Advanced emission controls and renewable fuels for low pollutants and lifecycle CO_2 emissions

Dr. Joachim Demuynck

Sustainable Internal Combustion Engine Virtual 'Live' • 3-4 Feb 2021

AECC
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)

Acknowledgements

- Project partners of ultra-low emissions diesel demonstrator

IPA
INTERNATIONAL PLATINUM GROUP METALS ASSOCIATION

automotive engineering iav

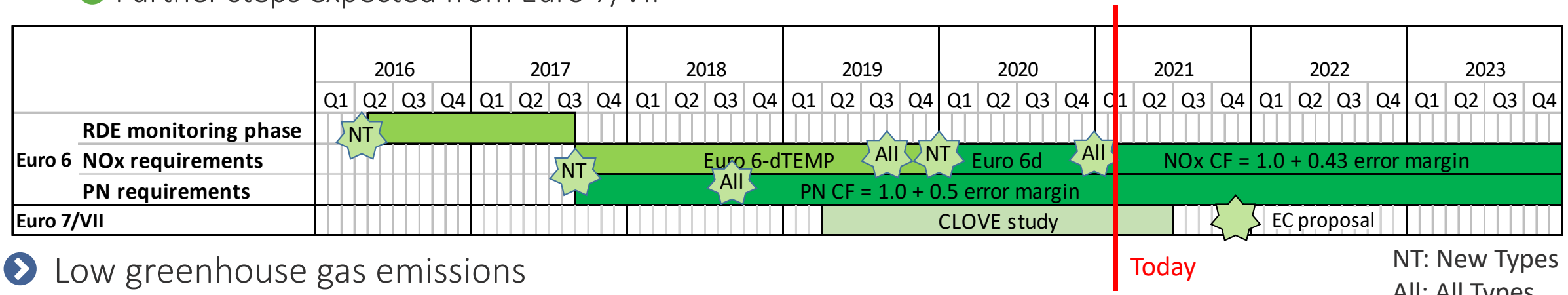
- Additional partner for follow-up work on renewable fuels and Well-to-Wheel analysis

Concawe
Environmental Science for European Refining

  - Roland Dauphin, Science Executive, Fuels Quality and Emissions at Concawe will join Q&A session
    Concawe is the scientific body of the European refining industry

Requirements for a sustainable ICE

- Low pollutant emissions
  - Significant steps taken with introduction of RDE towards Euro 6d
  - Further steps expected from Euro 7/VII



- Low greenhouse gas emissions
  - Increase in efficiency and level of electrification for new vehicles
  - Wider usage of renewable fuels to reduce Well-to-Wheel and lifecycle emissions
    - Immediate reductions for the existing fleet
    - New vehicles

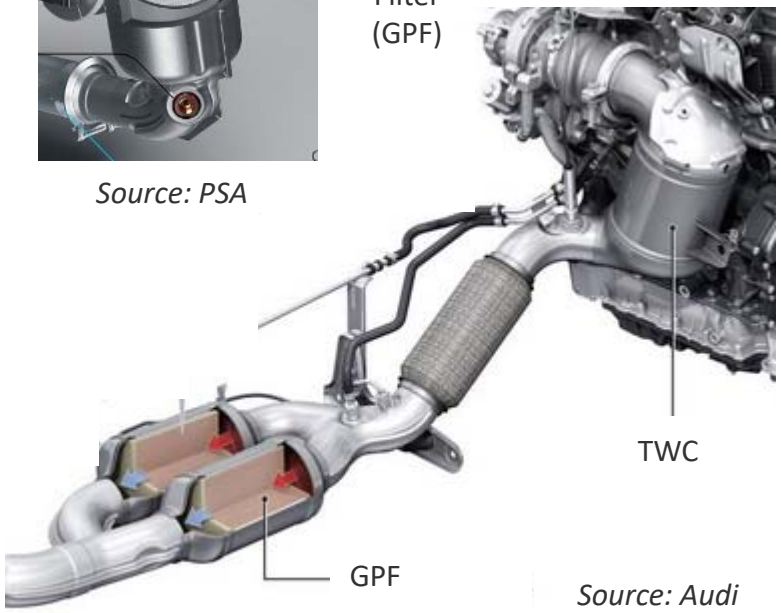
Advanced emission control systems towards Euro 6d

