

Real Driving Emissions of a GPF-equipped production car

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Real Driving Emissions
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Association for Emissions Control by Catalyst AISBL

Association for Emissions Control by Catalyst (AECC) AISBL

AECC members: European Emissions Control companies



Exhaust emissions control technologies for cars, commercial vehicles, motorcycles and non-road mobile machineries for original equipment, aftermarket and retrofit.

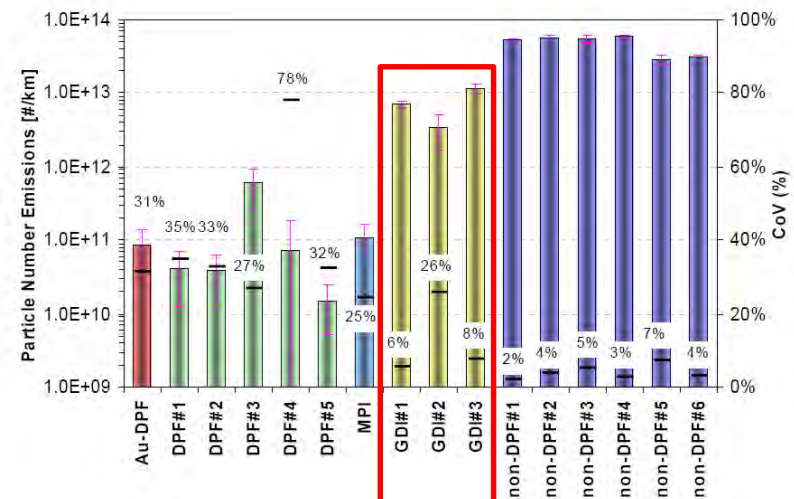
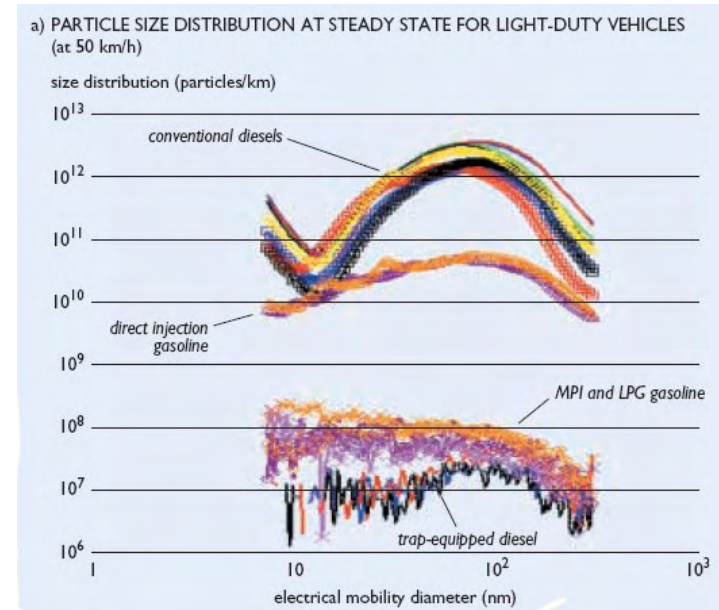


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GDI particle emissions background

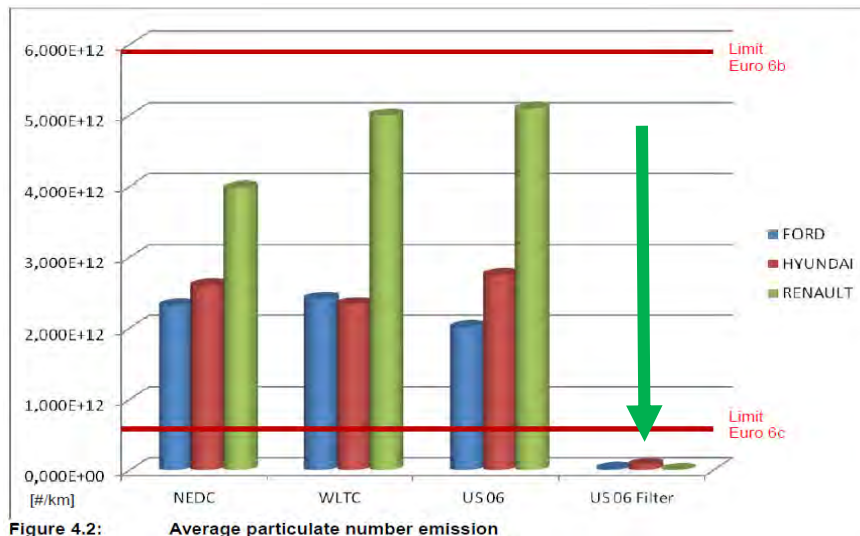
- 2001: Joint UK programme¹ indicated potential for significant particle emissions from GDI cars.
- 2007: UN PMP exercise² showed GDI particle number (PN) emissions in the range of 3×10^{12} to 1×10^{13} #/km compared to $< 2 \times 10^{11}$ #/km for DPF-equipped diesels.

1. DETR/SMMT/CONCAWE Particulate Research Programme
2. Particle Measurement Programme (PMP) Light-duty Inter-Laboratory Correlation Exercise (ILCE_LD) Final Report



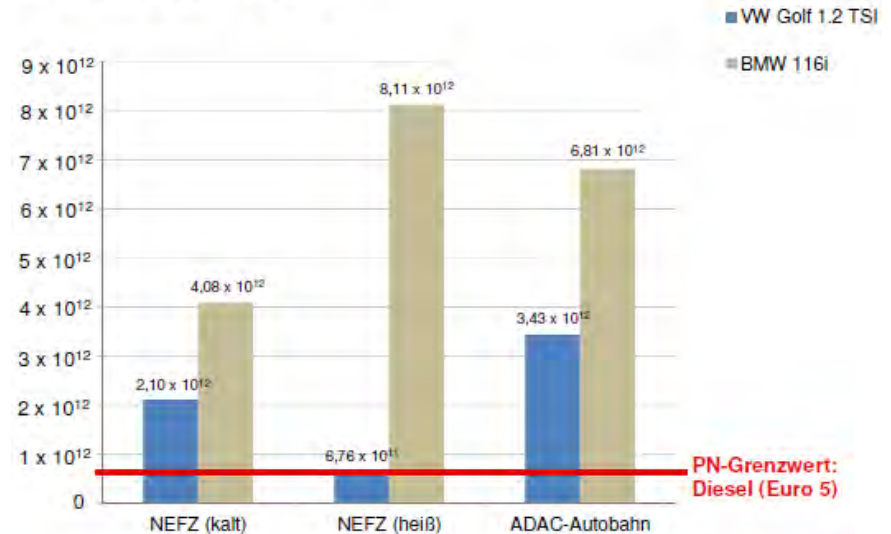
Recent GDI particle emissions measurements

- Other tests show higher PN from GDI than on the regulatory test cycle.
- Several papers and reports showed the potential of Gasoline Particulate Filter.



Source: T&E Briefing Particle emissions from petrol cars, November 2013.

