Institute for Transport Studies
FACULTY OF ENVIRONMENT

UNIVERSITY OF LEEDS

Routes to Clean Air - Air Quality Conference - IAQM
Friday 23rd October 2015

Real Driving Emissions (RDE):

Results from the 2015 remote sensing campaigns (UK)

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ITS

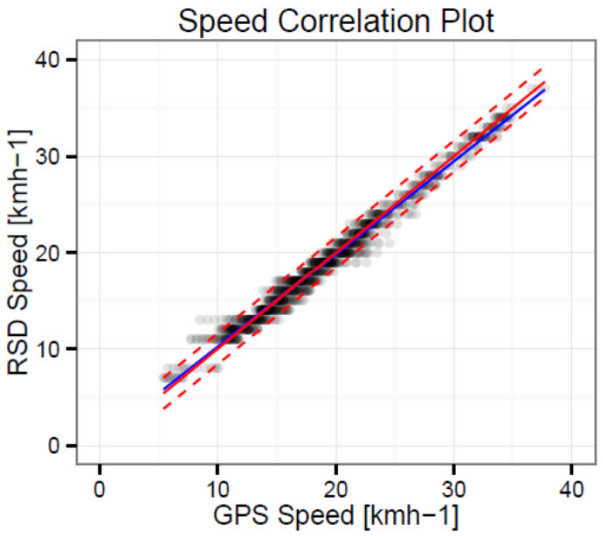
CONTENTS

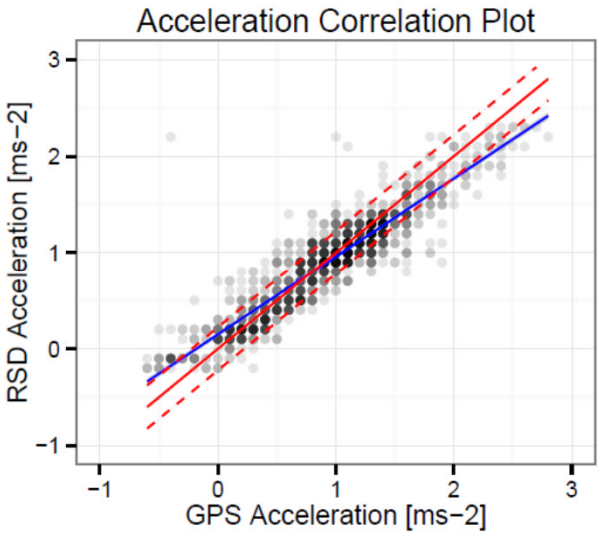
- Remote sensing Real Driving Emissions (RDE)
  - Method
  - Verification
- Results 2015
  - Euro VI
    - ✓ Passenger cars
    - ✓ HGVs
    - ✗ LGVs
    - ✗ Buses
  - Manufacturer comparison | Diesel passenger cars
- Recommendations