Gasoline – introduction of GPF

TWC

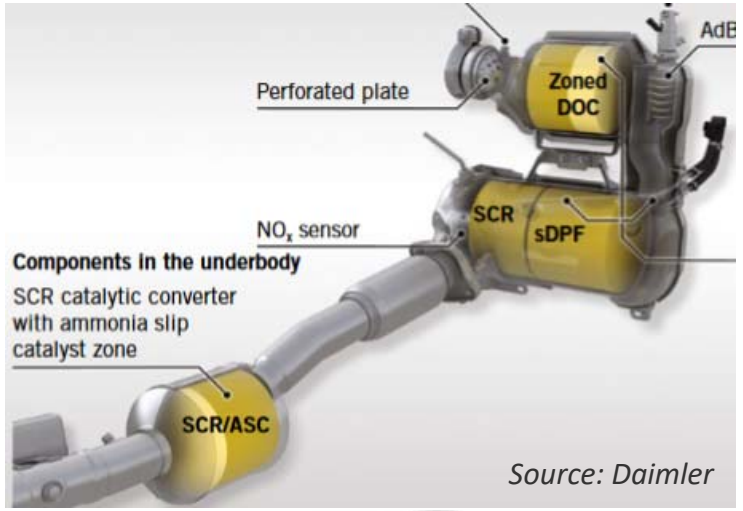
Gasoline Particulate Filter (GPF)