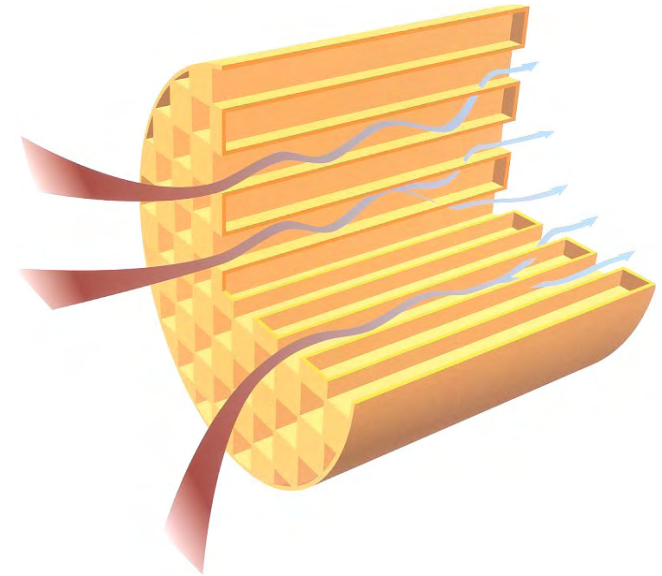
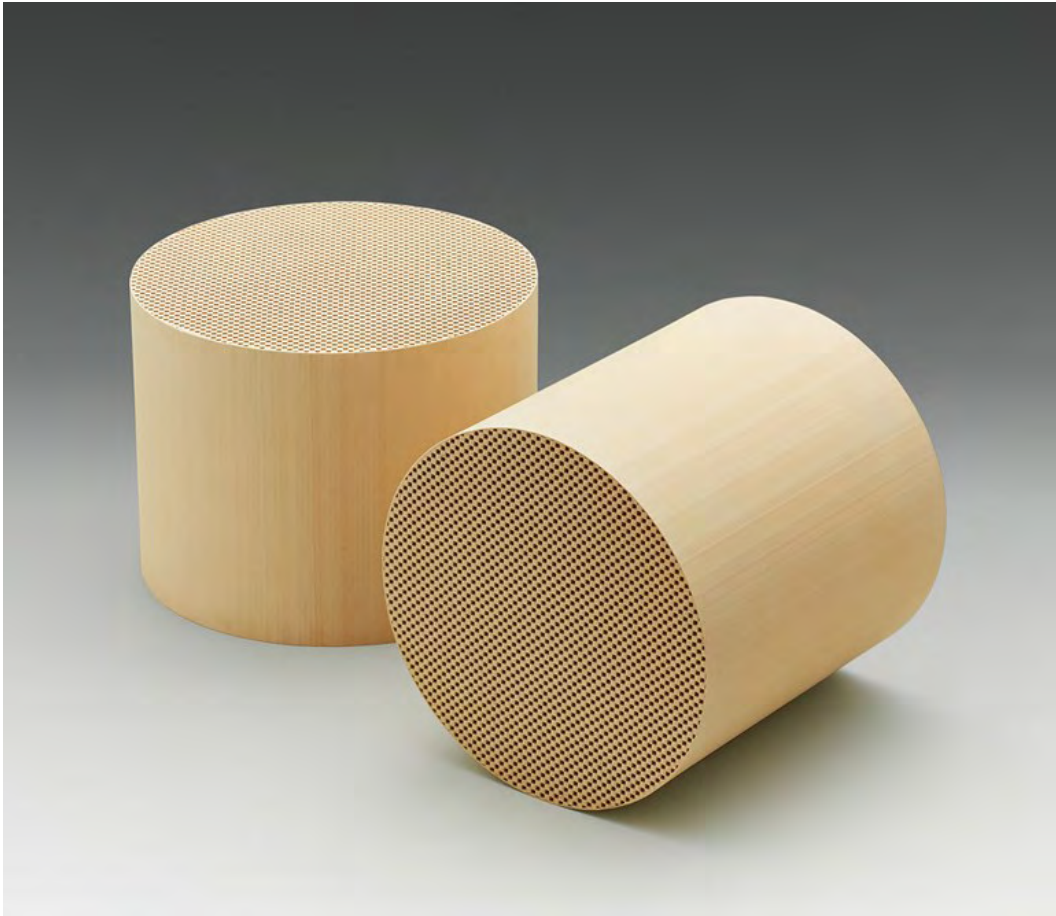
Partikelanzahl (PN)/km



Source: DUH, July 2011.

- The legislative PN limit for GDIs will be the same as diesels at Euro 6c.
- PN will be included in the RDE test procedure.

Gasoline Particulate Filter (GPF)



AECC-Concawe test programme

- **Objective:** evaluate the emissions performance of the first commercially available GDI passenger car equipped with GPF.



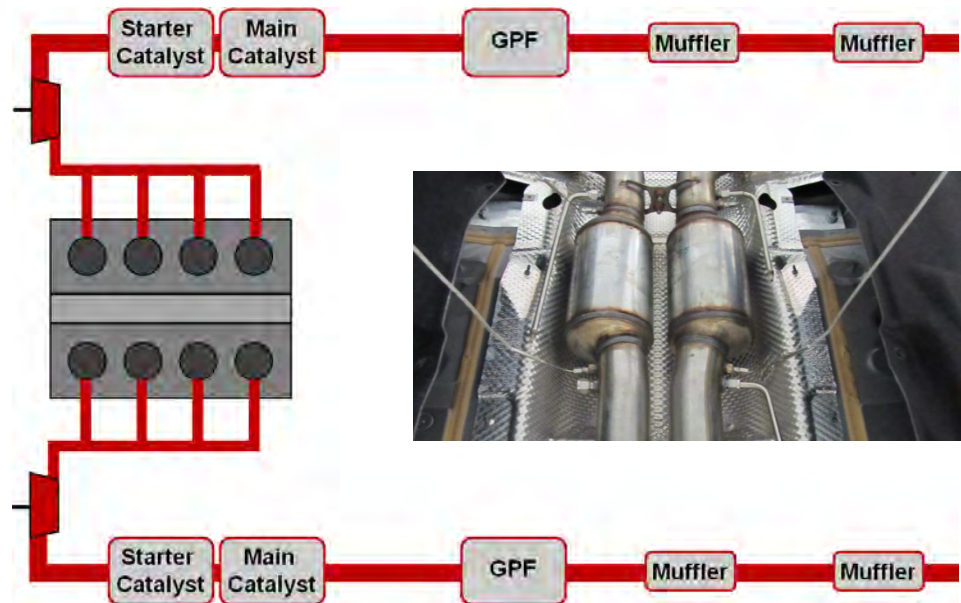
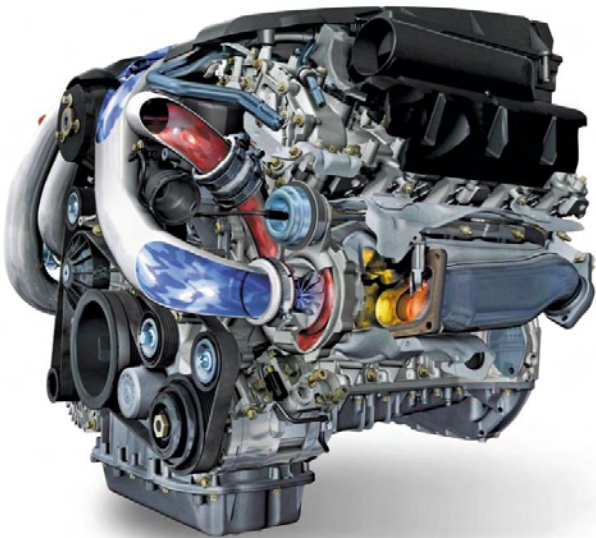
- Test car: F class 2-wheel drive 7-speed automatic.
- Mileage of 10600 km on receipt.

AECC-Concawe test programme

- New OEM exhaust system procured to allow fitment of instrumentation; run in for 1500 km.
- Actual coast-down determined (without PEMS).
- Measurements over the NEDC and WLTC test cycles + Real Driving Emissions using PEMS.
 - Ecostar LDV PEMS for CO/CO₂/NO_x, Pegasor Mi3 for PN.
- Market fuel used for all testing – 95.1 RON, 85.5 MON, 5.2 mass % ethanol, 2.8 mass % MTBE, C:H 84.43:13.22.

