Euro 7 for further innovation in emission control technologies

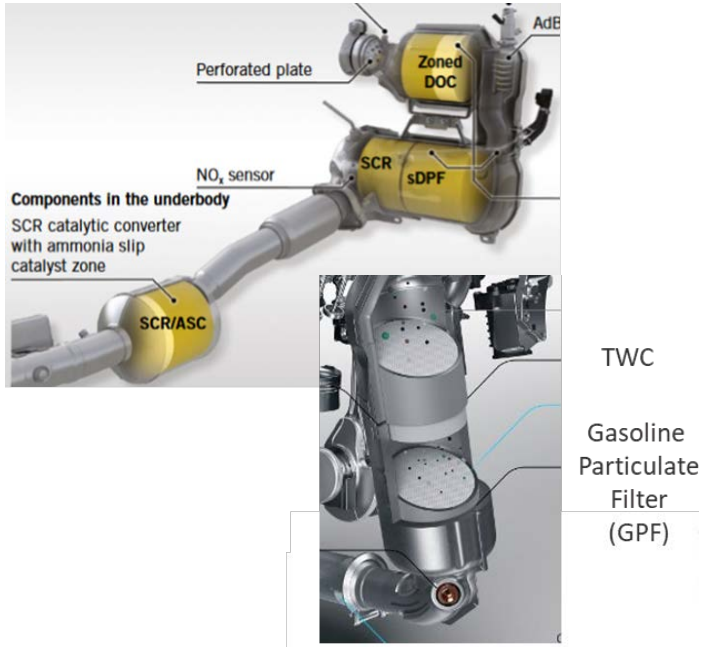
Joachim Demuynck

VERT forum • 21 March 2023

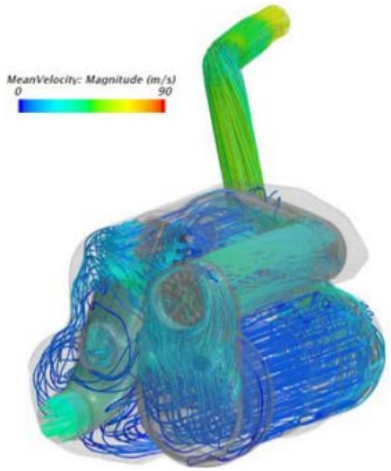
ASSOCIATION FOR EMISSIONS CONTROL BY CATALYST

Euro 6/VI significantly reduced impact on air quality

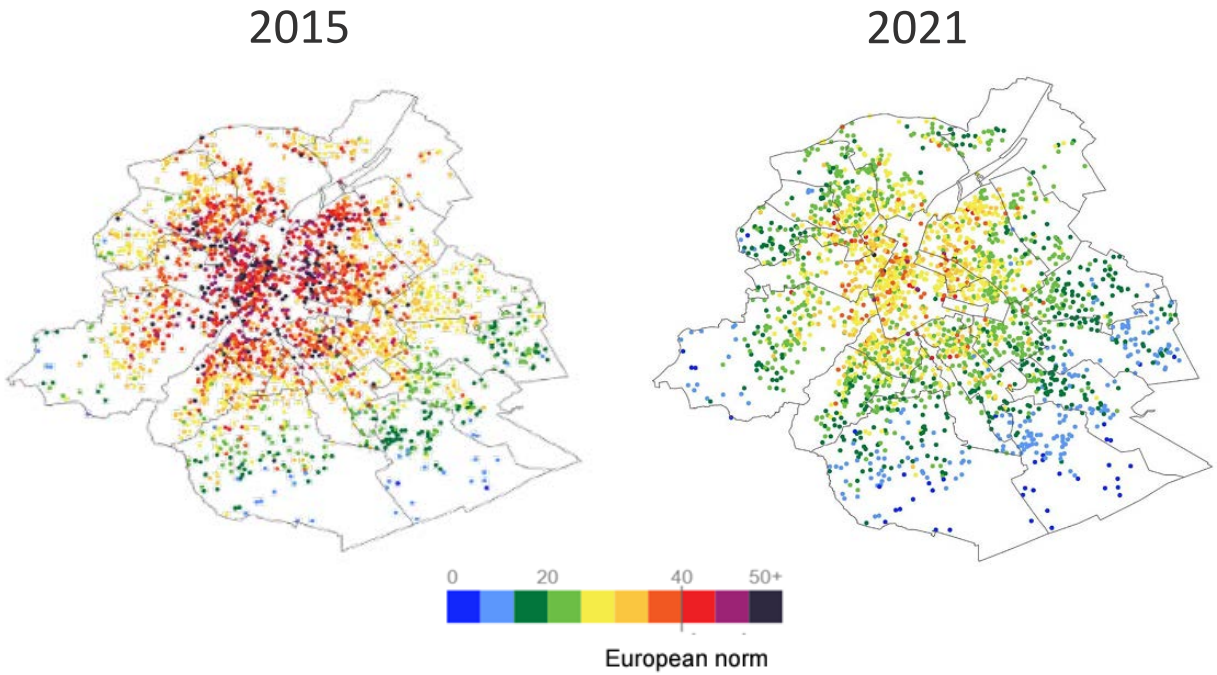
- Evolution in emission control systems
  - LD diesel - combination of deNOx technologies
  - LD gasoline - introduction of particulate filter
  - HD diesel - compact design of SCR and filter
- Several reports about improved air quality
- Example of NO_2 in Brussels