Source: PSA



Source: Audi

Diesel – combination of deNOx technologies

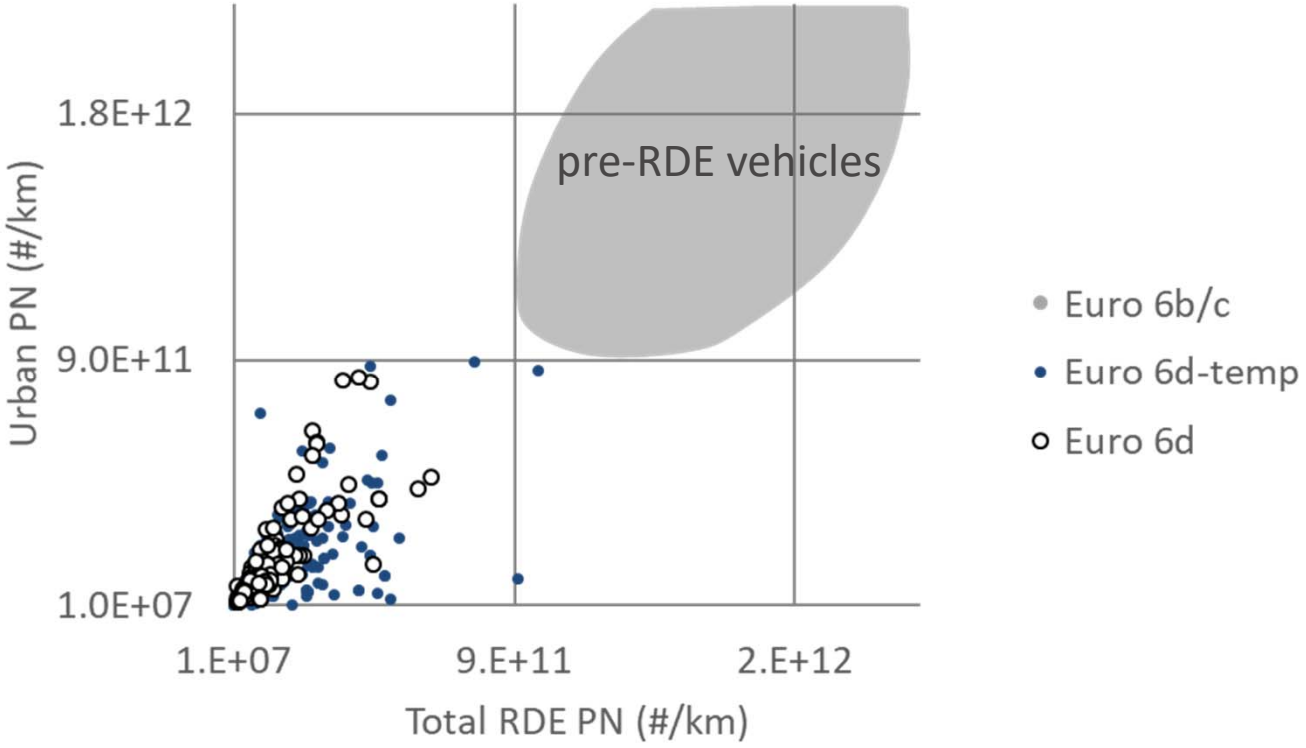


Source: Daimler

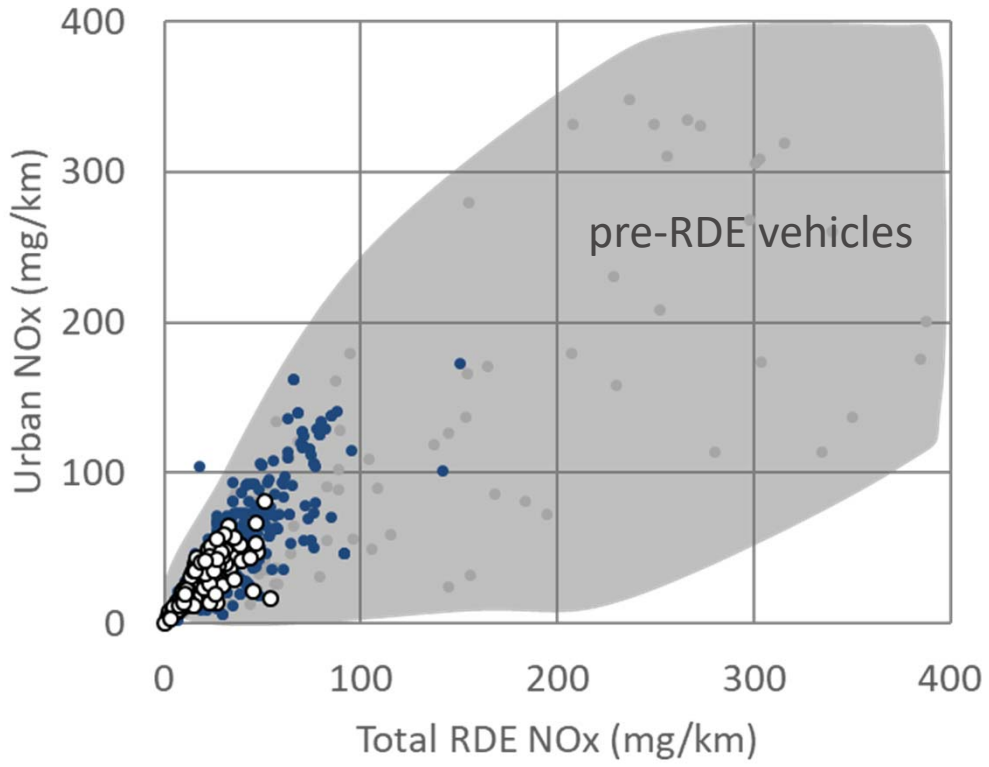
Source: VW

Pollutant emissions significantly reduced towards Euro 6d

Gasoline PN emissions