Engine and exhaust system

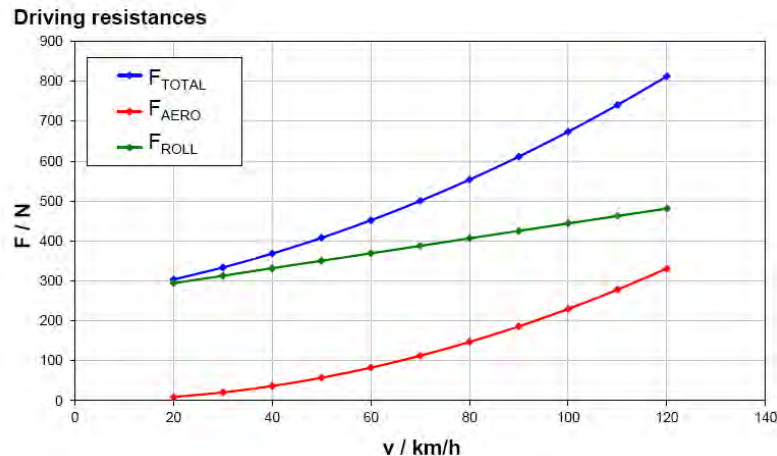
Engine Type		Capacity	Power	Emissions control
V8 Turbocharged	Direct Injection (Central Injector)	4.7 litres	335kW	2×TWC+GPF in each of 2 branches



Preparatory test work

Coastdown:

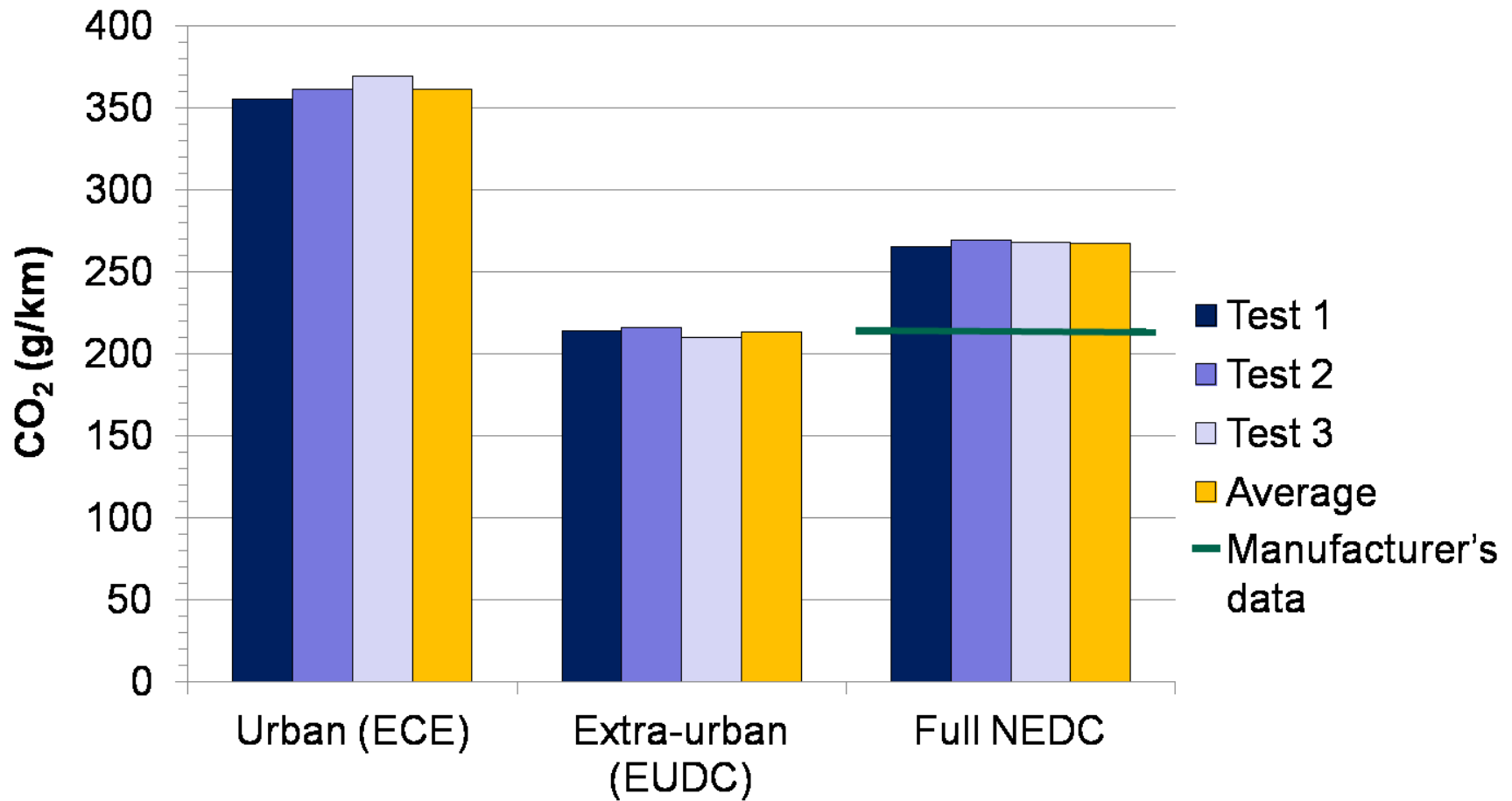
- Vehicle found to have high rolling resistance due to high weight from optional equipment and large tyres.



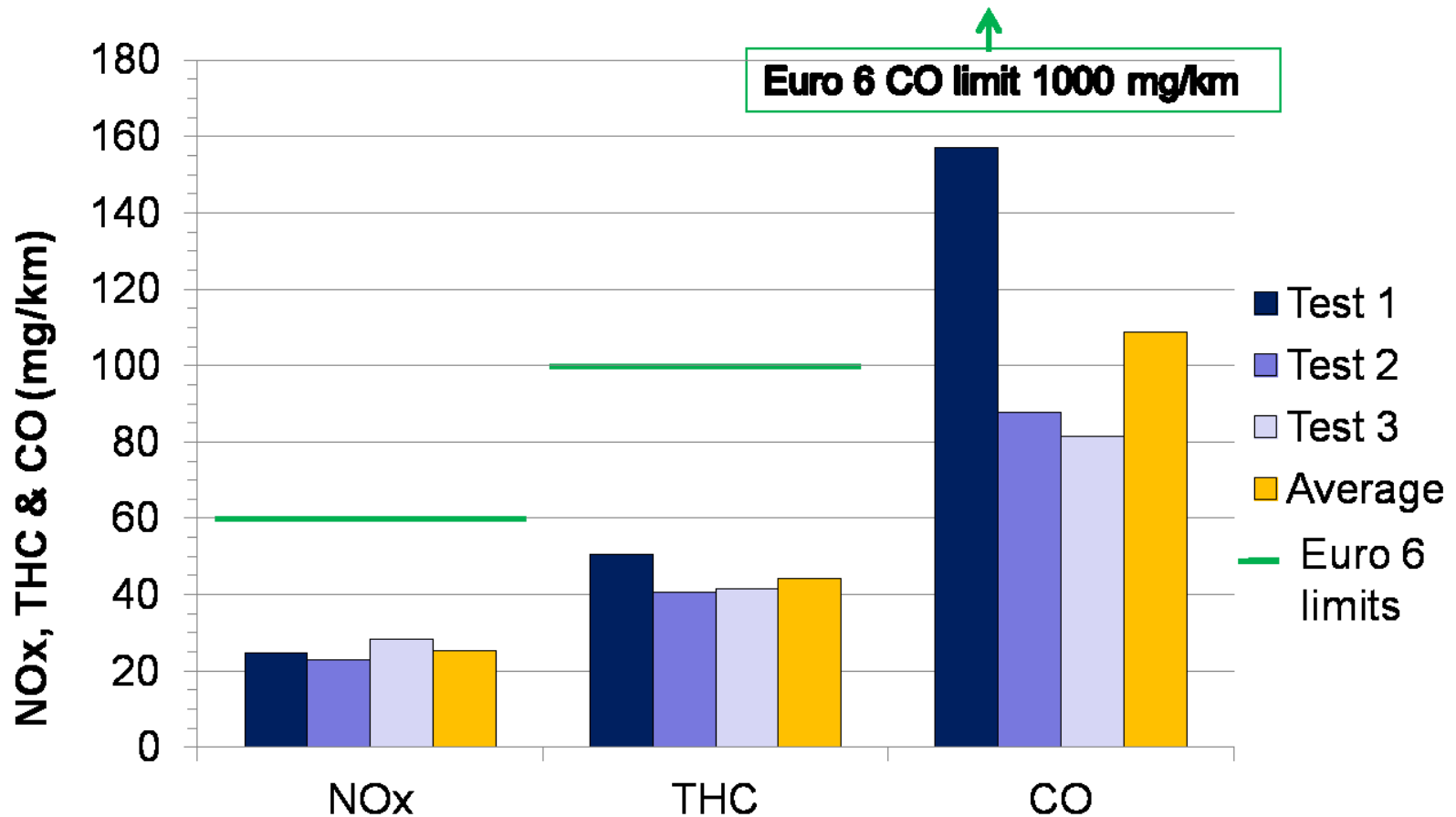
- PEMS-chassis dyno correlation tests run with PEMS positioned behind the vehicle to avoid any influence of additional weight.
- Correlation meets RDE requirements.