Source: PSA



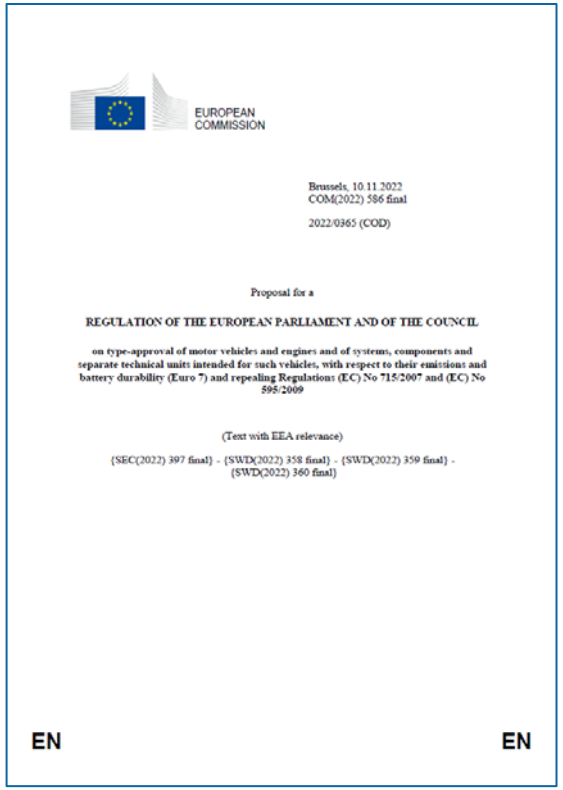
Source: Daimler 2022



Source: CurieuzenAir report air quality in Brussels, 2022

Euro 7 to further contribute to air quality improvement

- To support the revision of the Air Quality Directive, published on 26 October 2022
- The European Commission published the Euro 7 proposal for cars, vans, trucks and buses on 10 November 2022
- Two parallel processes have started
  - The ordinary legislative process by European Parliament and Council
  - Development of implementing legislation by the European Commission involving the AGVES expert working group and CLOVE consortium



EUROPEAN COMMISSION

Brussels, 10.11.2022
COM(2022) 586 final

2022/0365 (COD)

Proposal for a

REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

on type-approval of motor vehicles and engines and of systems, components and separate technical units intended for such vehicles, with respect to their emissions and battery durability (Euro 7) and repealing Regulations (EC) No 715/2007 and (EC) No 595/2009

(Text with EEA relevance)

