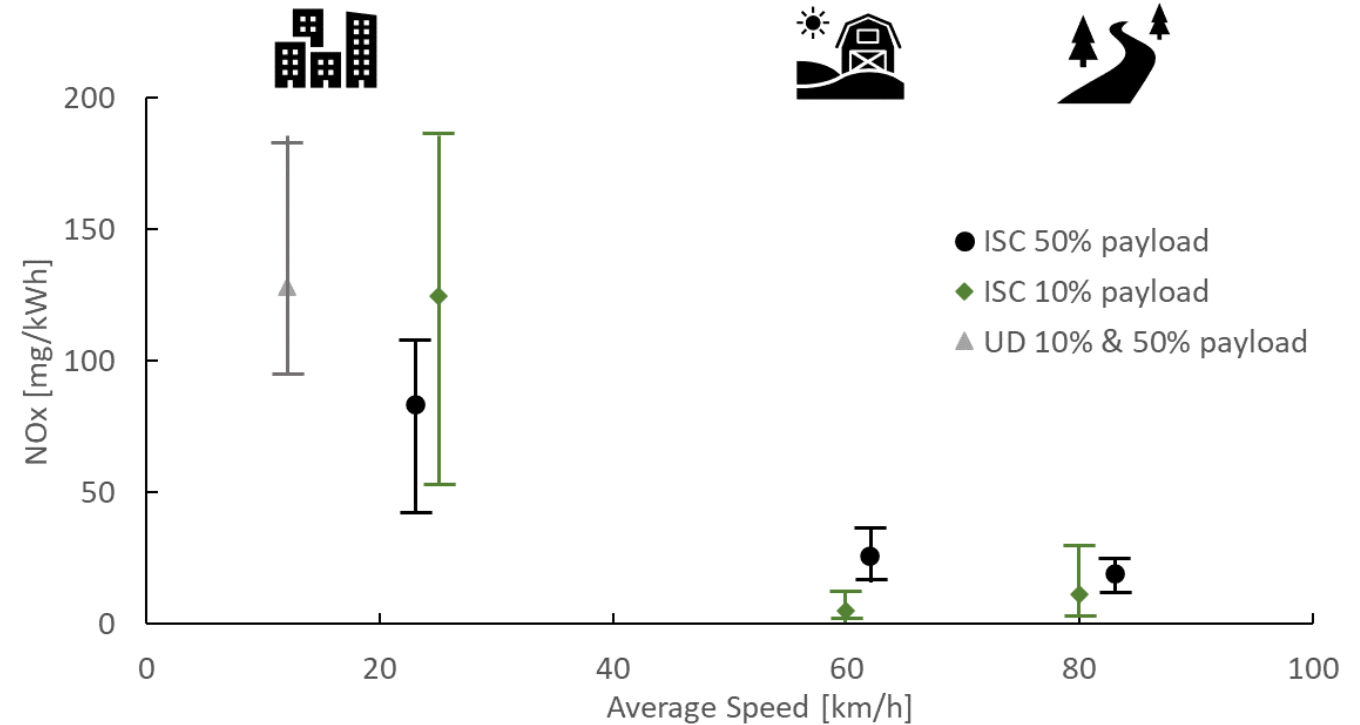


Automotive Grade Urea Sector Group



HD diesel demonstrator preliminary results

- Ultra-low NOx emissions over a broad range of operating conditions
 - ISC (N3 Euro VI-c route) and urban delivery¹ trips have been conducted with 10 and 50% payload
 - Tests cover a range of ambient temperatures from 4-11°C
- On-road testing results can be impacted by road events (traffic, altitude, etc.), temperature or even different drivers