Measurement method	CO ₂	NO _x	CO	PN
	(g/km)	(mg/km)	(mg/km)	(#/km)
NEDC				
Test bench	265	24.79	157.06	1.37e11
PEMS	282	29.28	140.98	1.19e11
WLTP				
Test bench	265	16.25	111.33	2.38e11
PEMS	278	14.59	174.01	1.43e11

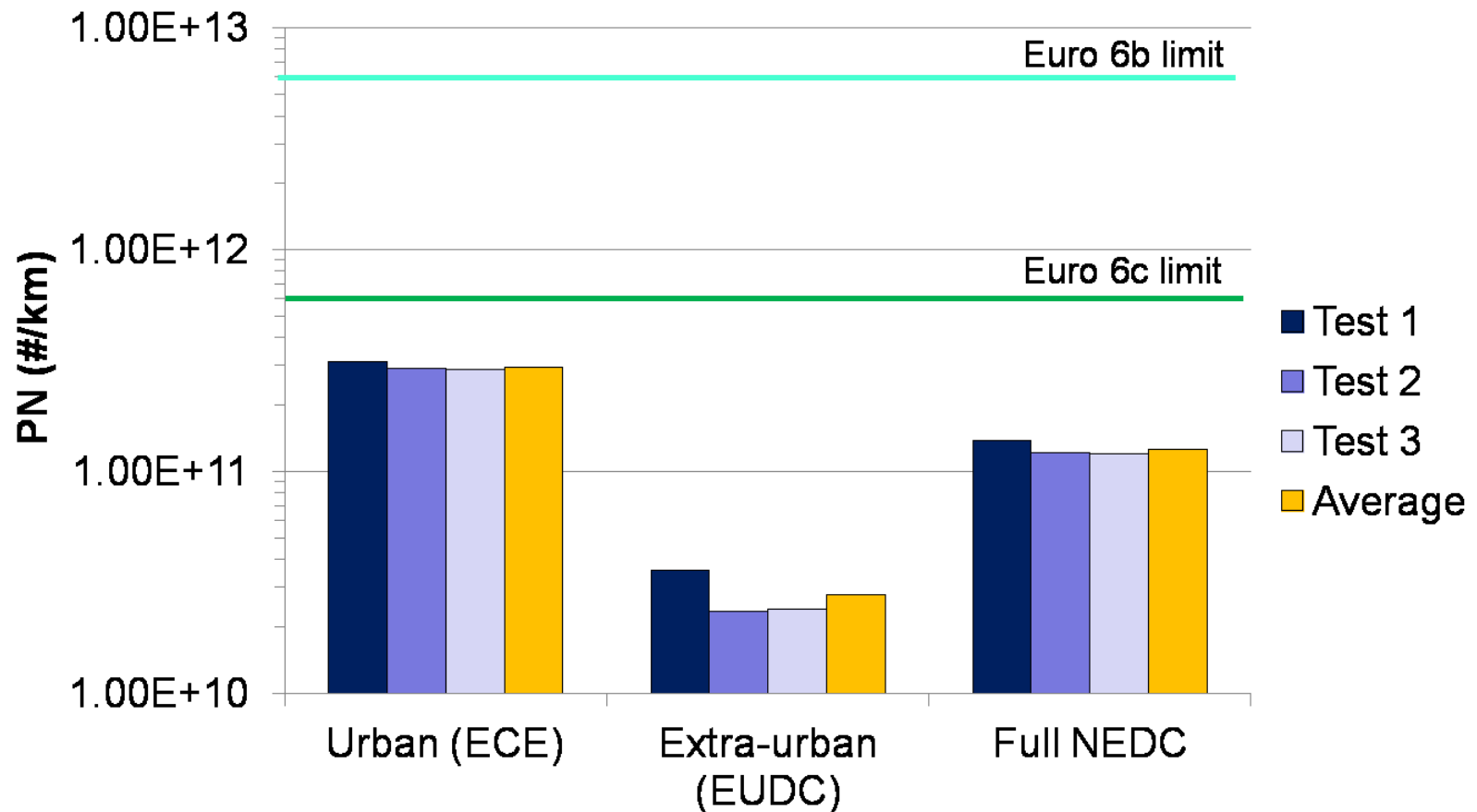
NEDC urban and extra-urban CO₂ emissions



