Low emissions measured on modern vehicles

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ASSOCIATION FOR EMISSIONS CONTROL BY CATALYST

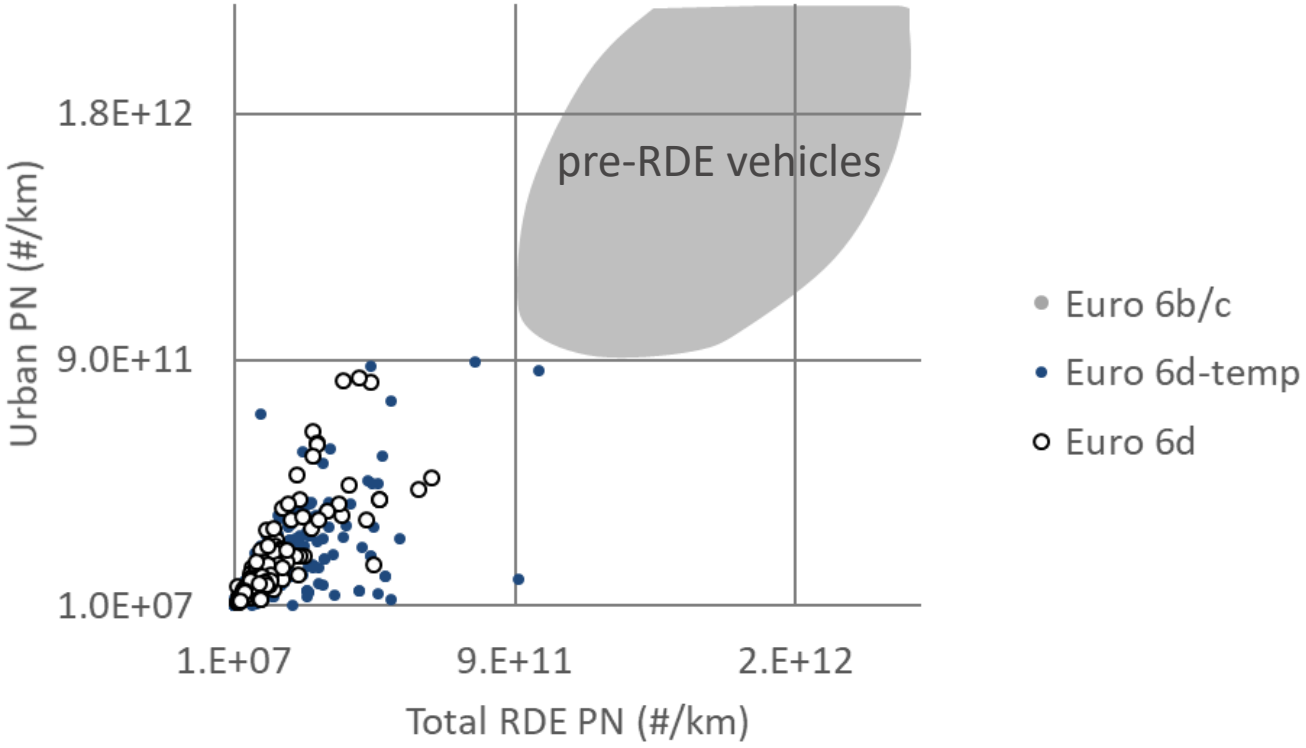
Association for Emissions Control by Catalyst (AECC AISBL)

AECC members : European Emissions Control companies

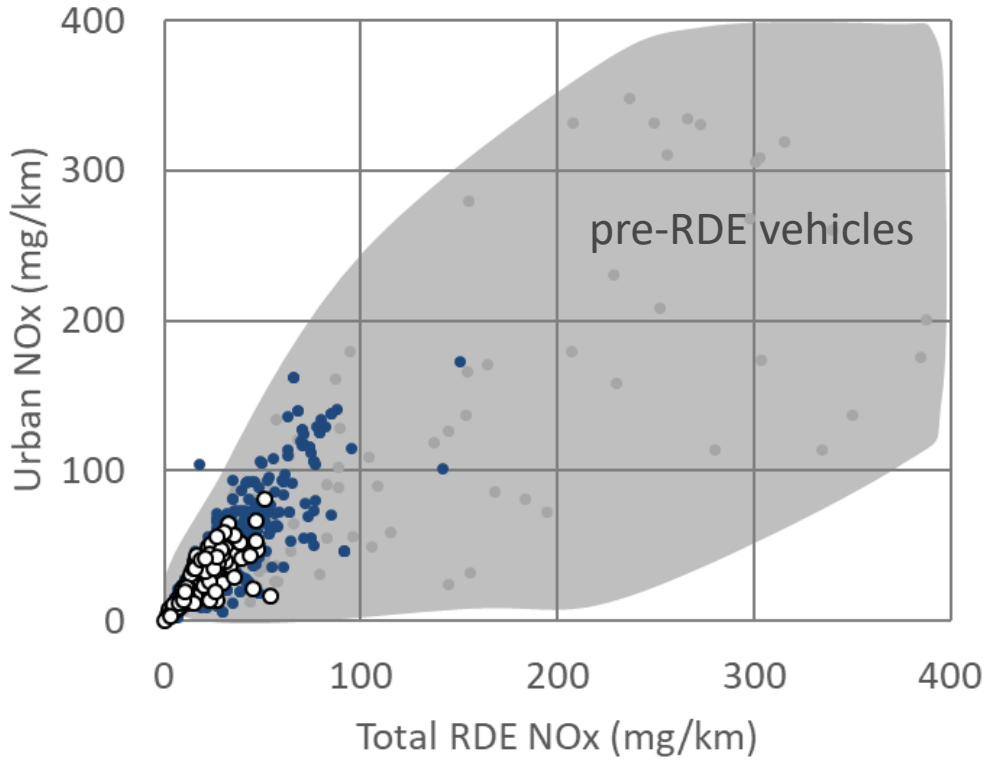
- Exhaust emissions control technologies for original equipment, retrofit and aftermarket for all new cars, commercial vehicles, motorcycles, and non-road mobile machinery
  - AECC is # 78711786419-61 in EU Transparency Register and has consultative status with the UN Economic and Social Council (ECOSOC)