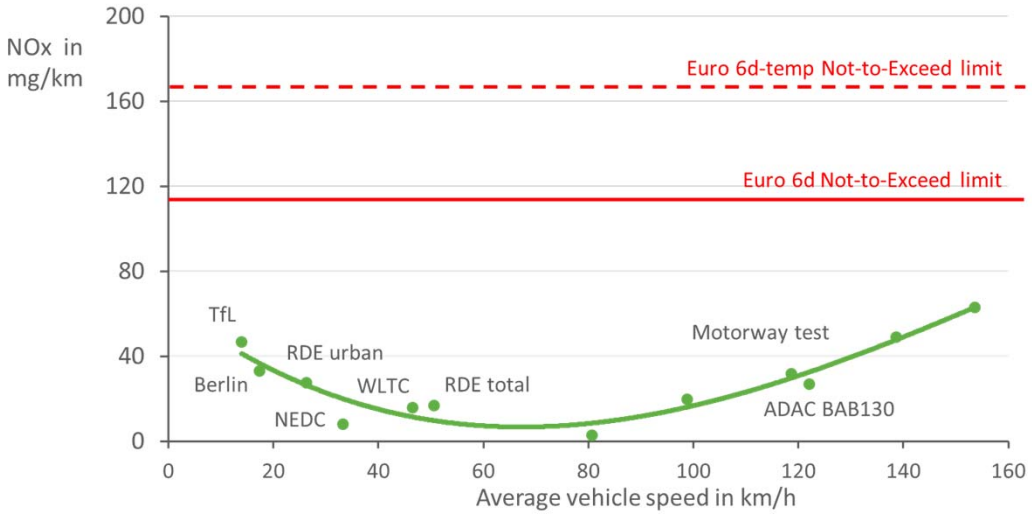
Diesel NOx emissions



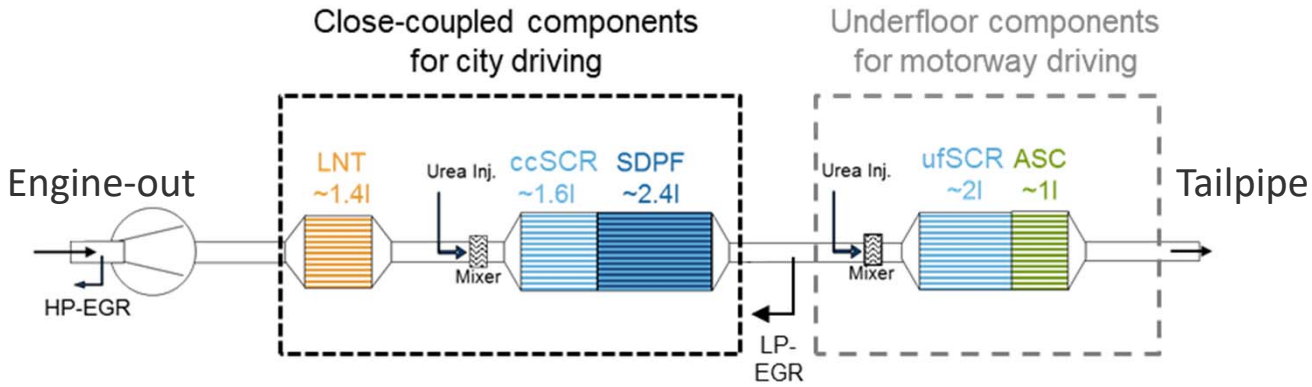
Sources:
- *ACEA/JAMA Euro 6d(-TEMP) PEMS data consulted 17 July 2020*
- *pre-RDE PN emissions factors from B. Giechaskiel, Int. J. Environ. Res. Public Health, 2018*