NEDC NO_x, THC & CO emissions readily meet Euro 6 limits

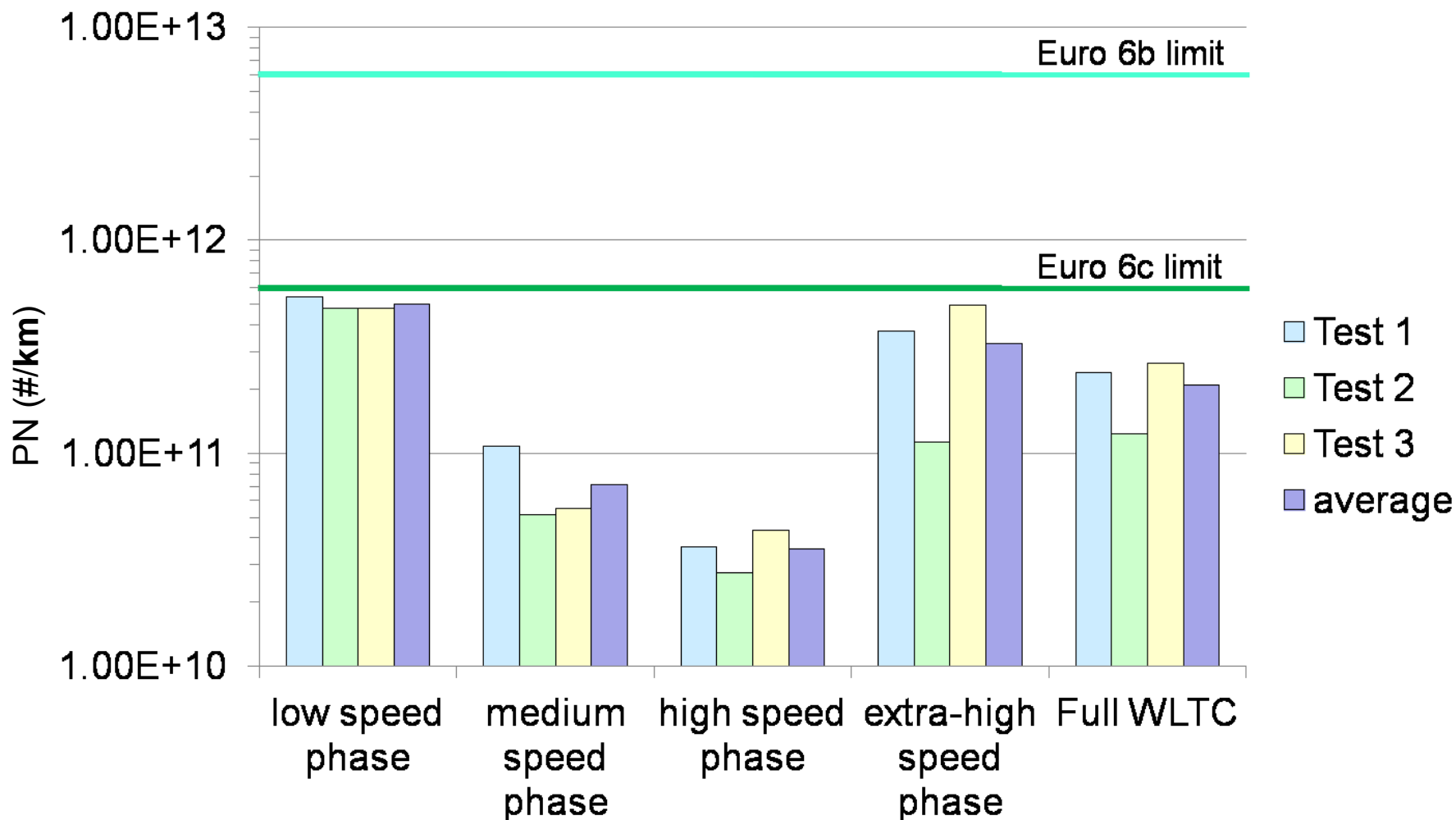


NEDC PN emissions meet Euro 6c limit



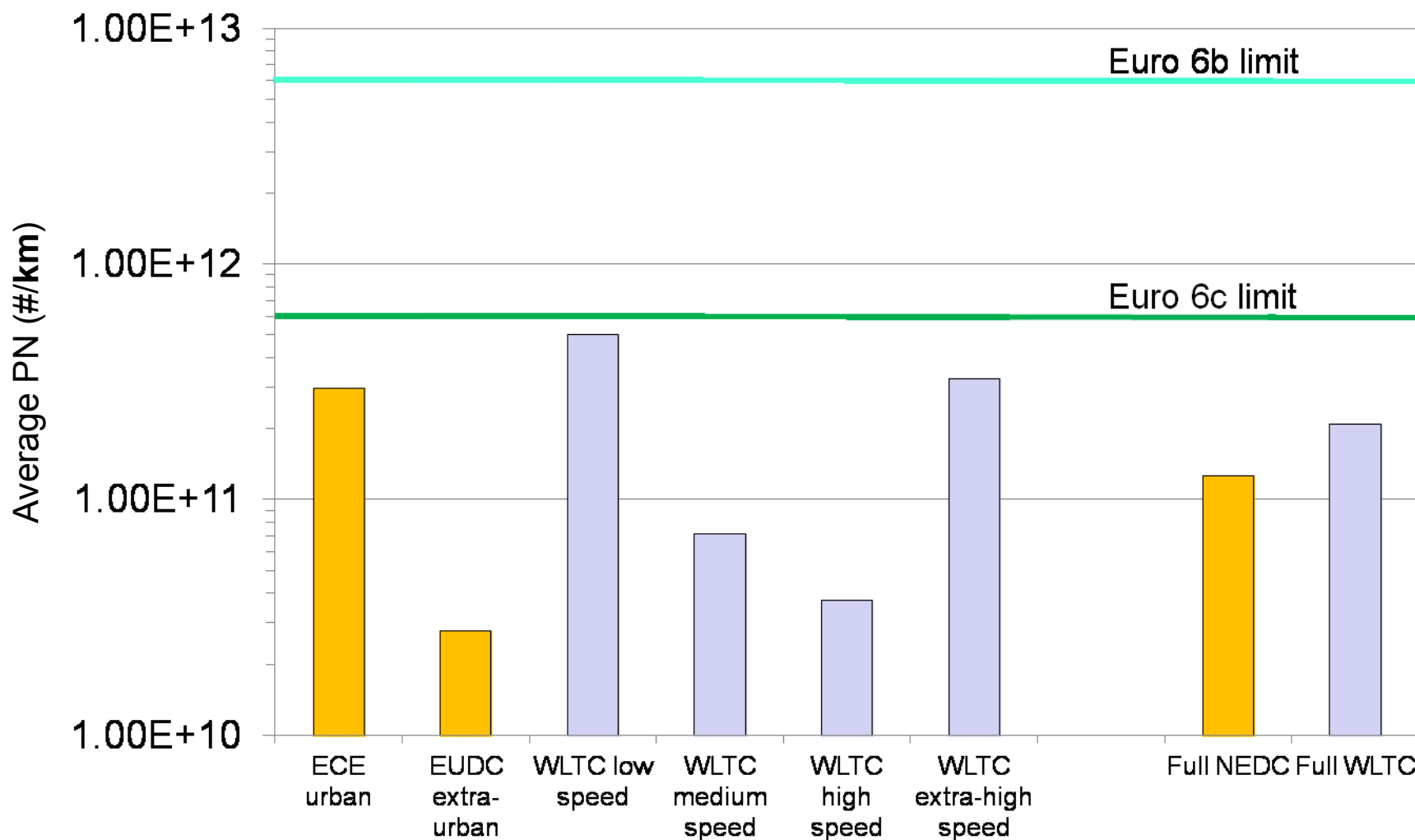
Average PM emissions 0.37 mg/km (full NEDC)

WLTC PN emissions all meet Euro 6c

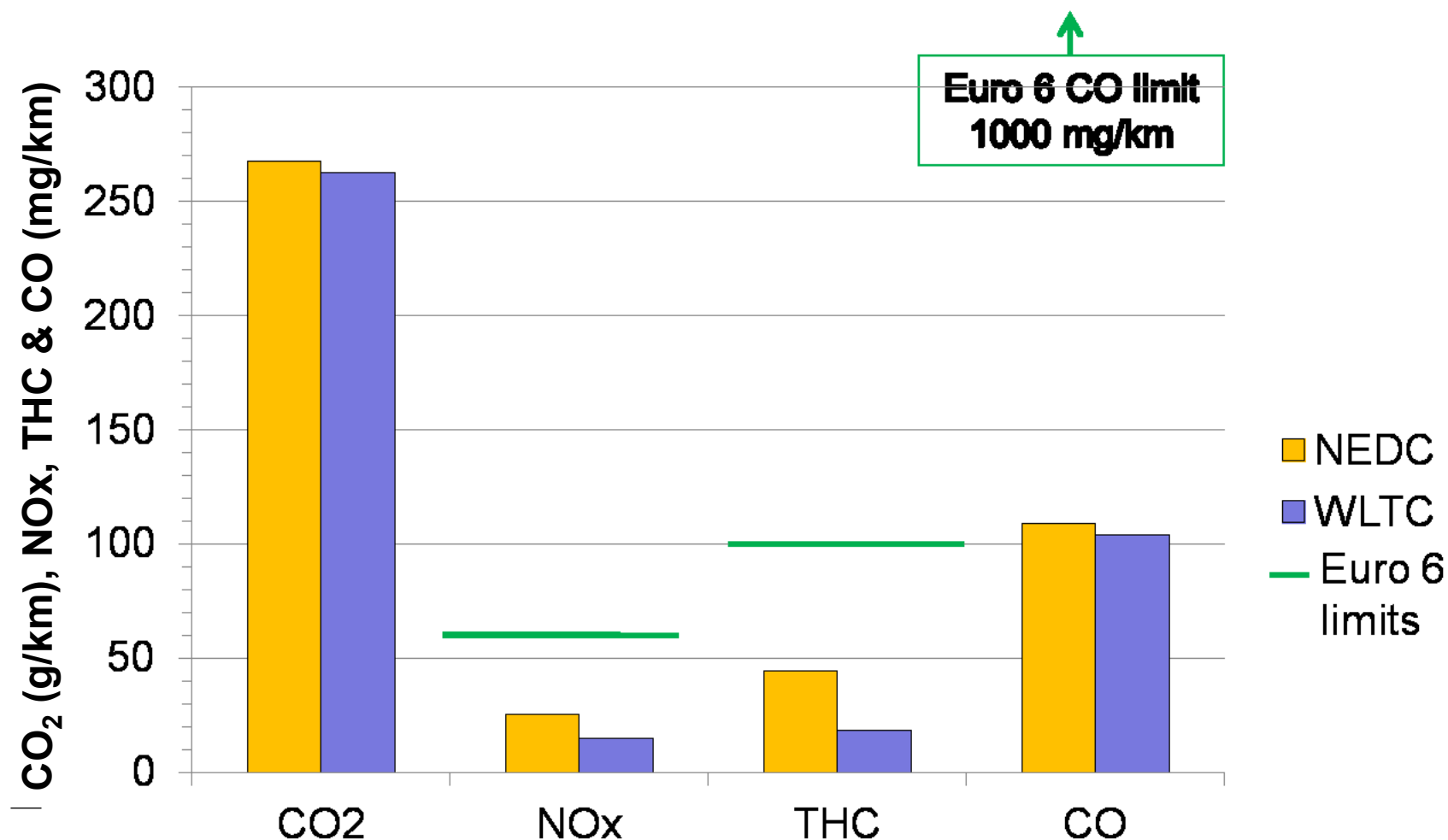


Average PM emissions 0.25 mg/km (full WLTC)