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*

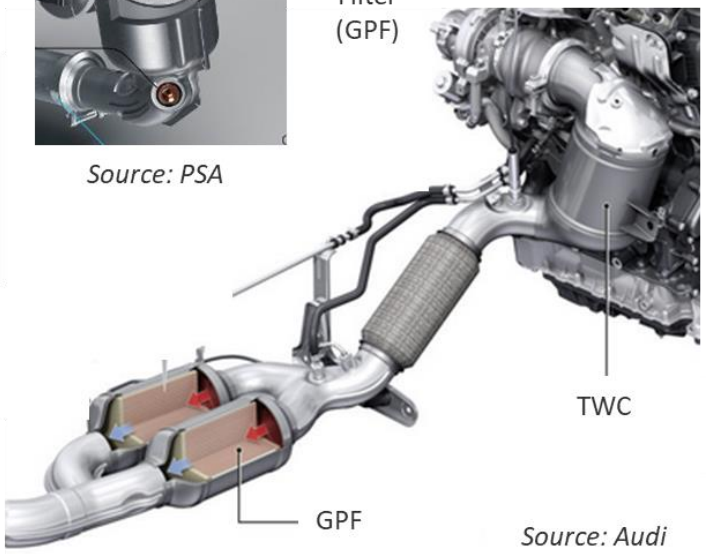
Advanced emission control systems for light- and heavy-duty

- LD Gasoline – introduction of Gasoline Particulate Filter
- LD Diesel – combination of deNOx technologies
- HD diesel – announcement of system with close-coupled components

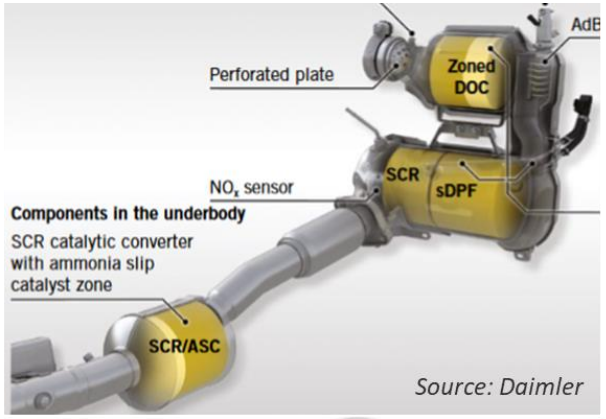
TWC

Gasoline Particulate Filter (GPF)