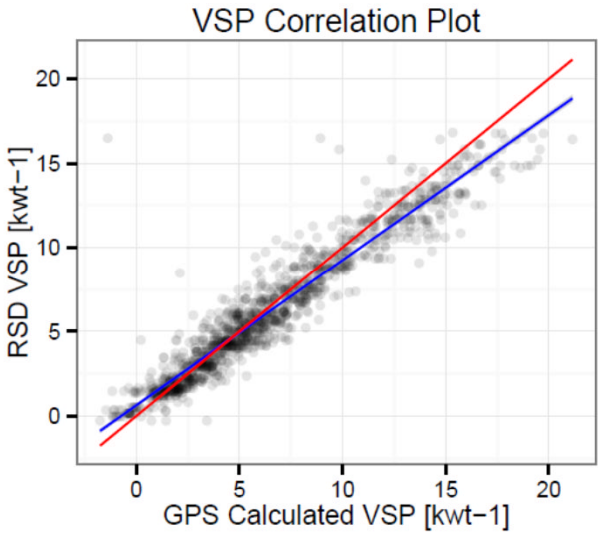
METHOD

METHOD

Verification of speed & acceleration measurements





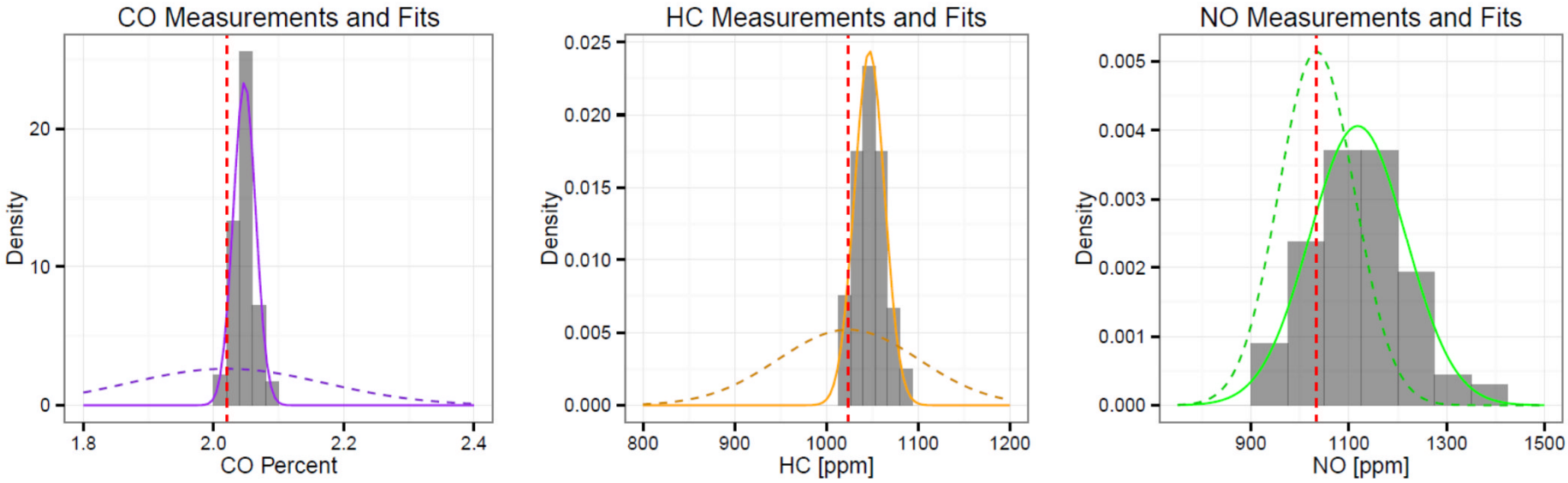


$$VSP = (0.2va) + (4.39vsin(\theta)) + (95.4 \times 10^{-3}v) + (27.2 \times 10^{-5}v^3)$$

v = speed, a = acceleration, θ = road gradient

METHOD

Verification of concentration measurements

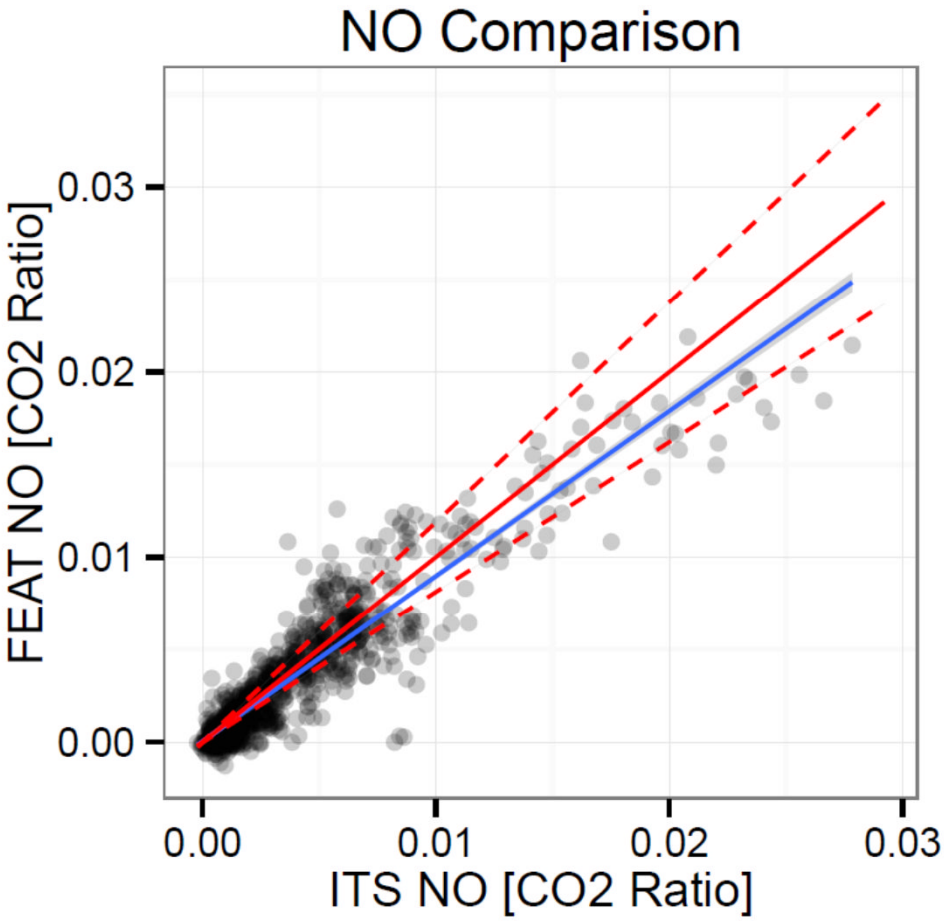


Distribution of the measurement distribution of a controlled gas mixture with known relative abundances. The binned data shows the measurements with the solid line showing a Normal distribution derived from the measured data (solid) and theoretical (dashed).