WLTC vs NEDC particle number emissions

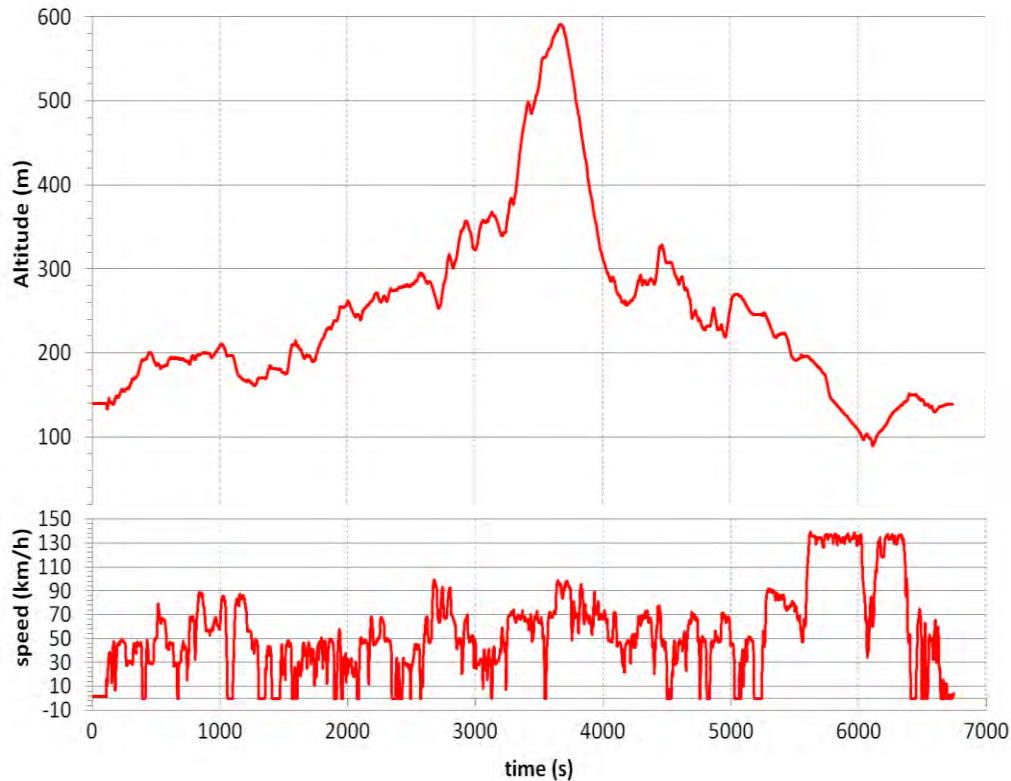


Average WLTC vs NEDC gaseous emissions

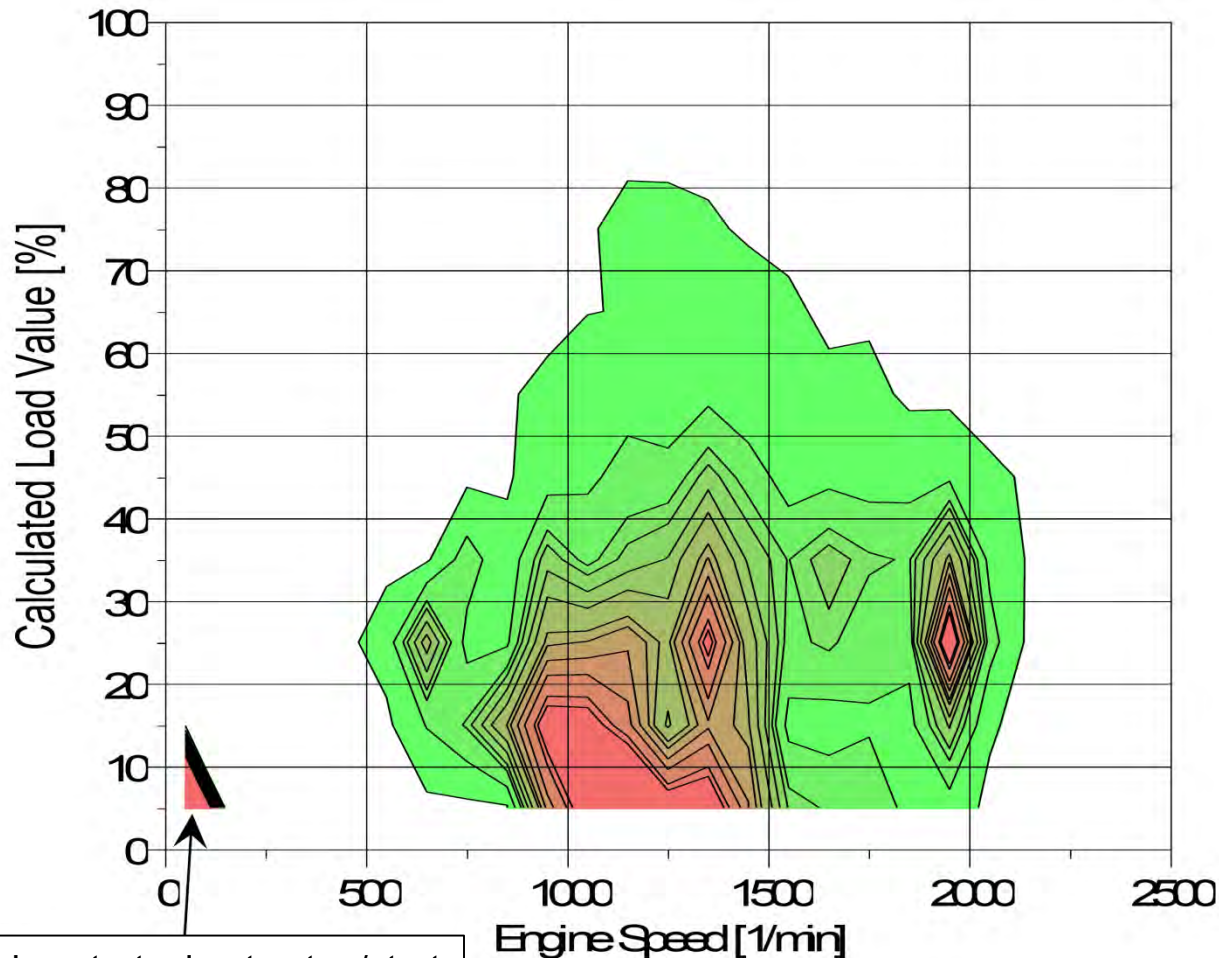


RDE route

- Approx 100 km; 1/3 each urban, rural and motorway