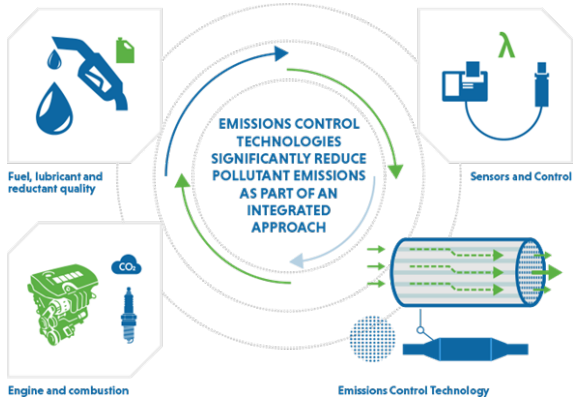
{SEC(2022) 397 final} - {SWD(2022) 358 final} - {SWD(2022) 359 final} - {SWD(2022) 360 final}

EN EN

AECC ASSOCIATION FOR EMISSIONS CONTROL BY CATALYST

AECC demo data supports Euro 7 and ‘Fit for 55’ discussions

- Demonstrators show ultra-low pollutant emissions with emission control technologies in an integrated approach
- Tests show compatibility with drop-in sustainable renewable fuels, with substantial reduction in WtW CO_2 emissions



IPA IAV Concawe

IPA IAV DENSO CATALER BOSCH aramco PORSCHE

IPA FEV CORNING cefic sector group

Automotive Grade Urea Sector Group

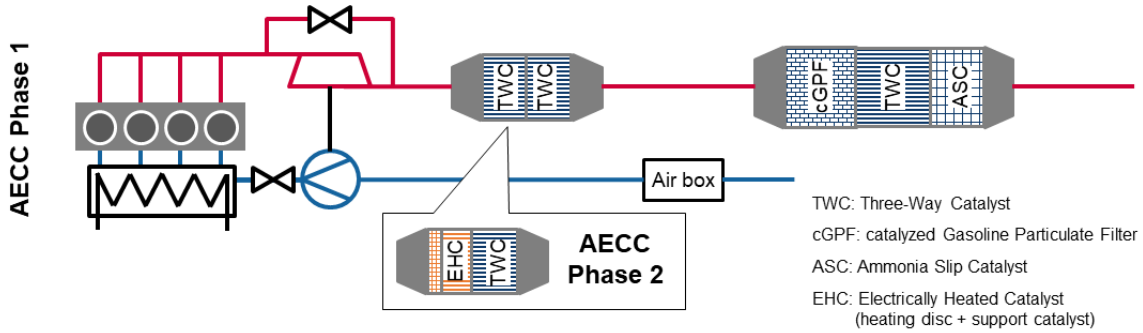
NESTE aramco

AECC ASSOCIATION FOR EMISSIONS CONTROL BY CATALYST

LD gasoline demonstrator concept

- Base vehicle
  - C-segment vehicle
  - 1.5l engine with 4 cylinders
  - Variable valve train and cylinder deactivation
  - 48V mild-hybrid
  - Euro 6d type-approval baseline: cc cGPF + uf TWC