Species	Percentage Error	Offset	Specified Error
CO	1.5	+0.02%CO	15%
HC	3.2	+23ppm	15%
NO	18.9	+84ppm	15%

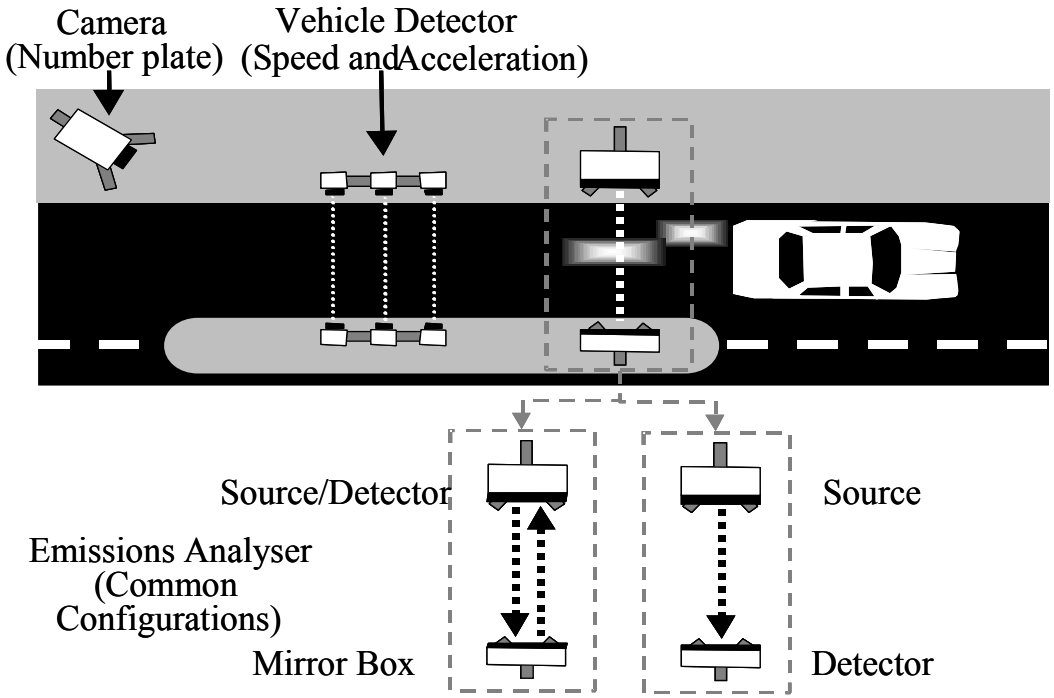
METHOD

Inter-comparison of two Remote Sensing Devices



METHOD

Measurements



ESP RSD-4600 instrument

www.esp-global.com

Emission ratios

From peak exhaust plume conc.

$$CO/CO_2$$

$$HC/CO_2$$

$$PM_{OPACITY}/CO_2$$

$$NO/CO_2$$

Predict NO_2 and total NO_X contribution using f-NO2 reported by Carslaw (2014)

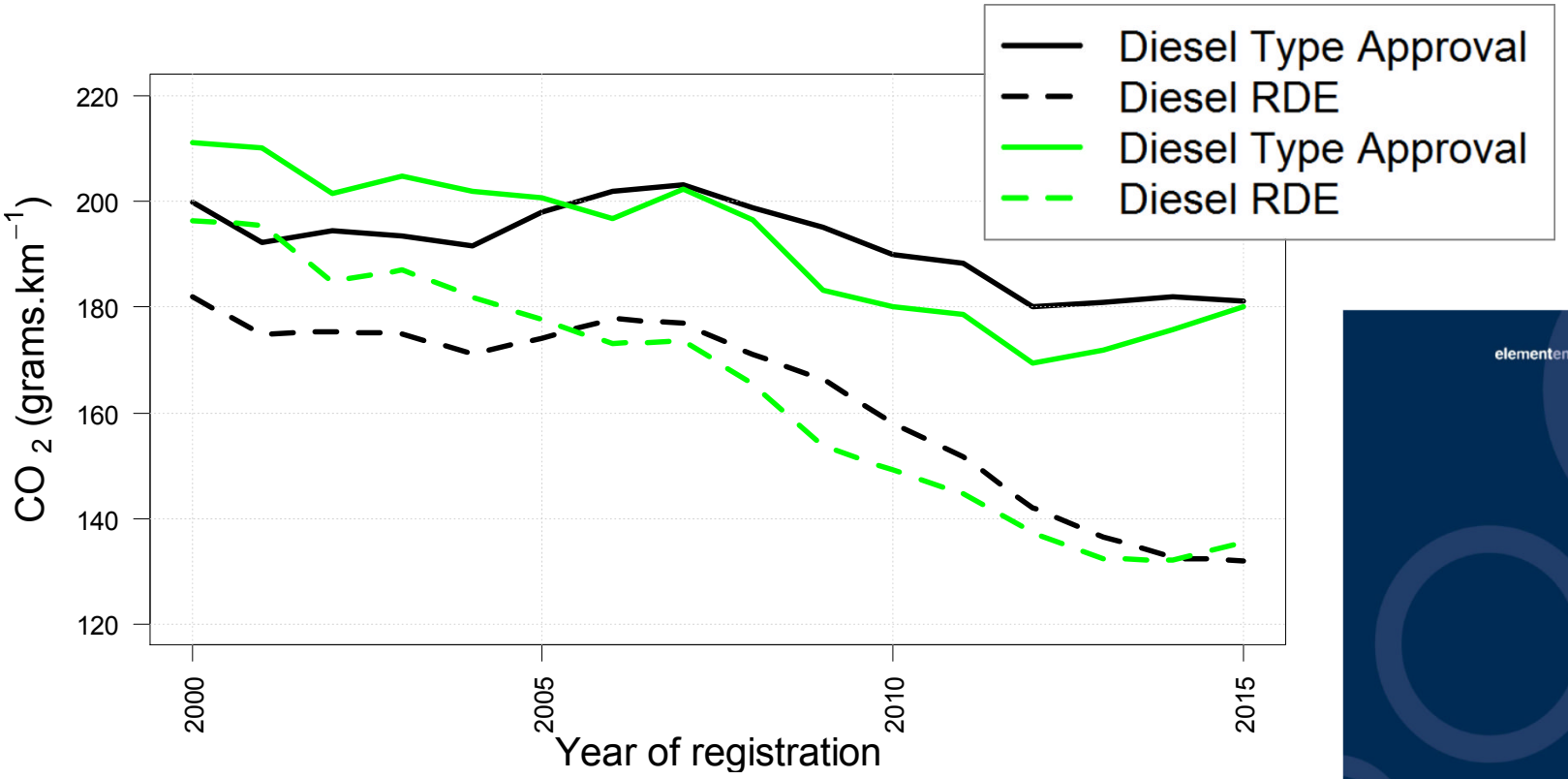
Euro Standard	Petrol f-NO_2	Diesel f-NO_2
Euro 0	2	8
Euro 1	2	8
Euro 2	3	8
Euro 3	4	16
Euro 4	7	26
Euro 5	12	26
Euro 6	12	34