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

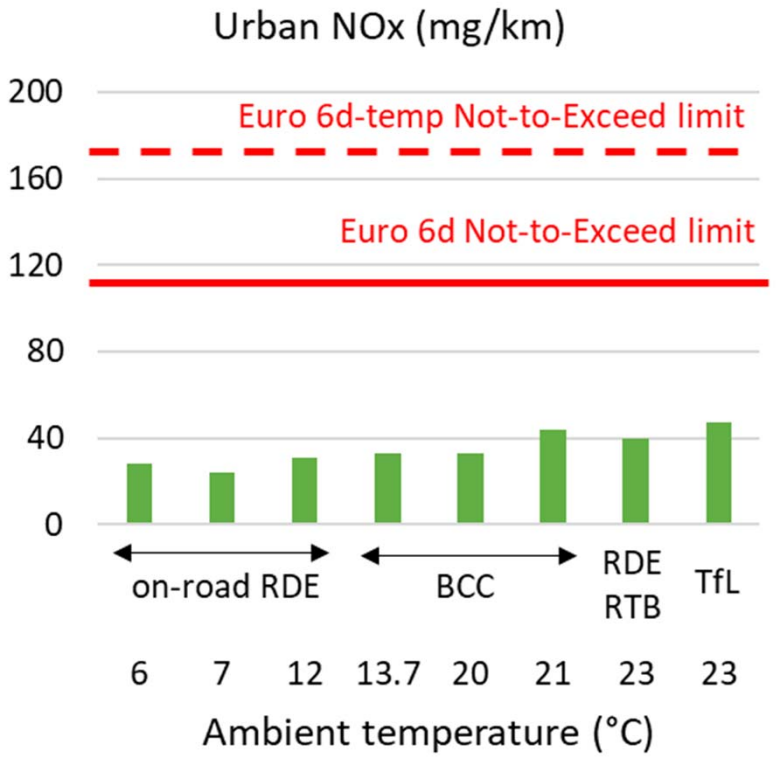


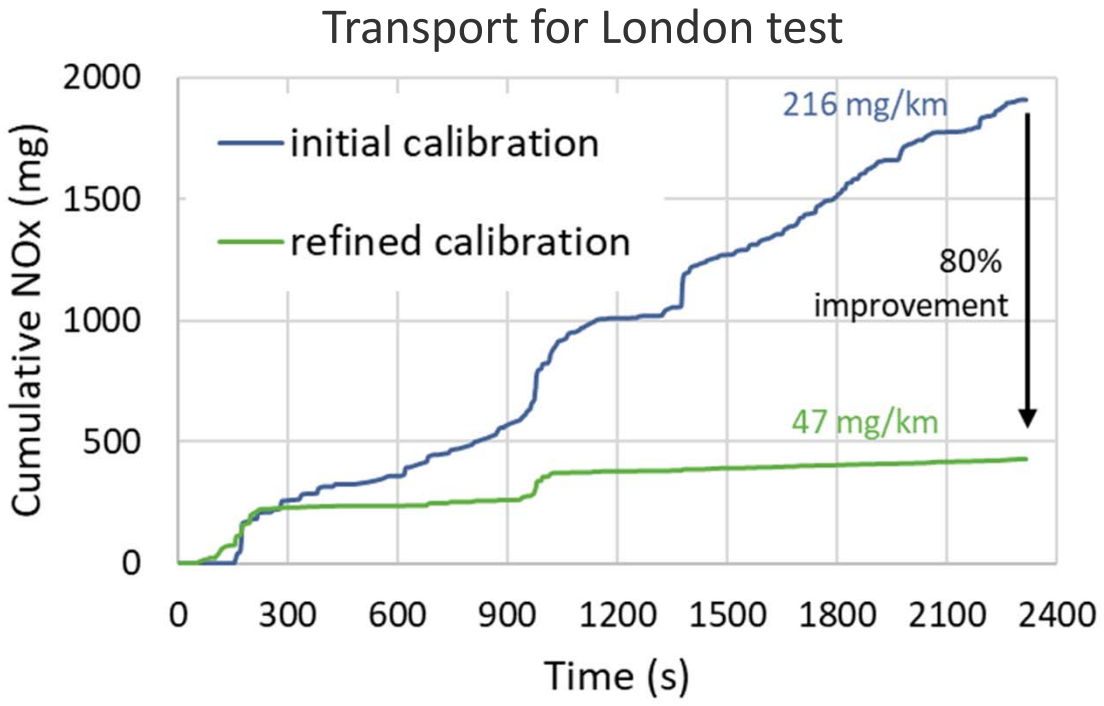
Note: hydrothermal aged components used targeting 160k km