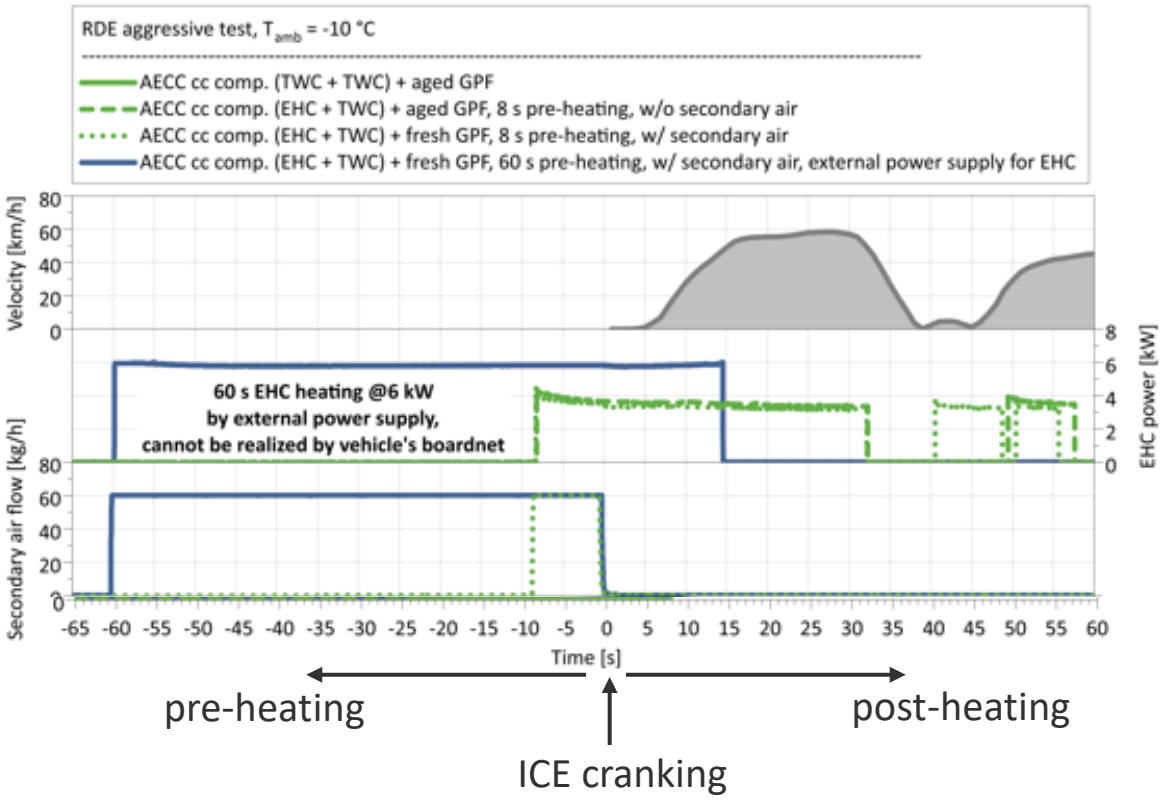
- AECC emission control system
  - Phase 1: cc TWC, uf cGPF+TWC+ASC
  - Phase 2: cc EHC|TWC, uf cGPF+TWC+ASC
  - Bench aged components targeting 160k km



J. Demuynck, et al.; "Ultra-low Emissions of a 48V Mild-Hybrid Gasoline Vehicle with Advanced Emission Control Technologies", 15th International Conference on Engines and Vehicles, 2021
J. Demuynck, et al.; "Zero-Impact Emissions from a Gasoline Car with Advanced Emission Controls and E-Fuels" 43rd International Vienna Motor Symposium, 2022

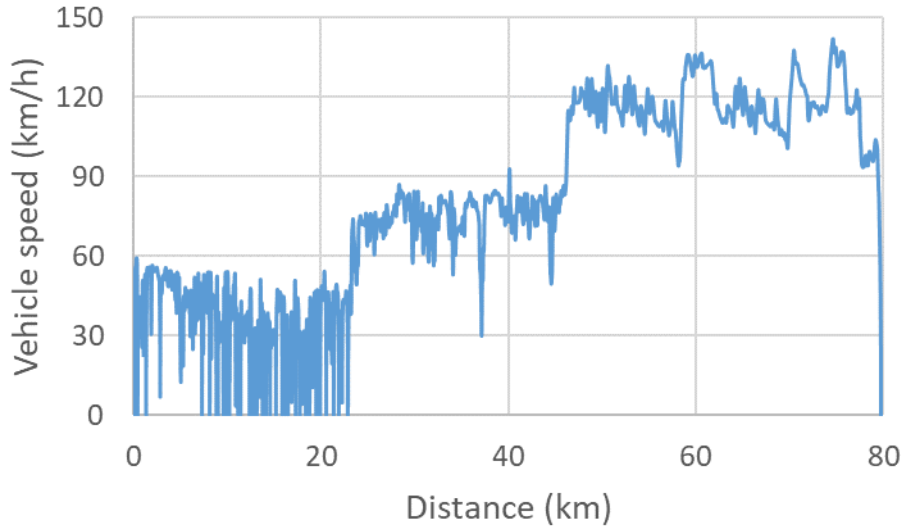
Implementation of electrically heated catalyst (EHC)