Carslaw, D., Priestman, M. 2014. Analysis of the 2013 vehicle emission remote sensing campaigns data. King's College London, Final draft, 10th November 2014

METHOD

Estimation of Emission Factors

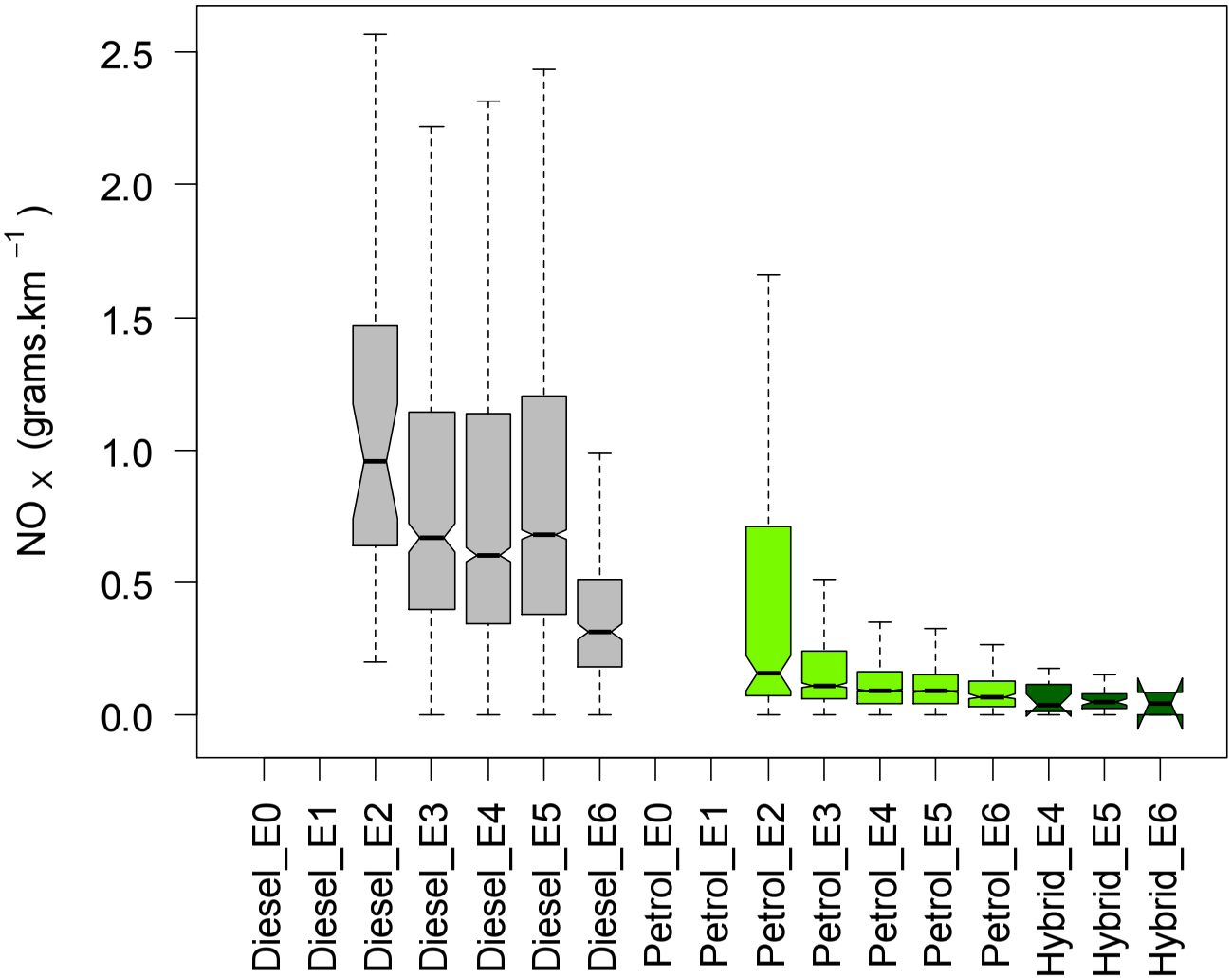
$$EMISSION\ FACTOR\ (gr.km^{-1})_{RSD} = \left(\frac{NO_X}{CO_2}\right)_{RSD} \times \left(\frac{CO_2}{km}\right)_{MANU} \times (Correction\ Factor)_{ICCT}$$