Source: PSA

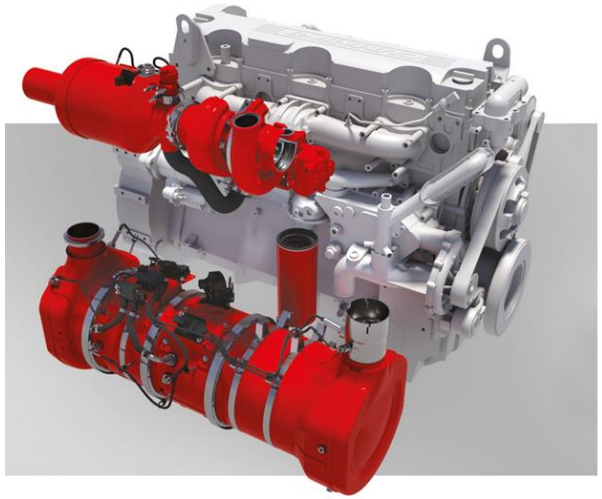


Source: Audi



Source: Daimler

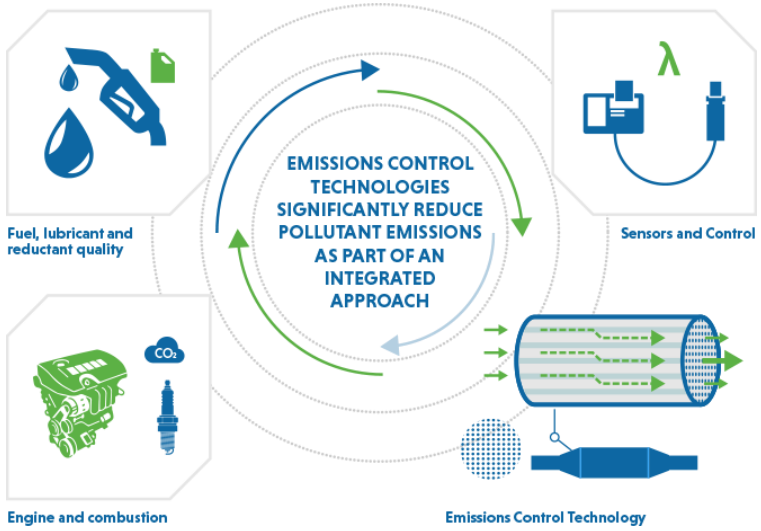
Source: VW



Source: Cummins

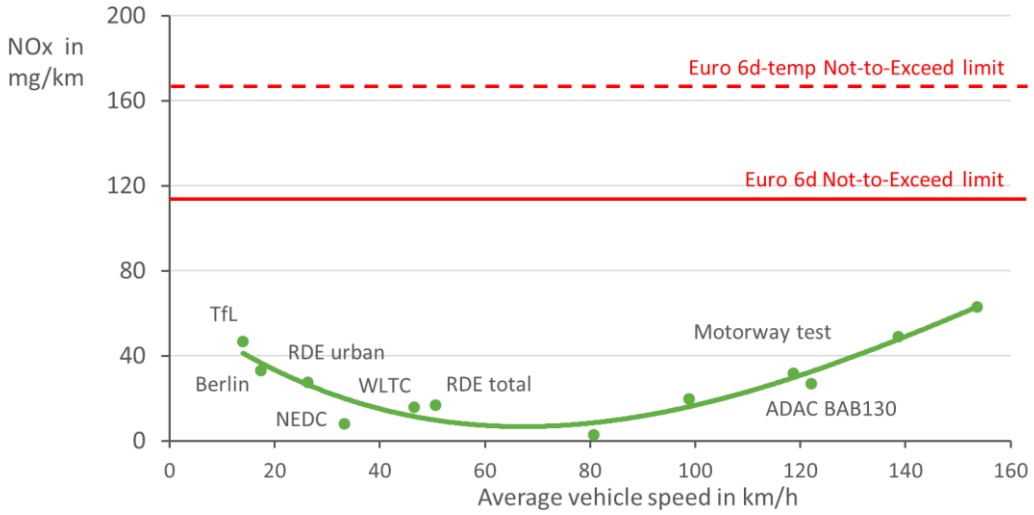
Euro 7/VII will drive further innovation

- 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

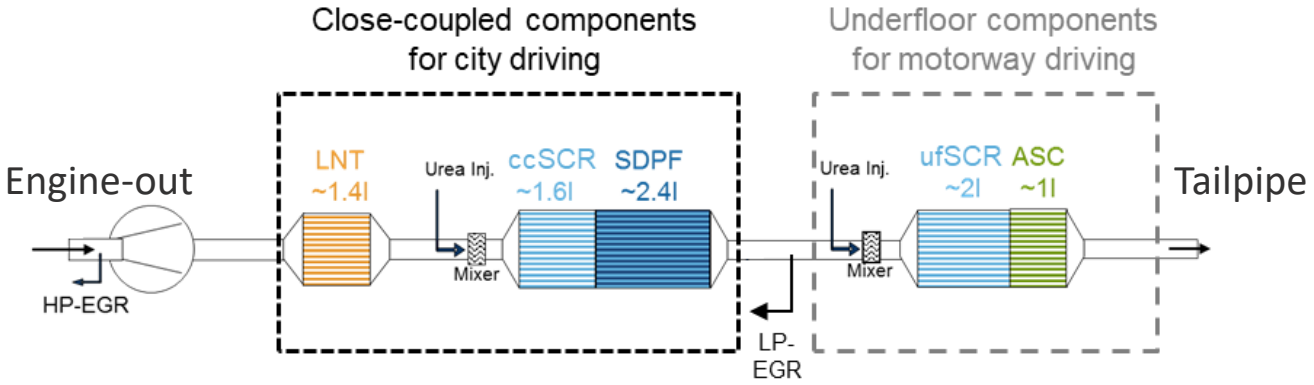


Ultra-low emissions diesel demonstrator

- Objective is to demonstrate ultra-low NOx 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. Demuynck, et al.; "Integrated Diesel System Achieving Ultra-Low Urban and Motorway NOx 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/UCbPS9op5ztLqrv6zlMH_IcQ