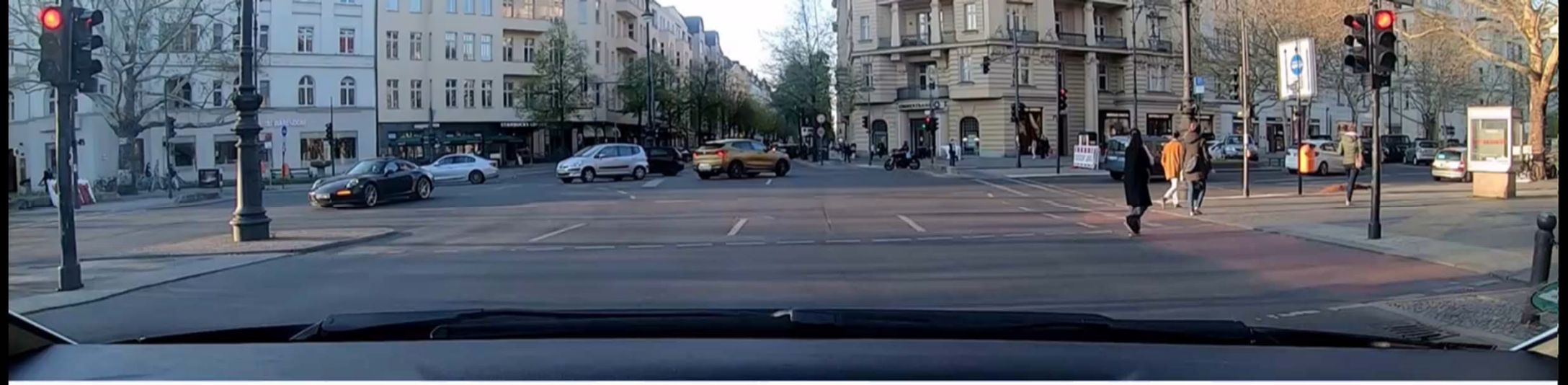
1) *J. Demuynck, et al.; "Integrated Diesel System Achieving Ultra-Low Urban and Motorway NOx Emissions on the Road", 40th Vienna Motor Symposium, 2019*
https://www.aecc.eu/wp-content/uploads/2019/04/190516-AECC-IAV-IPA-Integrated-Diesel-System-achieving-Ultra-Low-NOx-on-the-road-Vienna-Symposium.pdf
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

Ultra-low emissions diesel demonstrator

- Low urban NOx emissions for different tests over range of ambient temperature
- Significant improvement achieved due to LNT regeneration stabilisation and thermal management