8 https://www.theccc.org.uk/wp-content/uploads/2015/09/Impact-of-real-world-driving-emissions-for-UK-cars-and-vans.pdf

Euro VI

Passenger cars, Spring/ Summer 2015



Euro VI

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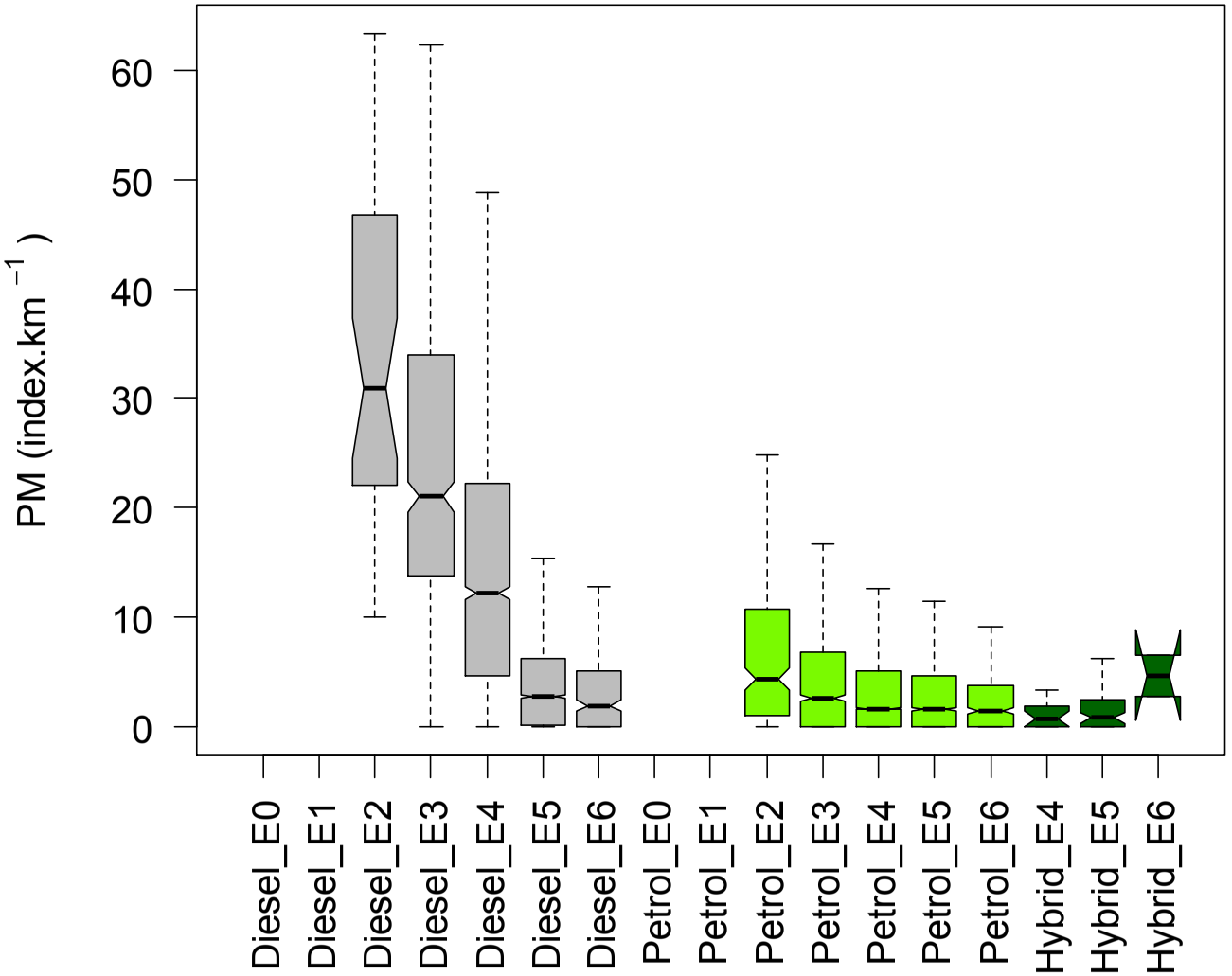
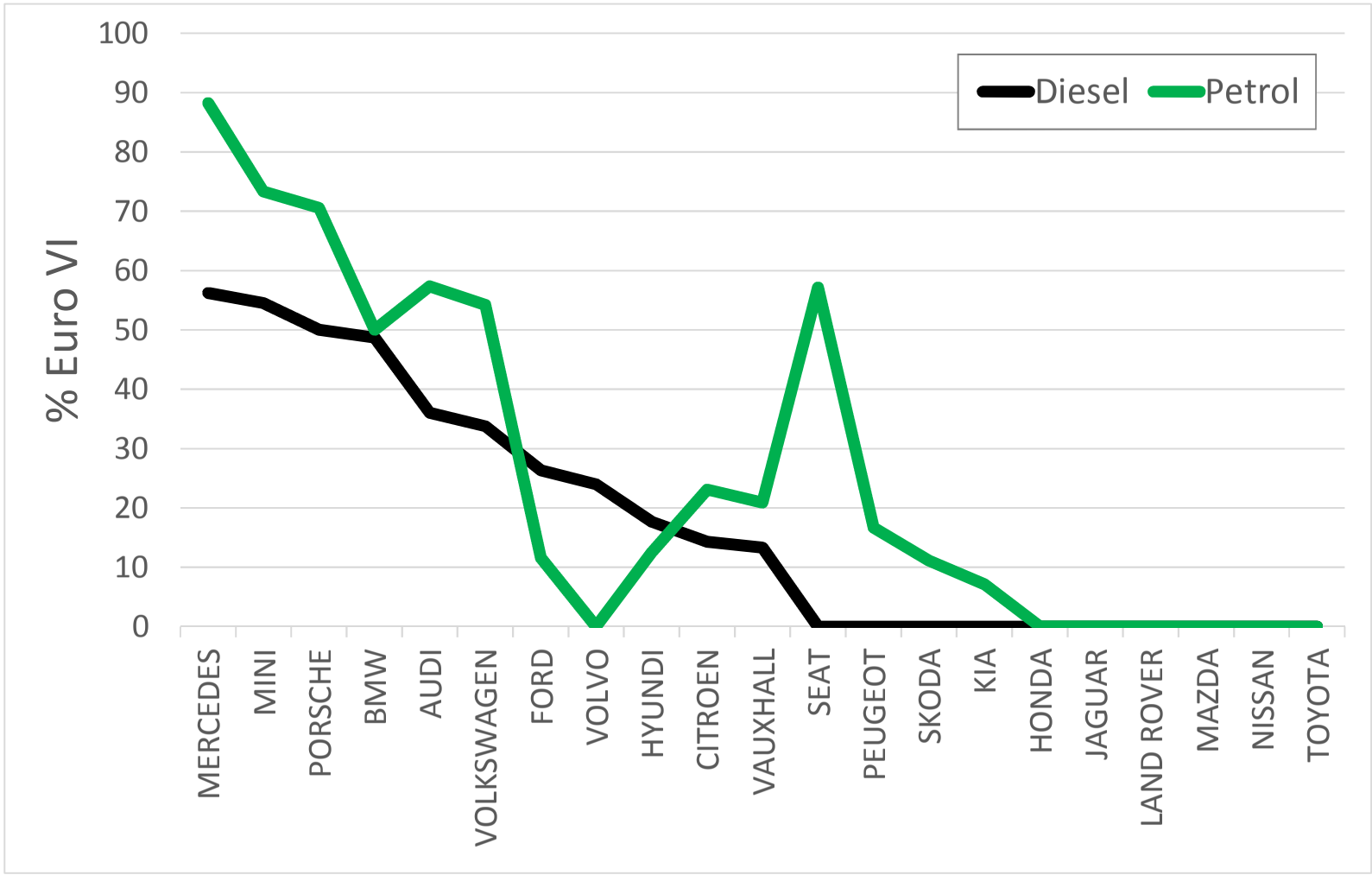