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

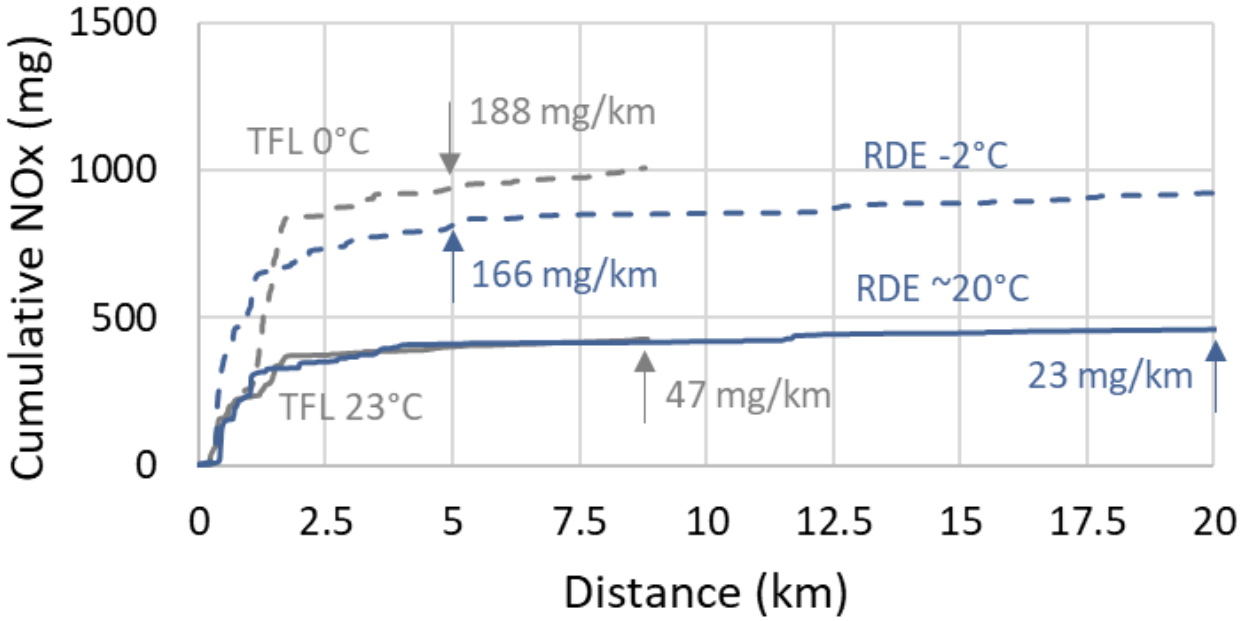
50
0
NOx
35 ppm

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

500
0
NOx
0 ppm

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

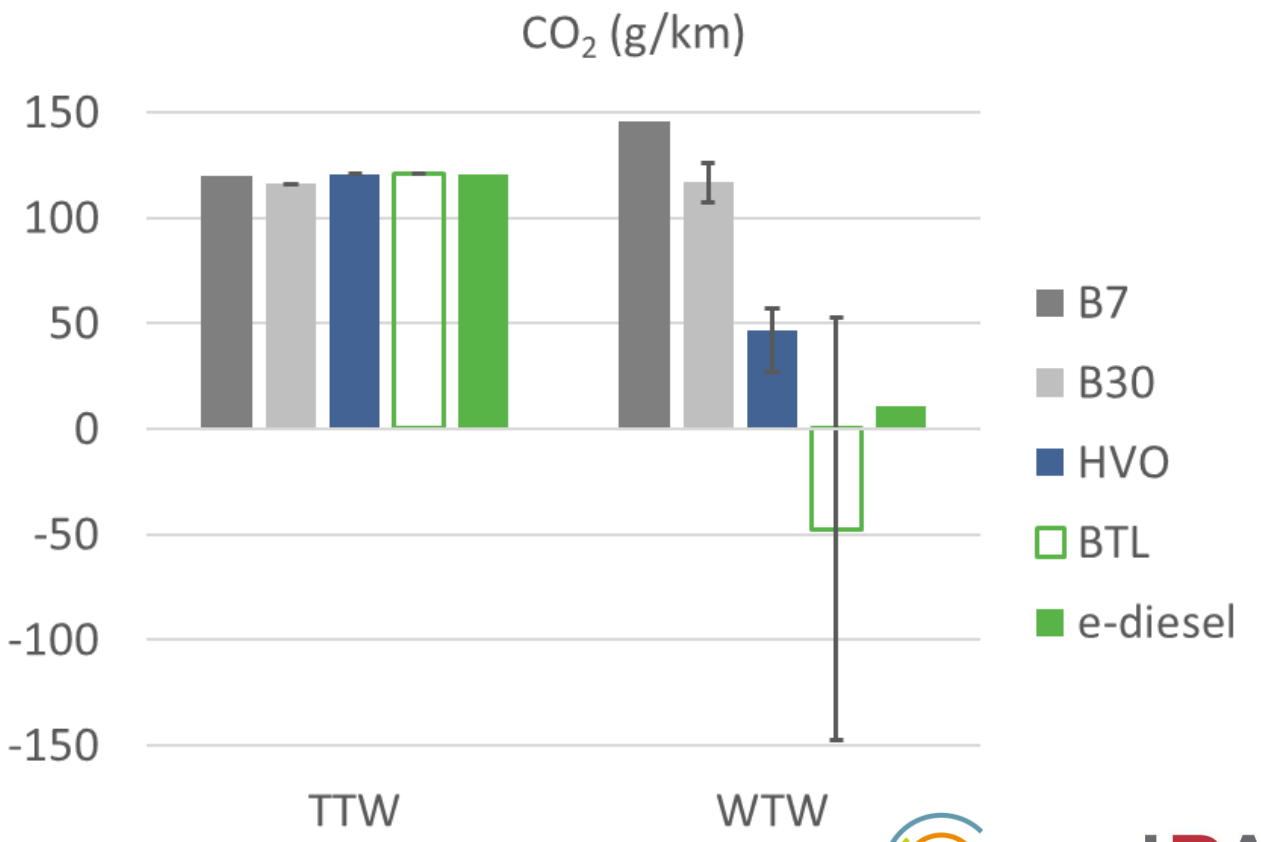


Note: a minimum trip length of 5 km applied according to CLOVE scenario 27/10/20

Reduction in WtW CO_2 emissions with low carbon fuels

diesel

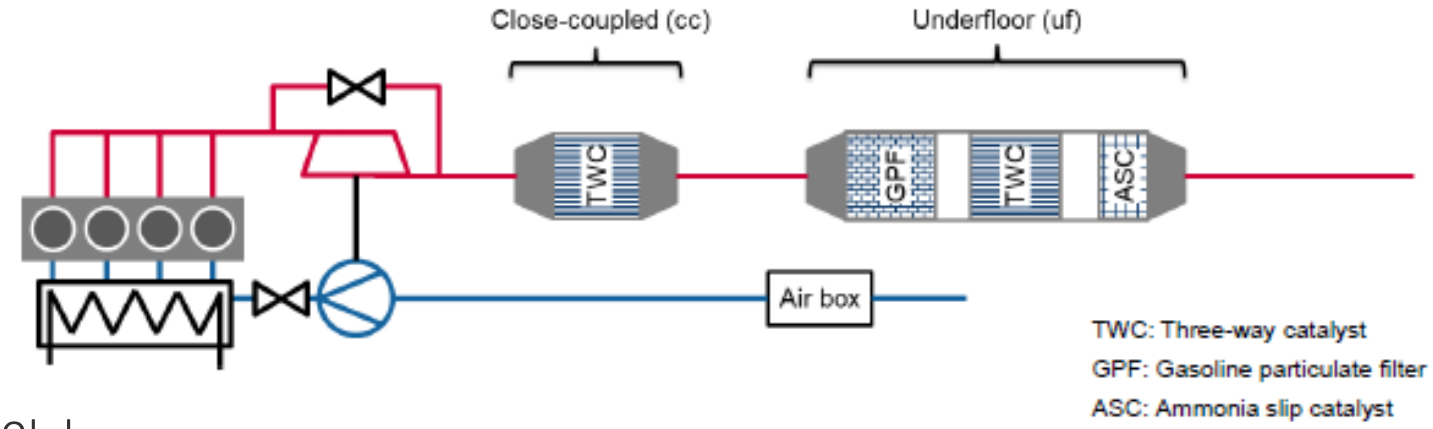