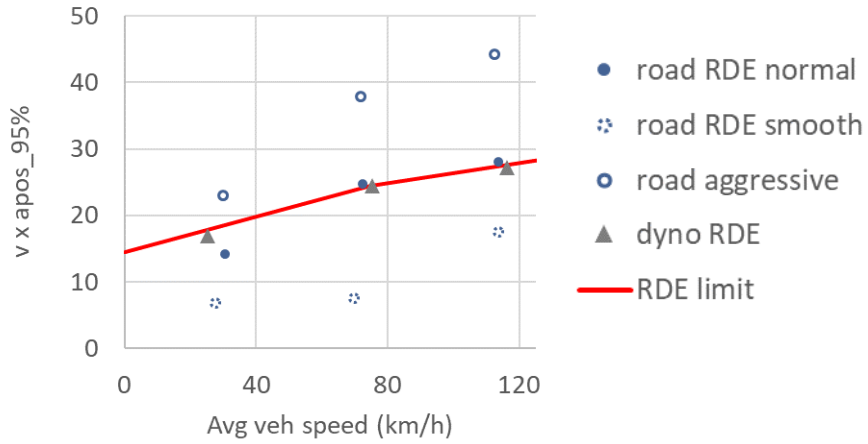
- Operation strategy
  - Pre-heating in combination with post-heating
  - 60s pre-heating as outlook to advanced hybrids
  - Secondary air in exhaust manifold to enhance heat transfer within catalyst during pre-heating phase
- There is further potential due to certain constraints within this project, for example
  - Flow distribution not uniform, 90° bend at inlet
  - The part was not insulated



Testing focused on challenging cold-start driving

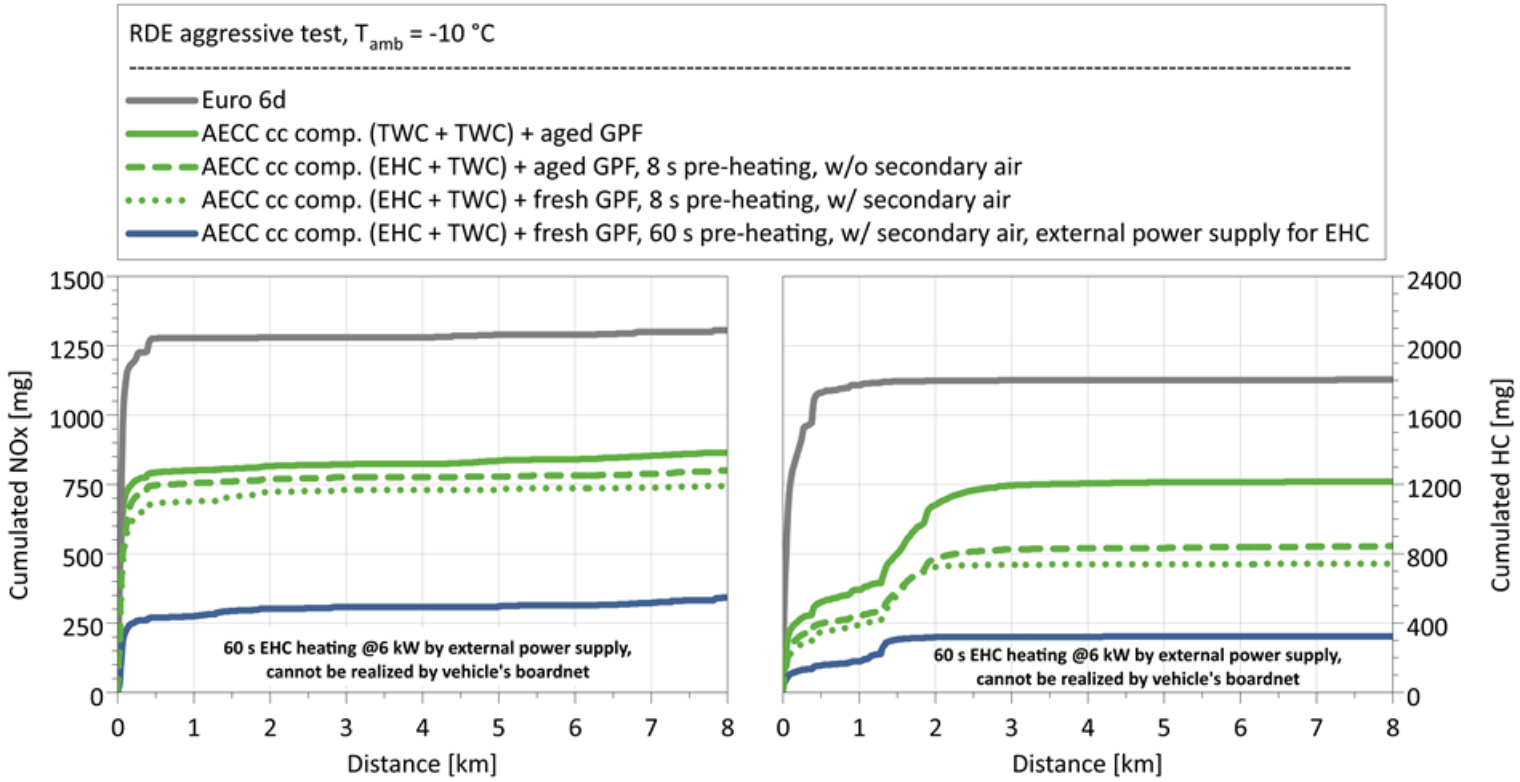
- This presentation focuses on results of the RDE aggressive test conducted on chassis dyno
  - At Euro 6 RDE boundary for vxa_{pos}
  - 3s of idling between key-on and drive-off
  - First acceleration immediately to 60 km/h
  - Maximum average wheel power during first 2 kilometers after the initial cold-start is ~15%