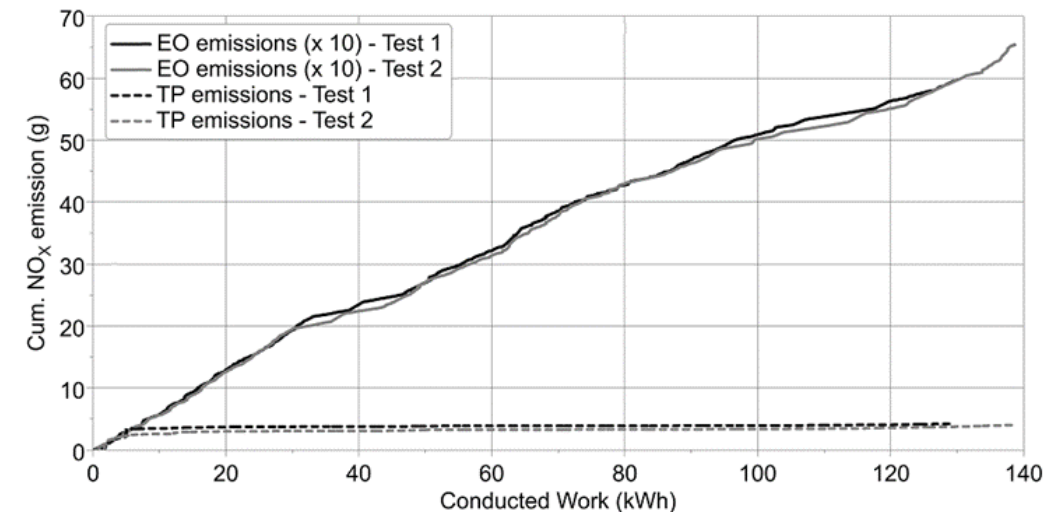
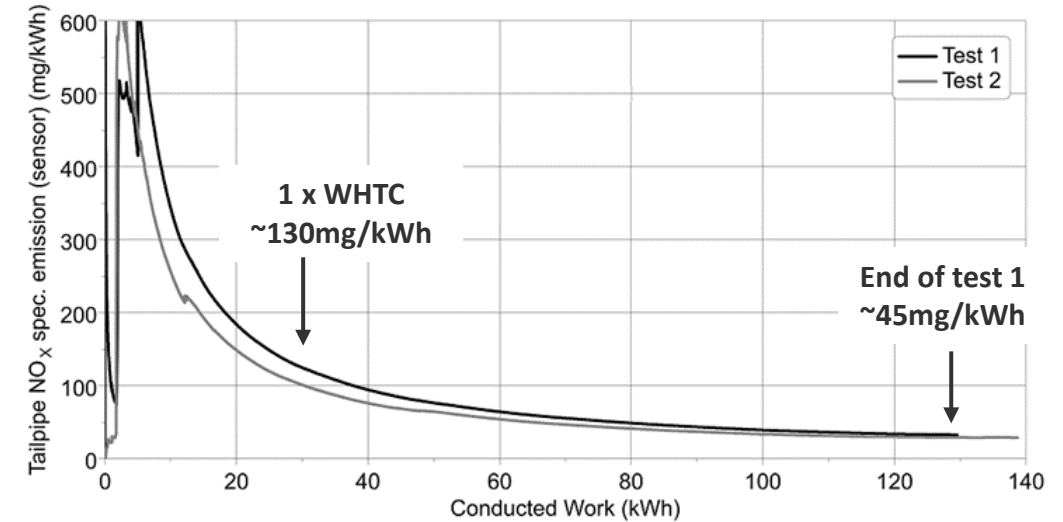


¹ Urban delivery (<35km/h) with 10 stops (~1 min), total trip duration is ~1 hour and work completed is about 14-16kWh

² The results are reported as measured under the specified test routes and conditions

HD diesel demonstrator preliminary results

- ISC¹ (N3 Euro VI-C route) NO_x results show that cold-start remains the main emission event
- The close-coupled catalysts result in a short heat-up time of the system
- Emissions are well controlled once the system is warm
- Minimum trip definition impacts report value in mg/kWh



¹ ISC tests performed with 10% payload, Test 1 & 2 conducted at 8°C and 10°C respectively

² The results are reported as measured under the specified test routes and conditions

Conclusions

- Low pollutant emissions over wide range of driving conditions shown with the use of advanced emission control systems
 - Light-duty diesel
 - Light-duty gasoline
 - Heavy-duty diesel
- Significant WtW CO₂ reductions possible with the use of renewable fuels, also for the existing fleet as most paraffinic compounds are drop-in for market diesel fuel
- Internal Combustion Engine is part of the solutions to contribute to EU Green Deal climate-neutral and zero-emission goals in 2050 along with electrification

THANK YOU !

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