- Tank-to-Wheel (tailpipe) measurements show similar results for the different fuels
- Well-to-Wheel evaluation versus B7 reference depending on production pathway
  - B30: -14 to -26%
  - HVO: -60 to -82%
  - BTL: -64% to -200%
  - E-fuel: -93%



LD gasoline demonstrator concept

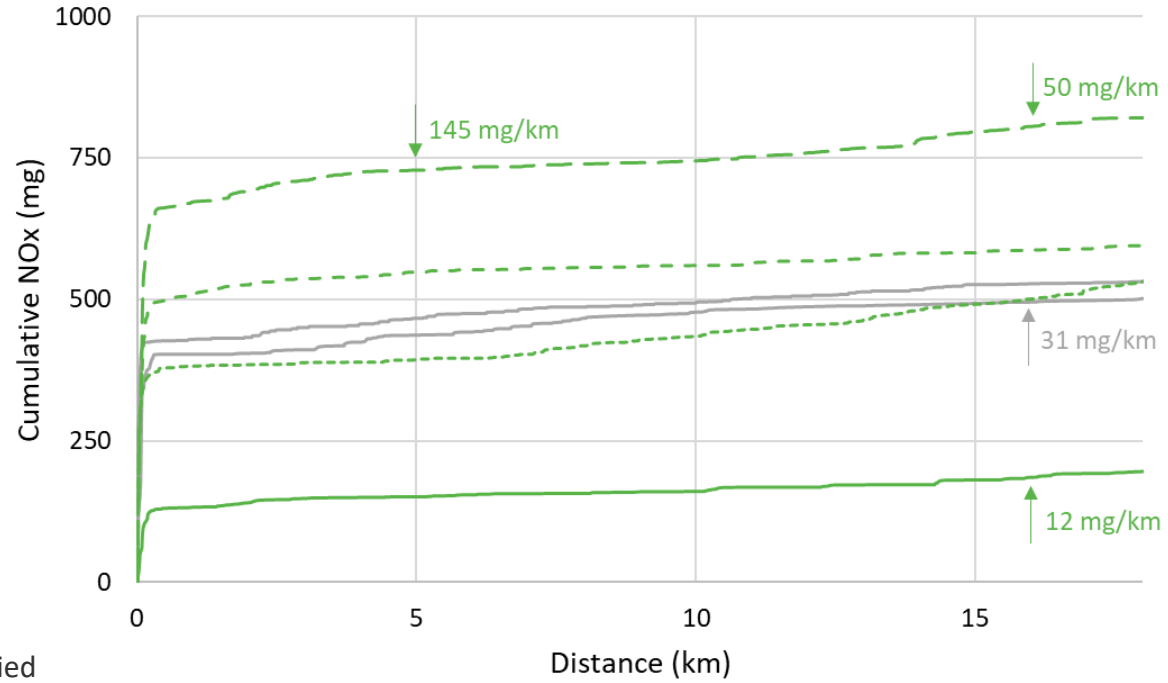
- Demonstrator concept
  - Euro 6d C-segment base vehicle
  - 4 cyl GDI with 48V mild-hybrid
  - ccTWC, ufGPF+TWC+ASC[1]