Reduction of cold-start emissions compared to Euro 6d

- EHC with 8s pre-heating similar to ccTWC for NOx, reduction for THC
- EHC with 60s pre-heating reduces cold-start at -10 °C to level measured at 23 °C



Ignition

Engine load: *0* %

Vehicle speed: *0* km/h

500

0

NOx

2 ppm

30 s or 150 m to near-zero emissions

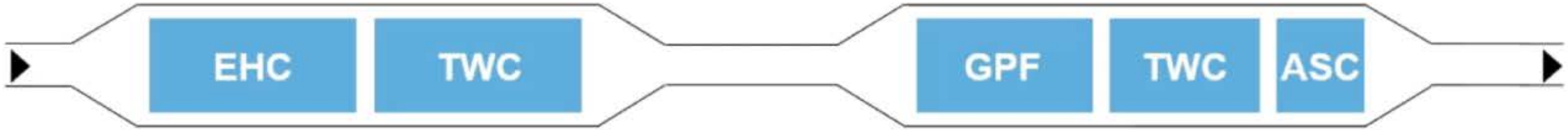
500

0

NOx

0 ppm

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



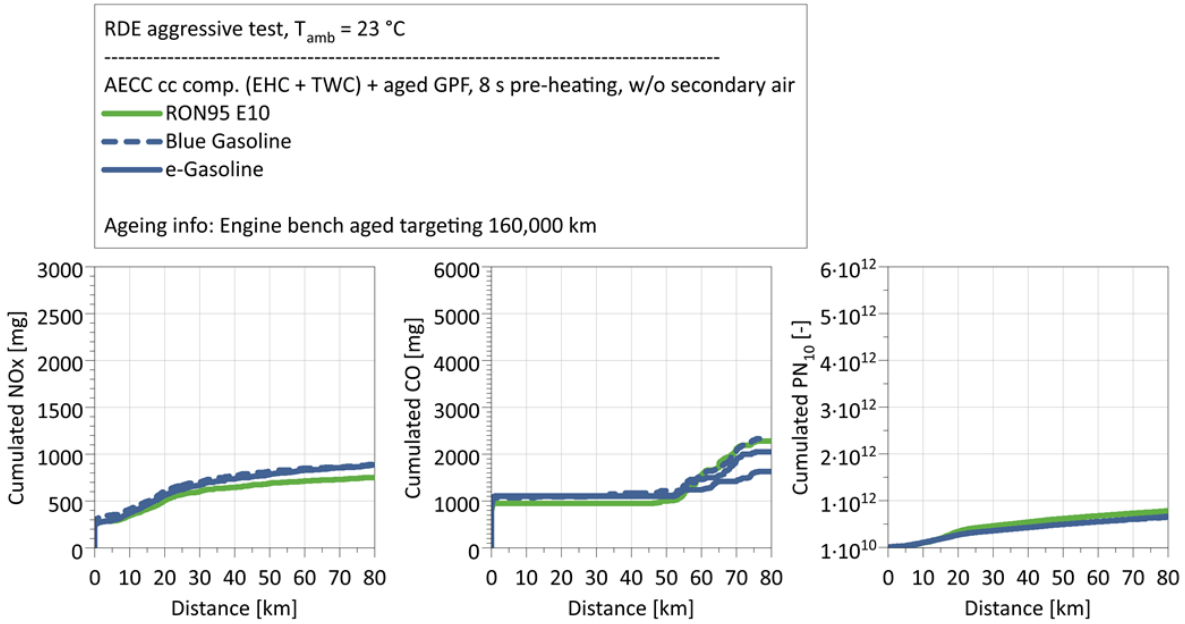
Engine catalyst heating

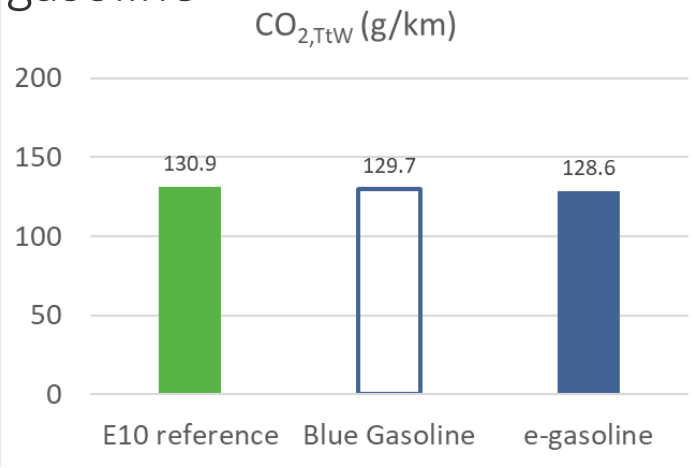
EHC heating

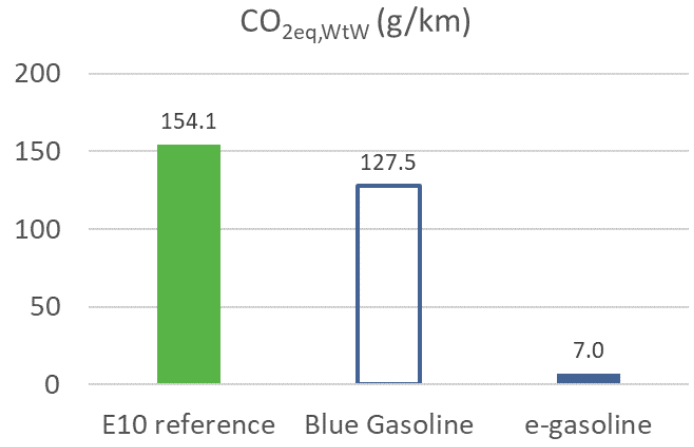
Closed-loop lambda control

LD gasoline demonstrator with sustainable renewable fuels

- Ultra-low pollutant emissions confirmed on Blue Gasoline and e-gasoline
- Blue Gasoline already offers today significant reduction of 17% (20% compared to E0), E-gasoline has the potential to nearly eliminate WtW CO_2 emissions