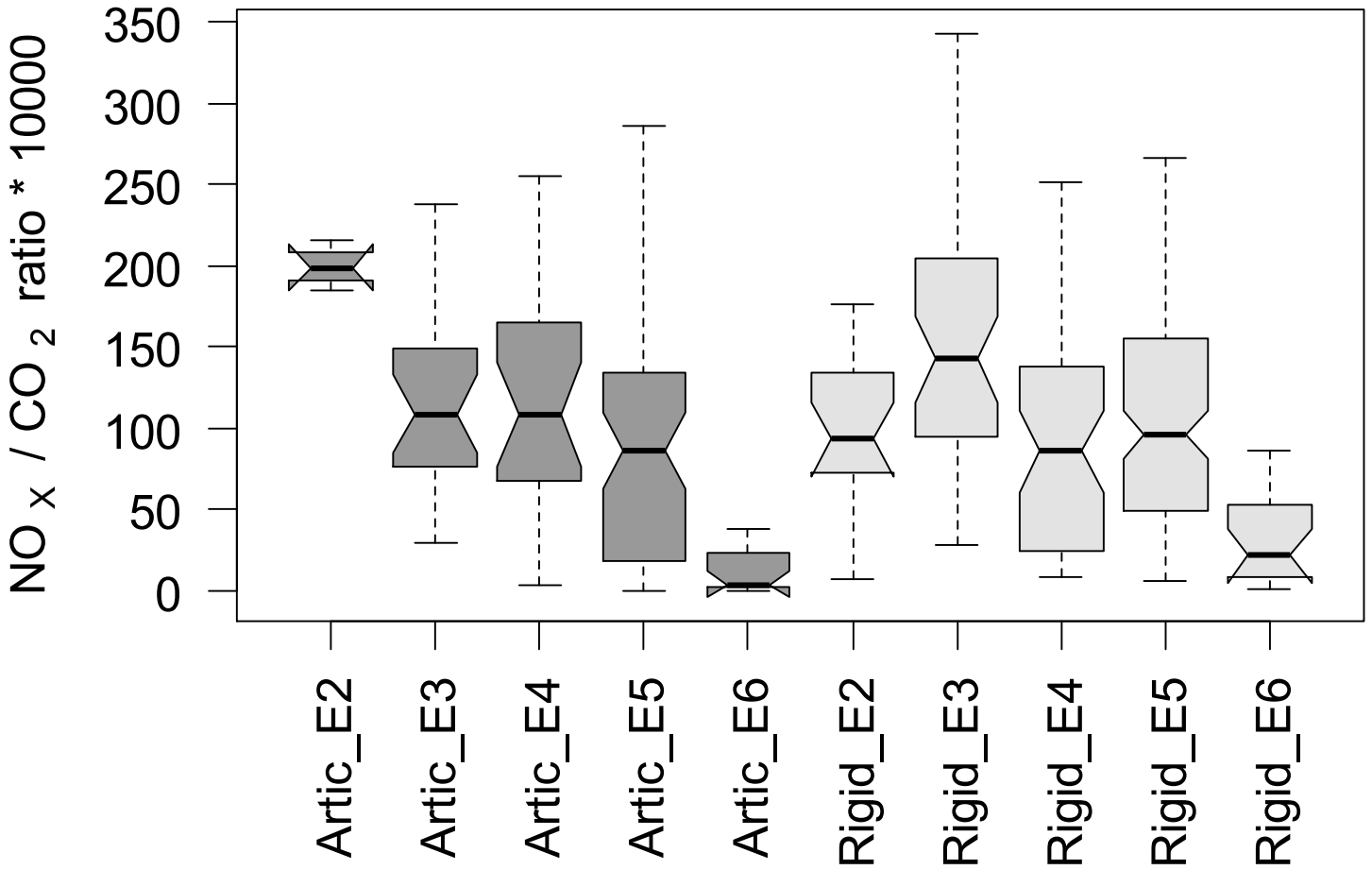
Euro VI

% of Passenger cars registered since Sept 2014 that are Euro VI



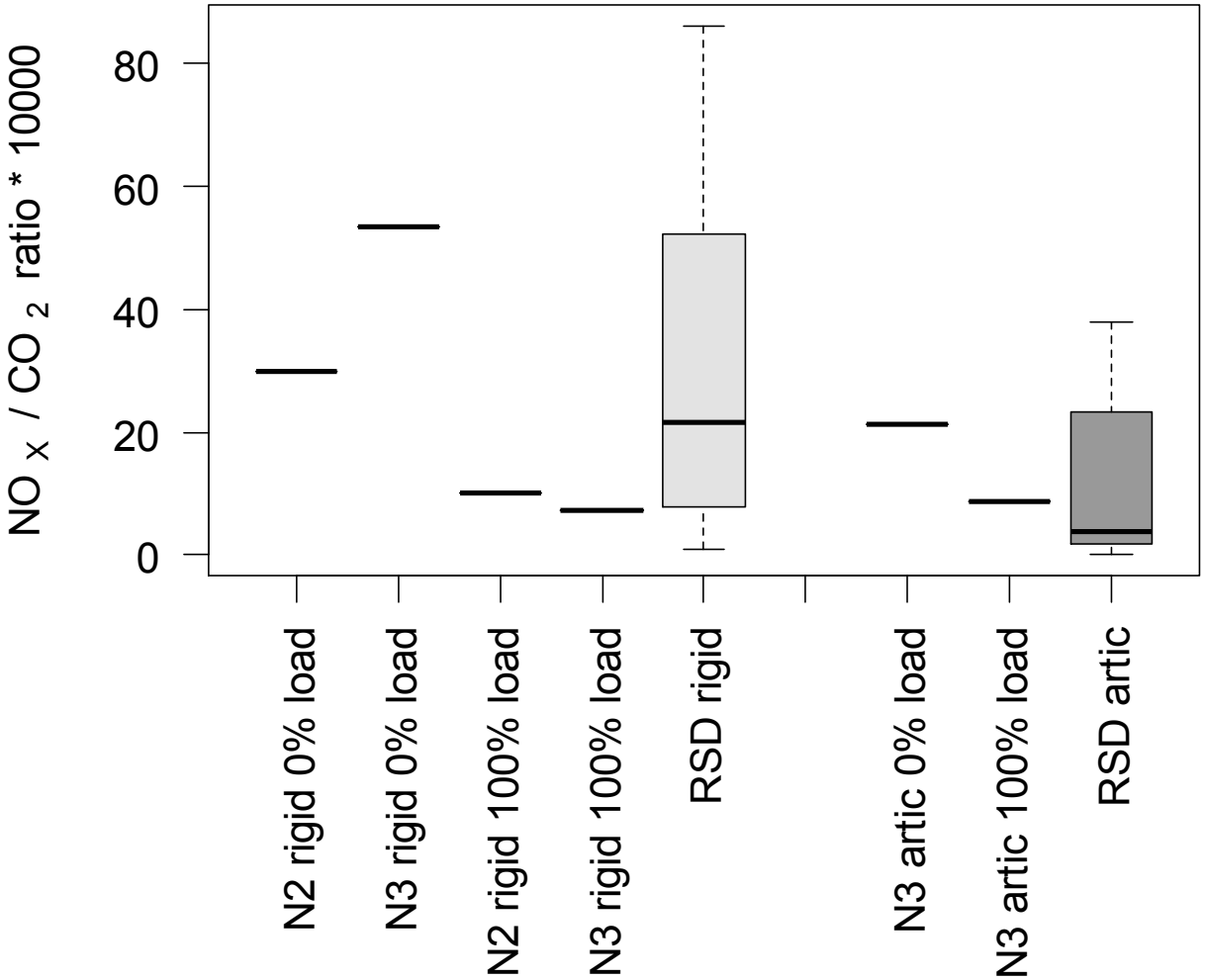
Euro VI

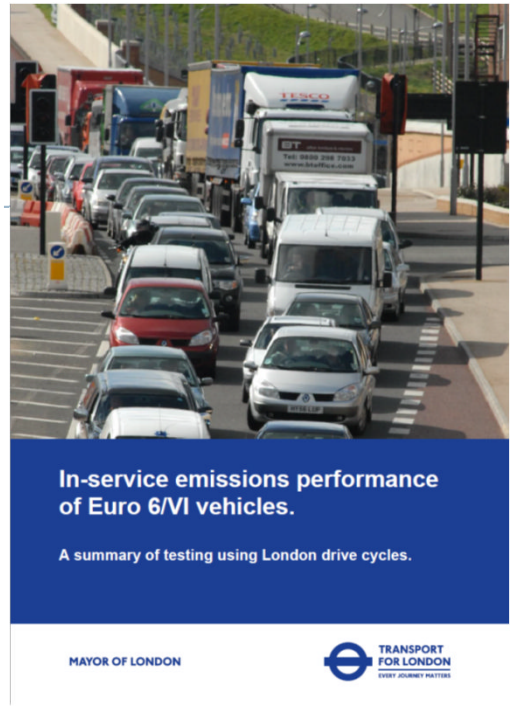
NO_X Heavy Commercial Vehicles, Spring/ Summer 2015