    [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 NOx 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



AECC RDE normal -5°C (MHEV)

AECC Calib Test aggressive 2°C (MHEV)

Euro 6d-TEMP normal ~20°C

AECC RDE aggressive 23°C (MHEV)

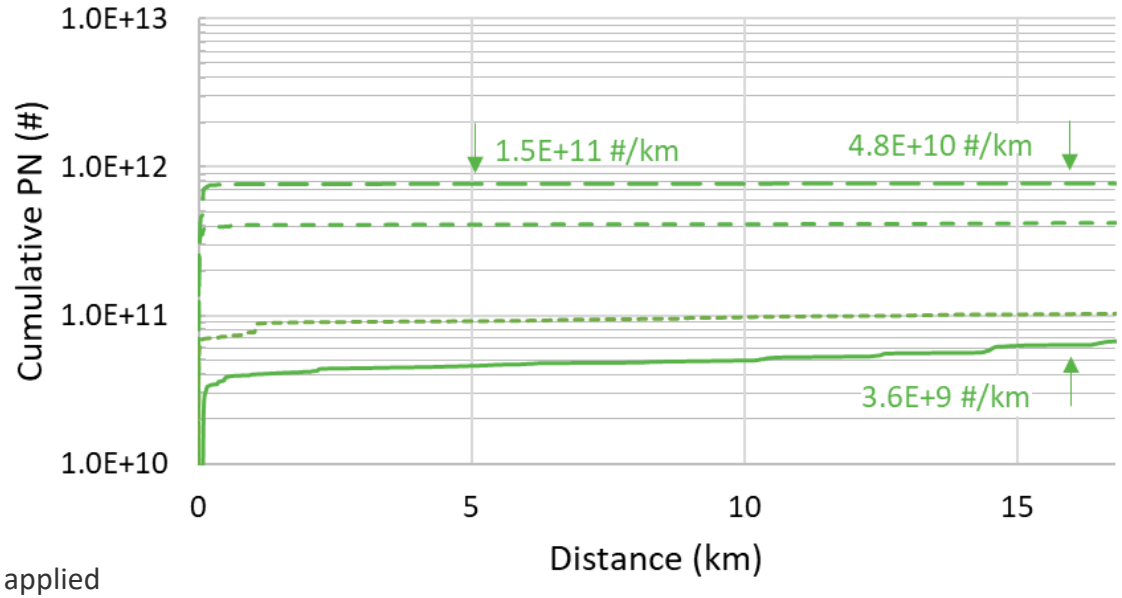
AECC Calib Test normal 23°C (MHEV)