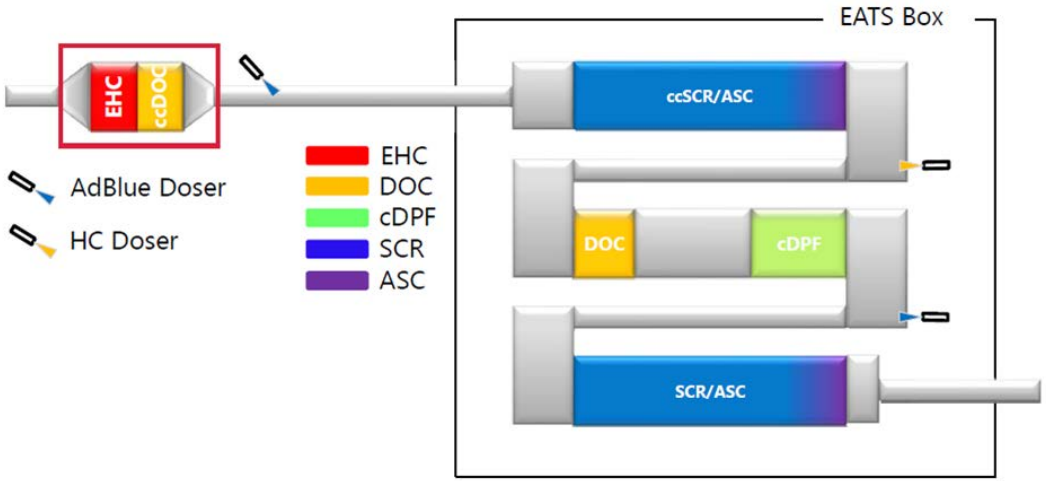




J. Demuynck, et al.; "Zero-Impact Emissions from a Gasoline Car with Advanced Emission Controls and E-Fuels" 43rd International Vienna Motor Symposium, 2022

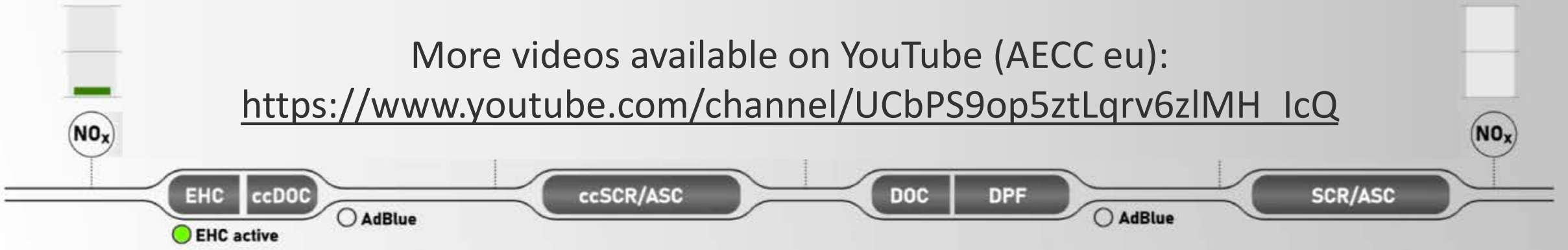
HD diesel demonstrator concept

- Base vehicle description
  - MB Actros 1845 LS 4x2
  - Engine OM 471
    - Euro VI C certified
    - 12.8 litres, 6 cylinder in-line
    - High Pressure EGR + DOC + DPF + SCR
- AECC emissions control system
  - Phase 1: ccDOC, ccSCR/ASC+ ufDOC+cDPF+ SCR/ASC, twin AdBlue dosing and HC doser
  - Phase 2: additional EHC as part of the ccDOC
  - Components are hydrothermally aged targeting 500k km



P. Mendoza Villafuerte, et al.; "Demonstration of Extremely Low NOx Emissions with Partly Close-Coupled Emission Control on a Heavy-duty Truck Application", 42nd Vienna Motor Symposium 2021
P. Mendoza Villafuerte, et al.; "Future-proof heavy-duty truck achieving ultra-low pollutant emissions", Transportation Engineering, Volume 9, September 2022, 100125, 2022

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



Summary

- Advanced emission control systems implemented on LD gasoline and HD diesel demonstrator vehicles
- Ultra-low pollutant emissions measured
  - Significant reduction of initial cold-start peak compared to already low Euro 6/VI level
  - Near-zero emissions after initial cold-start peak
- Emission control technologies fully operating in combination with drop-in sustainable renewable fuels enable ultra-low pollutant emissions while contributing towards net-zero CO_2 emissions
- AECC calls for a swift adoption to get Euro 7 well before the next EU elections

THANK YOU !

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