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

Engine heat-up

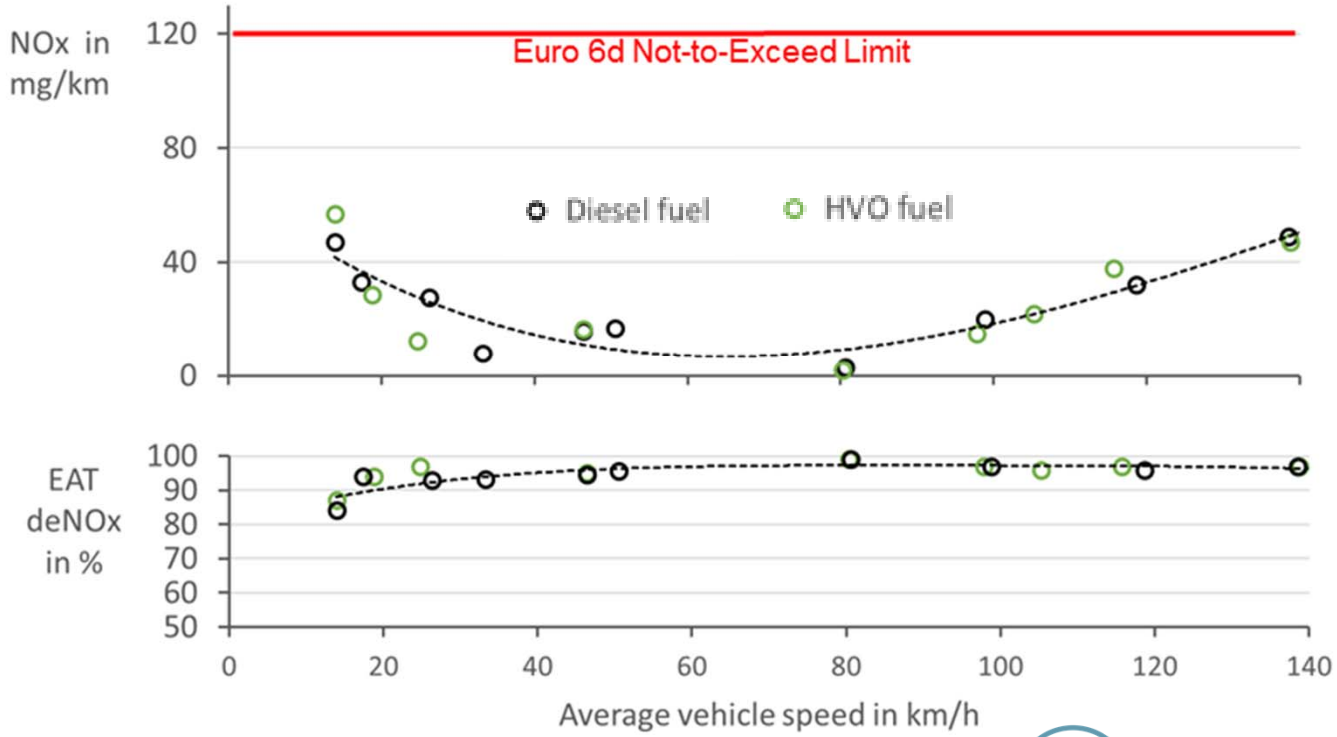
LNT regeneration

Urea doser 1

Urea doser 2

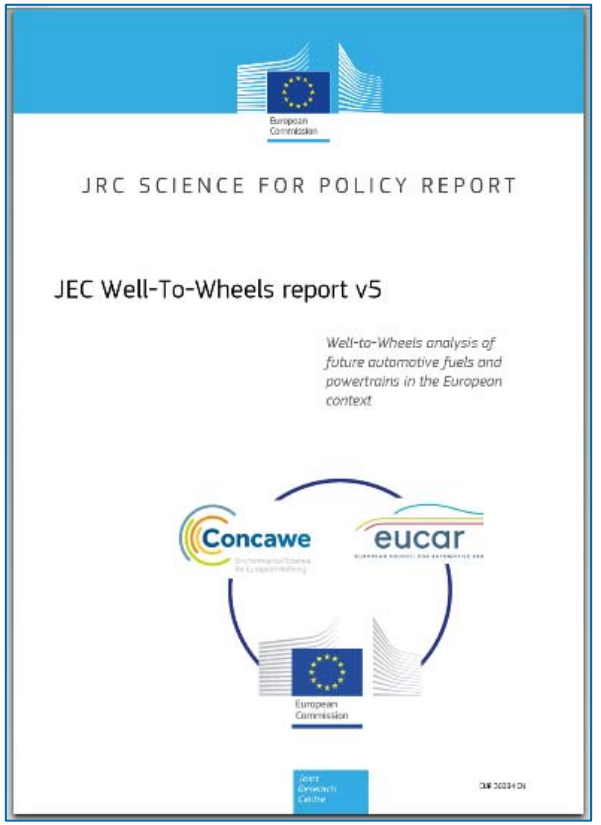
Low pollutant emissions confirmed for low carbon fuels

- Reference tests on B7 market diesel (7% fatty-acid-methyl-ester content)
- Tests on renewable fuels without modification to vehicle hardware or software
  - 100% HVO (Hydrotreated Vegetable Oil)
  - B30 diesel