[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



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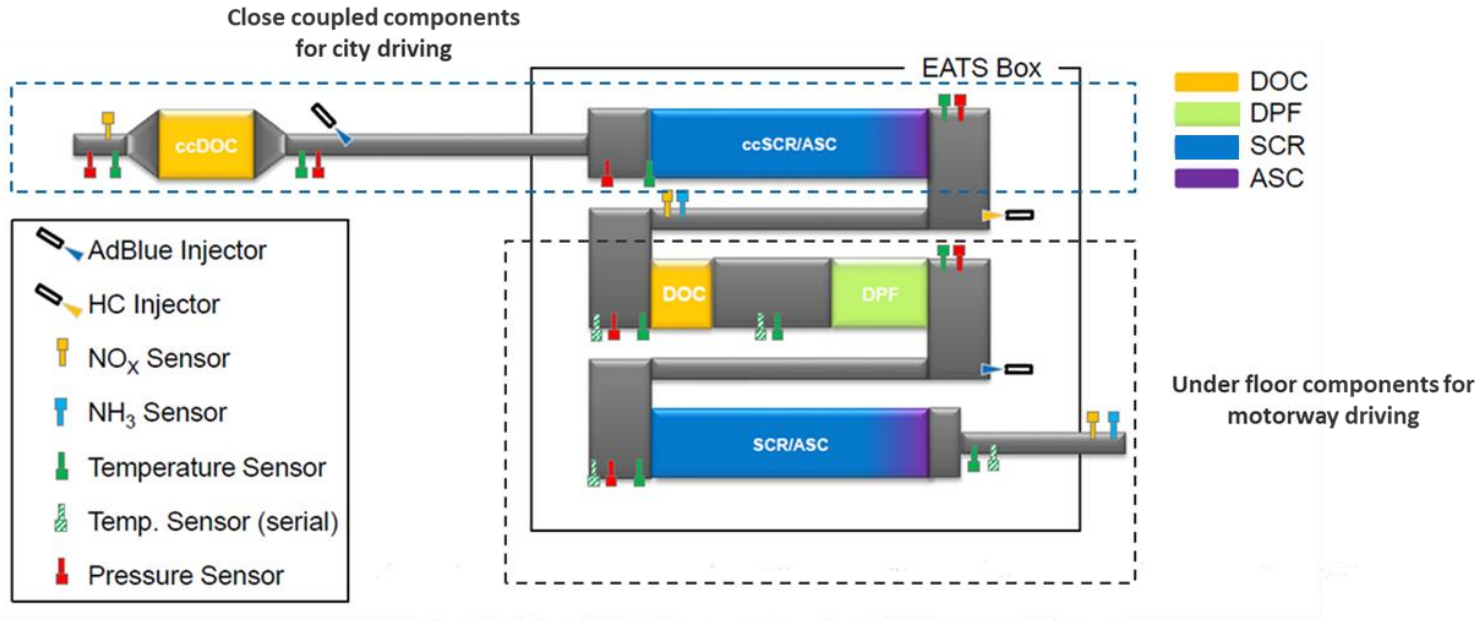
AECC Calib Test normal 23°C (MHEV)

[1] Minimum trip length of 5 and 16 km applied

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

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

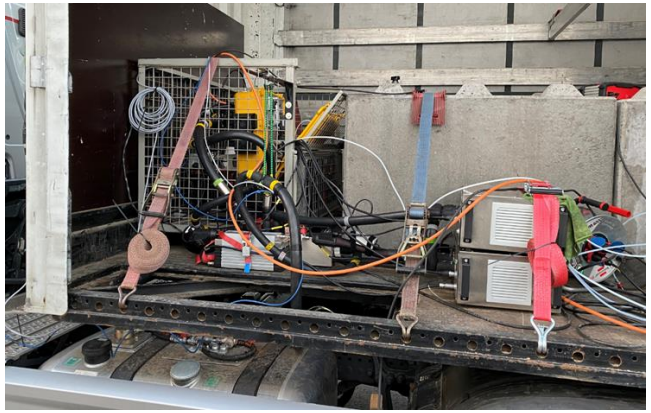


- Project partners

FEV IPA CORNING

Automotive Grade Urea Sector Group

cefic sector group



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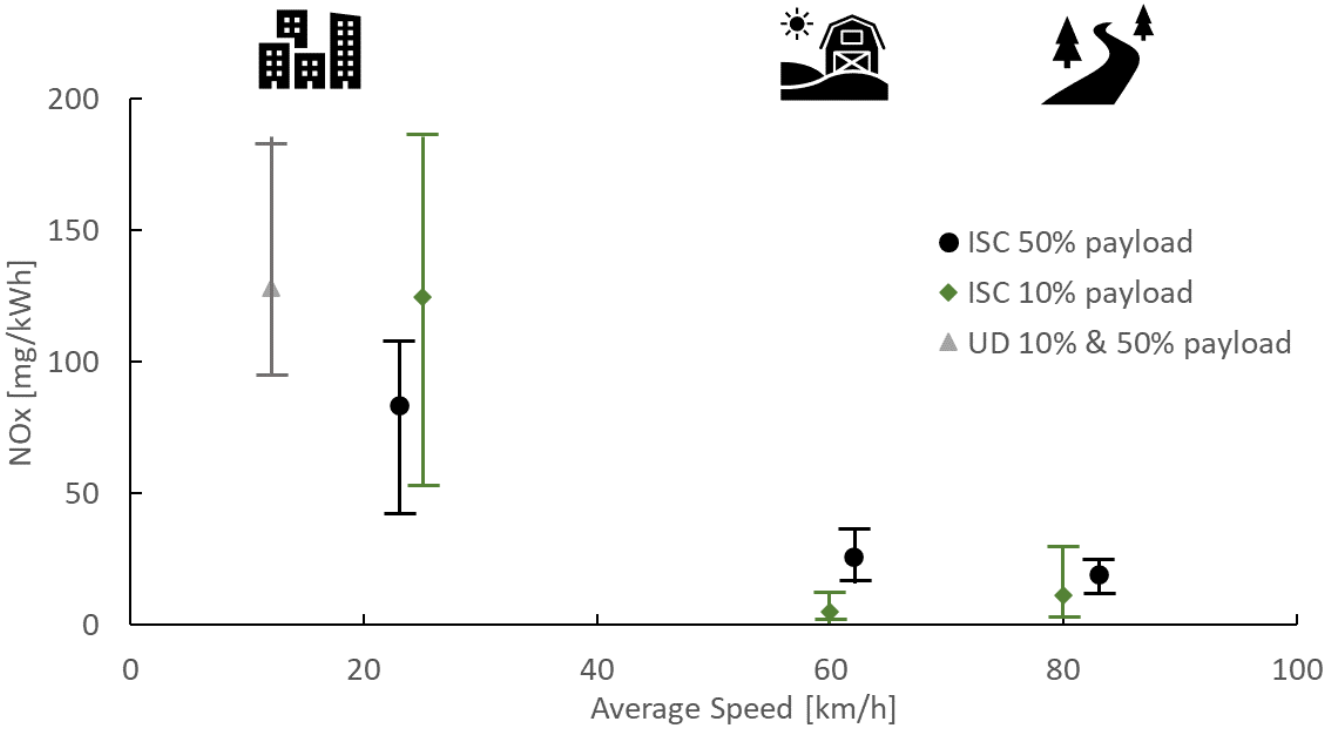
diesel