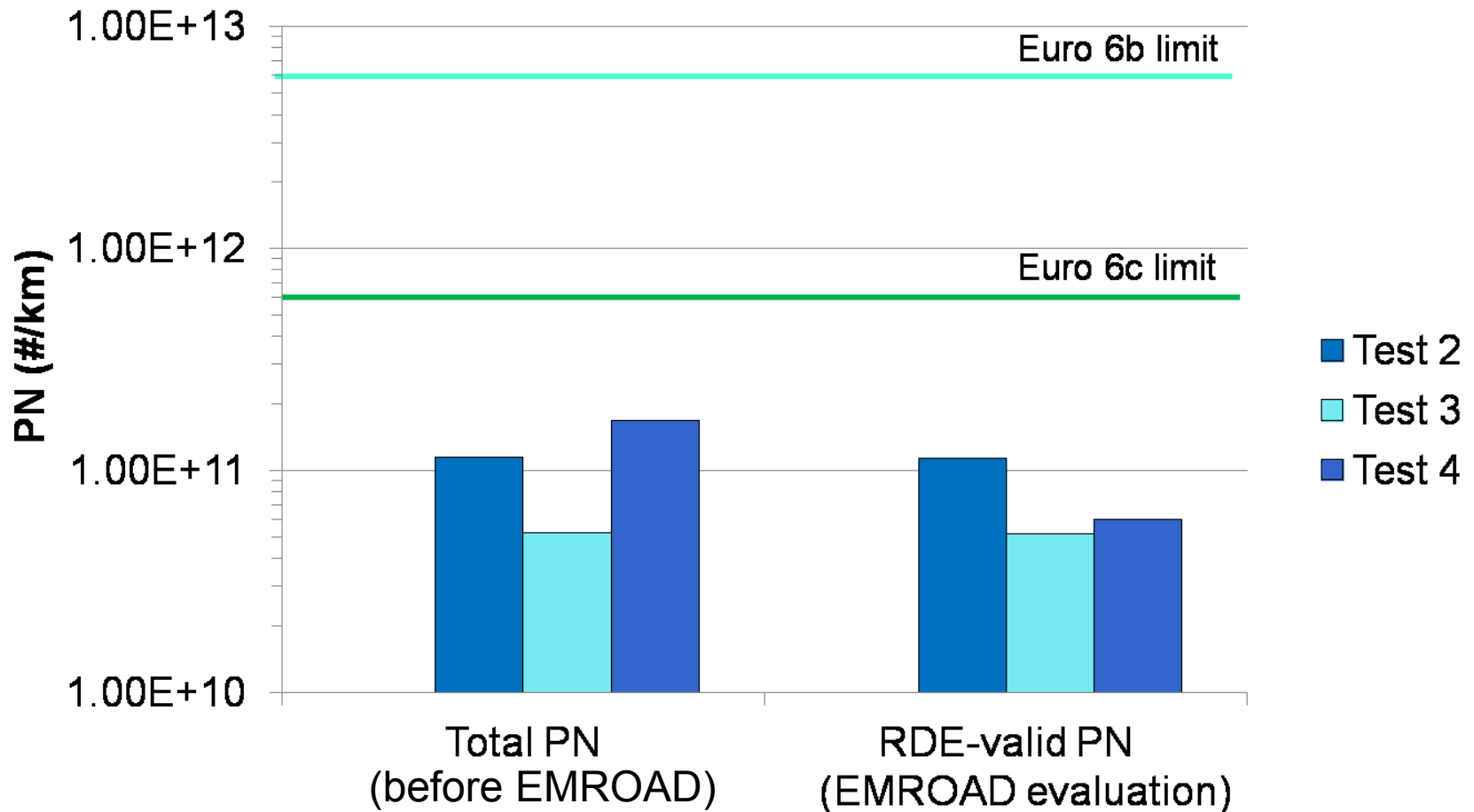


RDE test: engine speed-load map



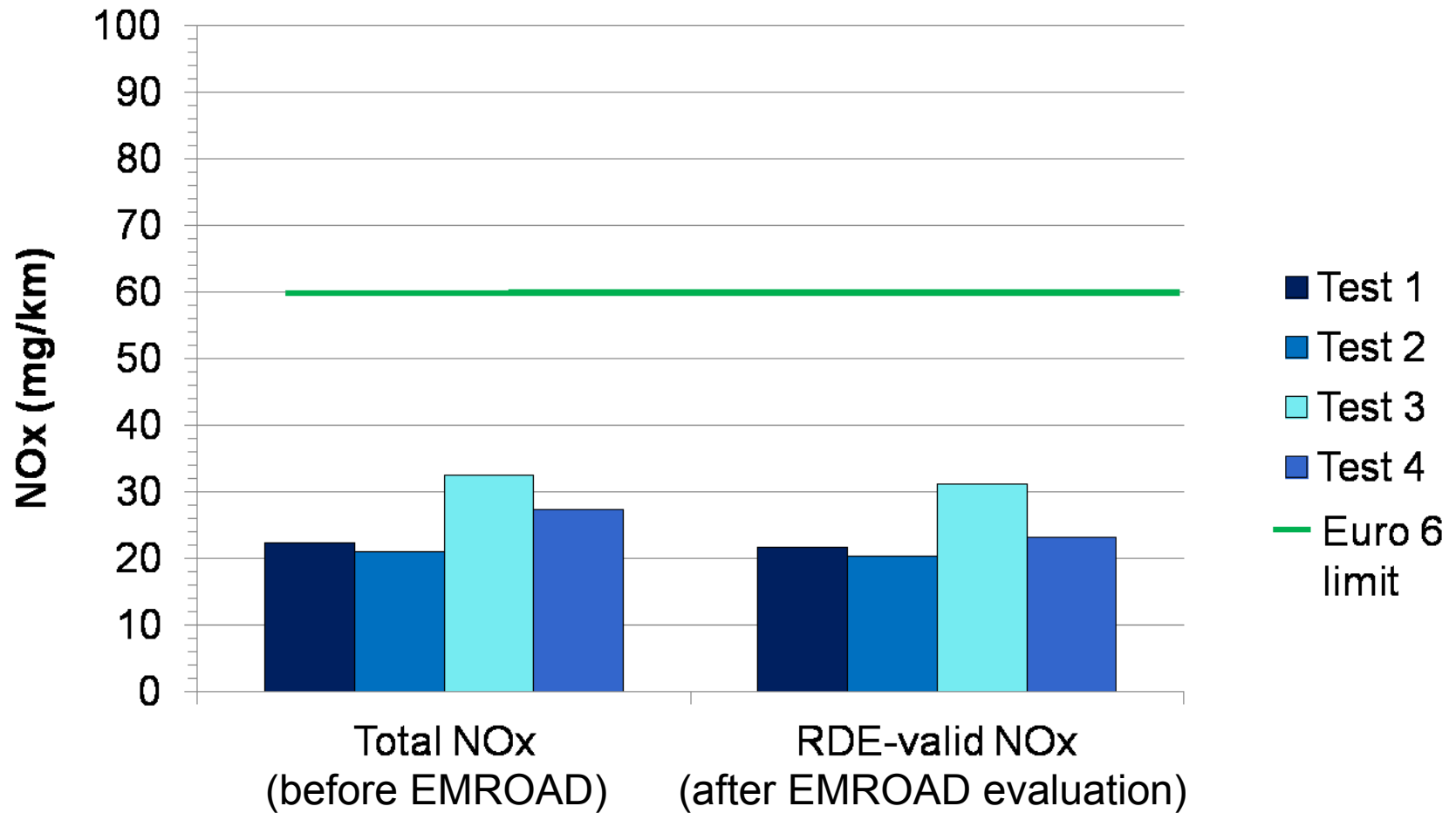
Colours represent amount of time at that engine speed/load point:
Green = lower
Red = higher