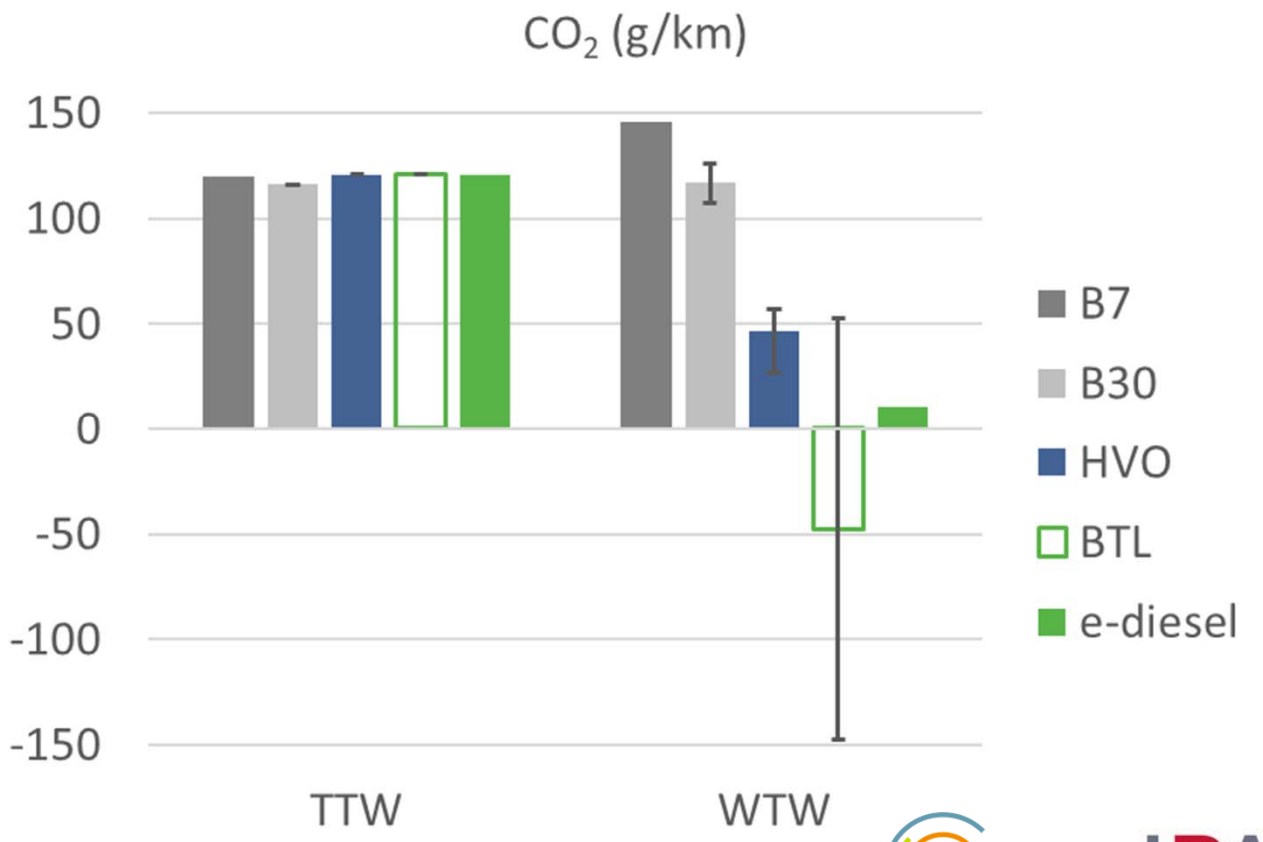
Well-to-Wheel calculations to investigate CO_2 impact

- Methodology of JEC WtW report v5 used http://dx.doi.org/10.2760/100379
- Several representative production pathways studied
  - Paraffinic fuels (associated with 100% HVO tests)
    - HVO: palm oil, waste cooking oil, EU mix
    - BTL (biomass-to-liquid): waste wood
      - Hydrothermal liquefaction
      - Fischer-Tropsch route with CCS (carbon capture and storage)
    - e-diesel: Fischer-Tropsch route with SOEC (solid oxide) electrolyser
  - FAME (associated with B7 and B30 tests)
    - Rapeseed oil
    - Palm oil
    - Waste cooking oil



Well-to-Wheel calculations to investigate CO_2 impact

- 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%



Conclusion and outlook

- Low pollutant emissions over wide range of driving conditions shown with the use of advanced emission control systems
- Significant WtW CO_2 reductions possible with the use of renewable fuels
- Part of this reduction is already possible for the existing fleet as most paraffinic compounds are drop-in for market diesel fuel, i.e. compatible with existing vehicles and infrastructure
- Internal Combustion Engine is part of the solutions to contribute to EU Green Deal climate-neutral and zero-emission goals along with electrification
- Further investigations for LD gasoline and HD diesel are under consideration
- AECC is providing input to the ongoing Euro 7 process reflecting the further developments and innovation needed for future engine systems
- Concawe is assessing the scalability of carbon-neutral fuel production

THANK YOU !

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