HD diesel demonstrator preliminary results

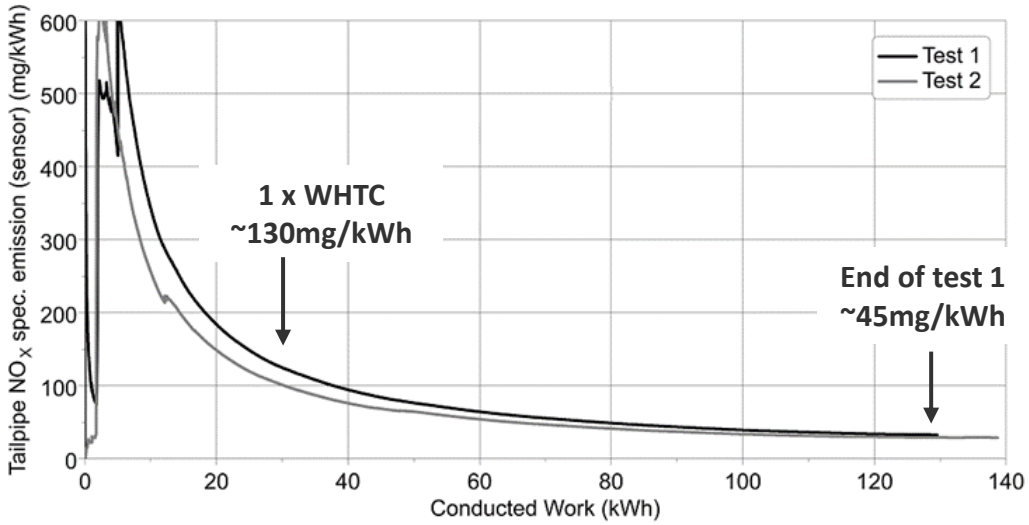
- Ultra-low NOx emissions over a broad range of operating conditions
  - ISC (N3 Euro VI-c route) and urban delivery[1] trips have been conducted with 10 and 50% payload
  - Tests cover a range of ambient temperatures from 4-11°C
- On-road testing results can be impacted by road events (traffic, altitude, etc.), temperature or even different drivers

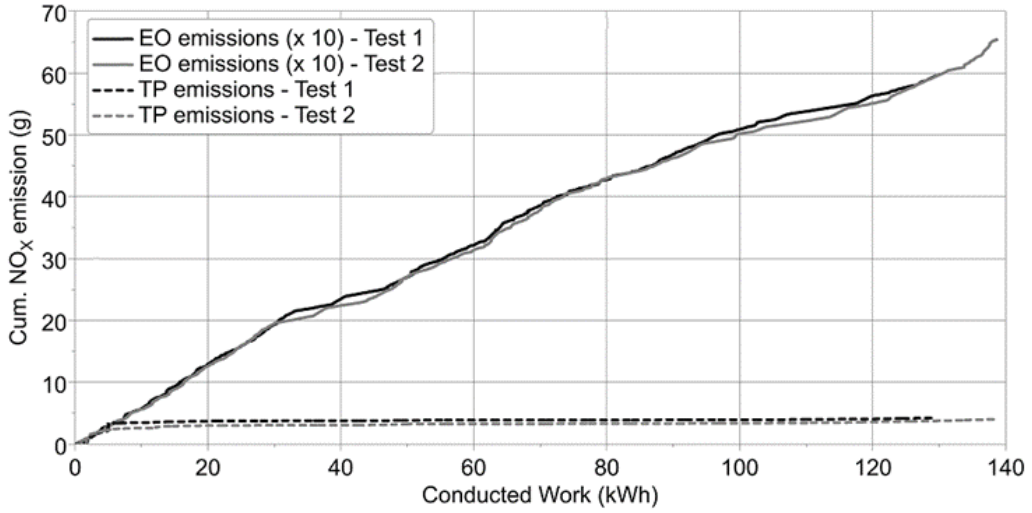


[1] Urban delivery (<35km/h) with 10 stops (~1 min), total trip duration is ~1 hour and work completed is about 14-16kWh
[2] The results are reported as measured under the specified test routes and conditions

HD diesel demonstrator preliminary results

- ISC[1] (N3 Euro VI-C route) NOx 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 CO_2 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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