RDE PN emissions meet Euro 6c limit

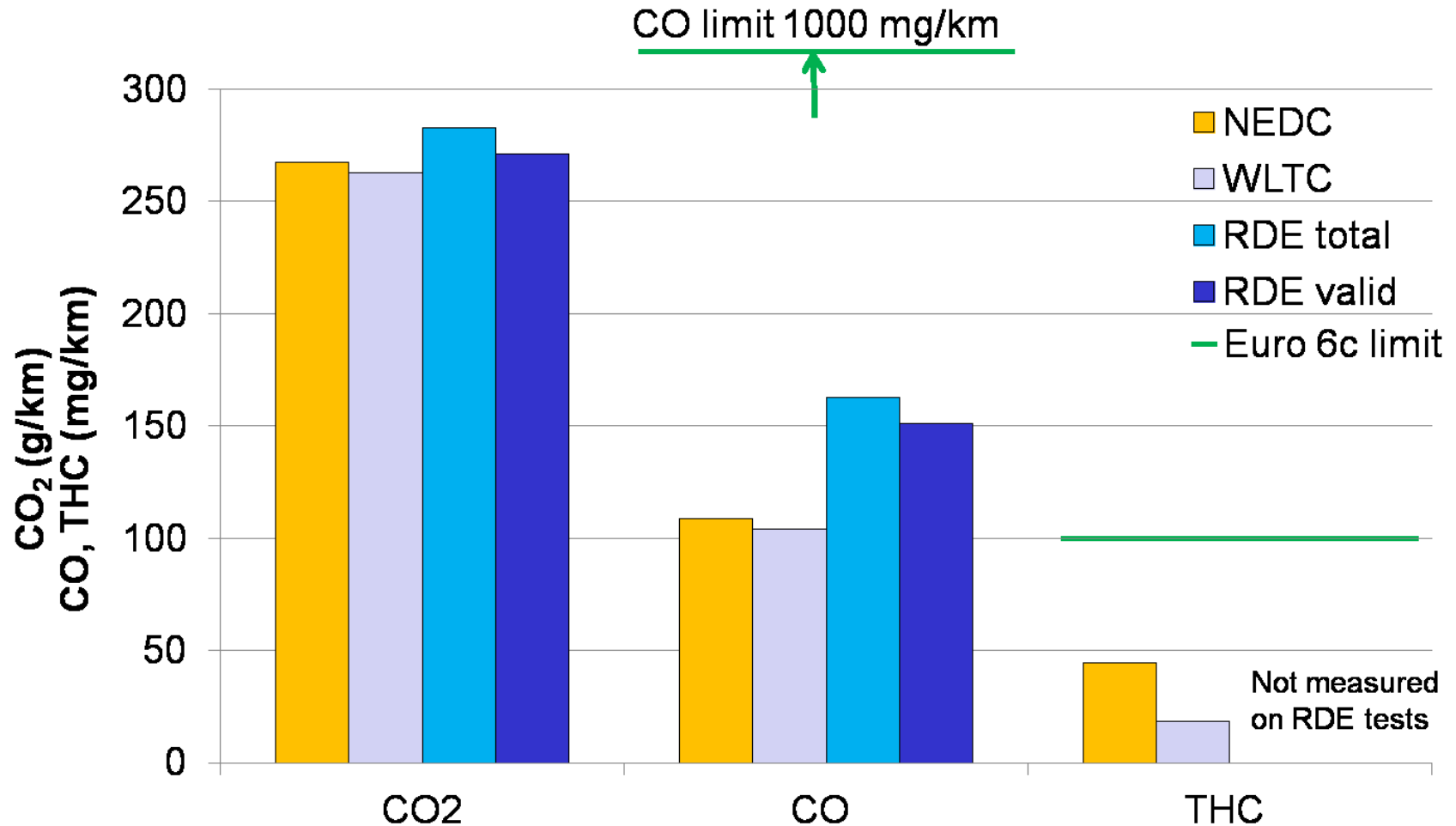


(Instrument failure on Test 1)

RDE NOx emissions well within Euro 6c limit

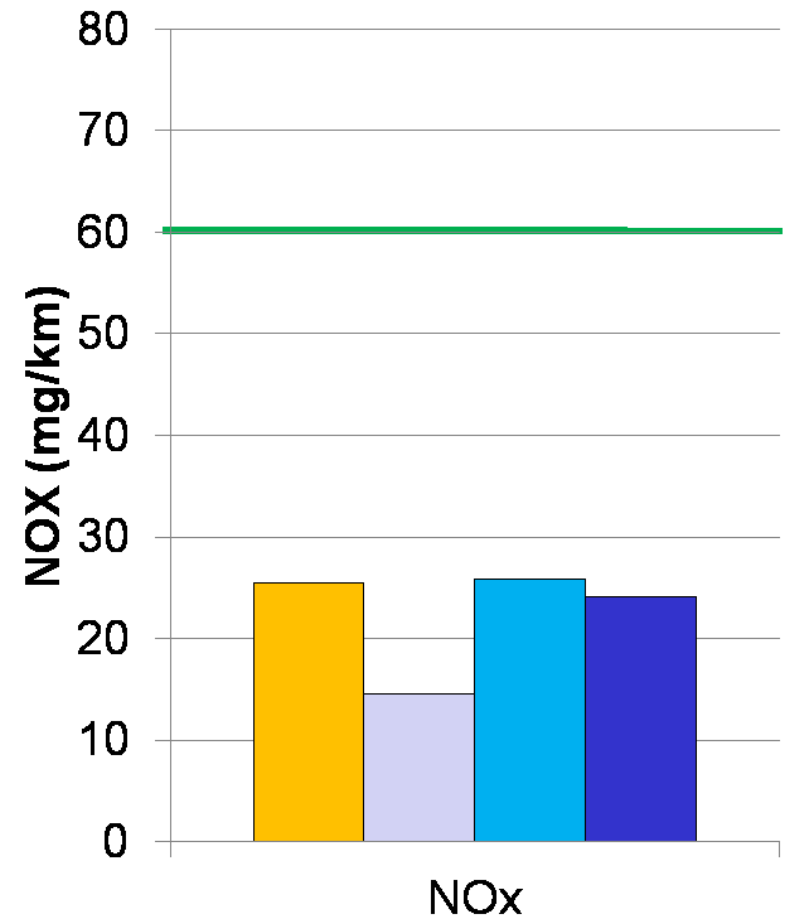
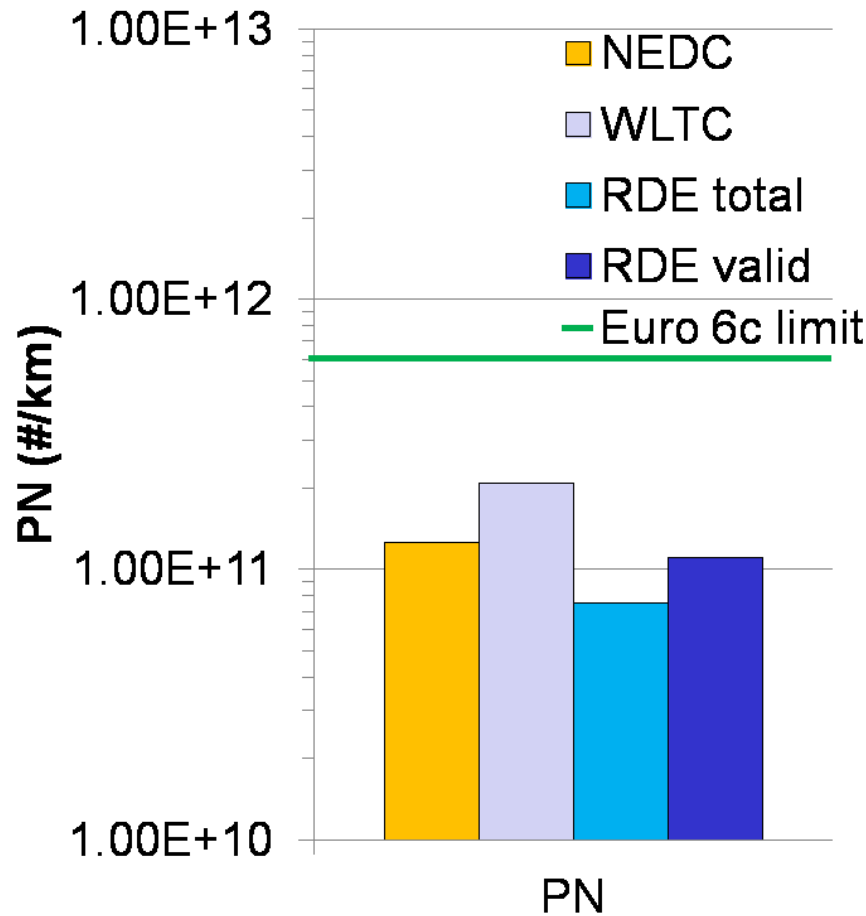


Comparisons of CO₂, CO and THC on NEDC, WLTC and RDE



RDE total = before EMROAD; RDE valid = after EMROAD

Comparison of NOx and PN emissions on NEDC, WLTC and RDE



RDE total = before EMROAD; RDE valid = after EMROAD

Summary

- AECC and Concawe jointly commissioned tests at an independent laboratory on a production Euro 6 GDI vehicle equipped with Gasoline Particulate Filters.
- NEDC, WLTC and RDE tests were conducted.
- NOx emissions on all cycles were less than half the Euro 6 limit.
- PN emissions on all cycles were well below half of the Euro 6c limit.
- PN in RDE conditions was also well below the Euro 6c limit for all tests, on the basis of both total test data and EMROAD evaluation.



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Who are AECC and what do we do ?

AECC is an international non-profit scientific association of European companies making technologies for engine exhaust emissions control.

The members of AECC are companies operating worldwide in the research, development, testing and manufacture of key technologies for emissions control.

Their products are the ceramic and metallic substrates for catalysts and filters; autocatalysts (substrates with catalytic materials incorporated or coated); adsorbers; filter-based technologies to control particulate emissions from diesel and other lean burn engines; and speciality materials incorporated into the catalytic converter or filter.

Catalyst-equipped cars were first introduced in the USA in 1974 but only appeared on European roads in 1985 and in 1993 legislation forced their use on cars. Now more than 275 million of the world's 500 million cars and over 85% of all new cars produced worldwide are equipped with autocatalysts. Catalytic

What are the emission control technologies?

Exhaust gas contains carbon monoxide (CO), hydrocarbons (HC), nitrogen oxides (NOx) and particulate matter (PM). The main technologies used to treat exhaust to remove harmful gases and particles are:

- autocatalysts
- adsorbers (traps)
- filters

There are more details on the technology pages.



Thank you for your attention

Dieselretrofit

Association for Emissions Control by Catalyst AISBL