Euro VI

NO_X HCVs – Corroboration TfL data

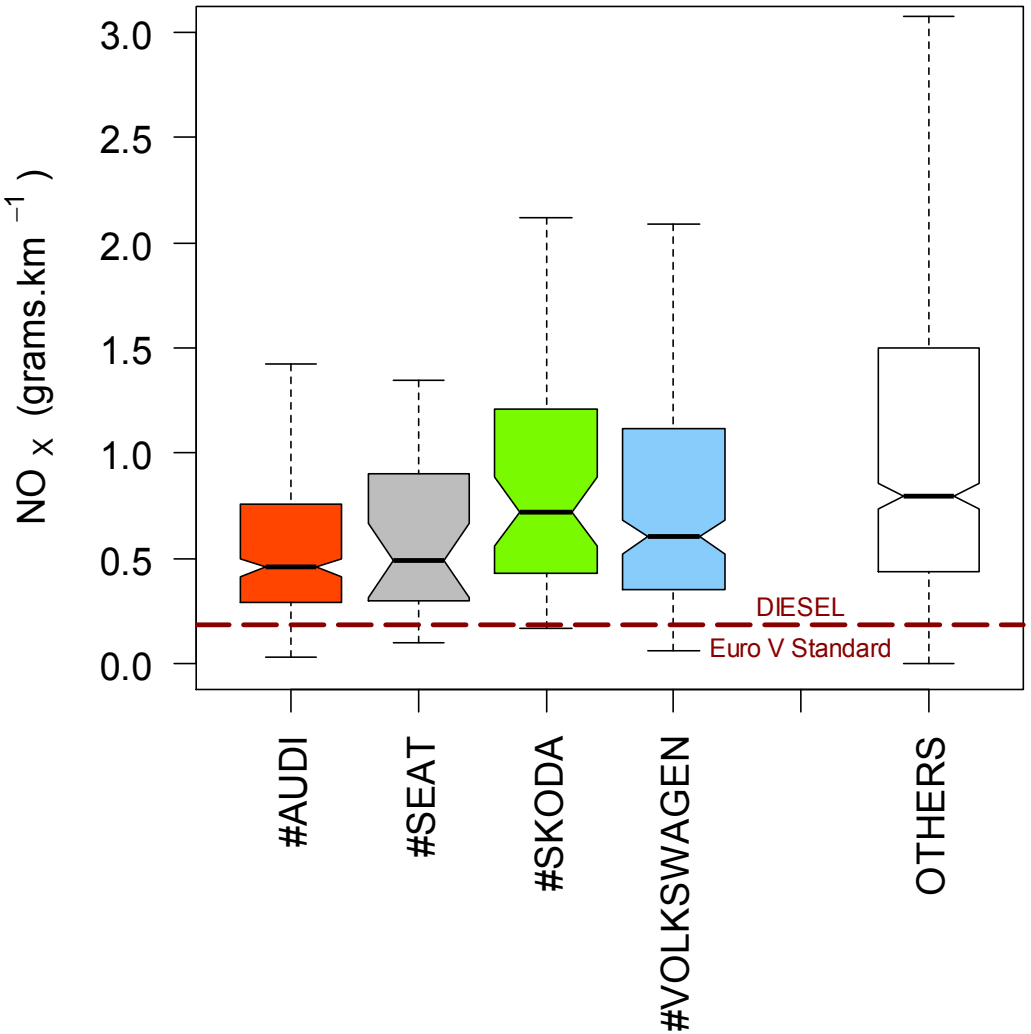




https://www.london.gov.uk/sites/default/files/In-service%20emissions%20performance%20of%20Euro%206VI%20vehicles%20WEBSITE%20COPY.pdf

Manufacturer comparison

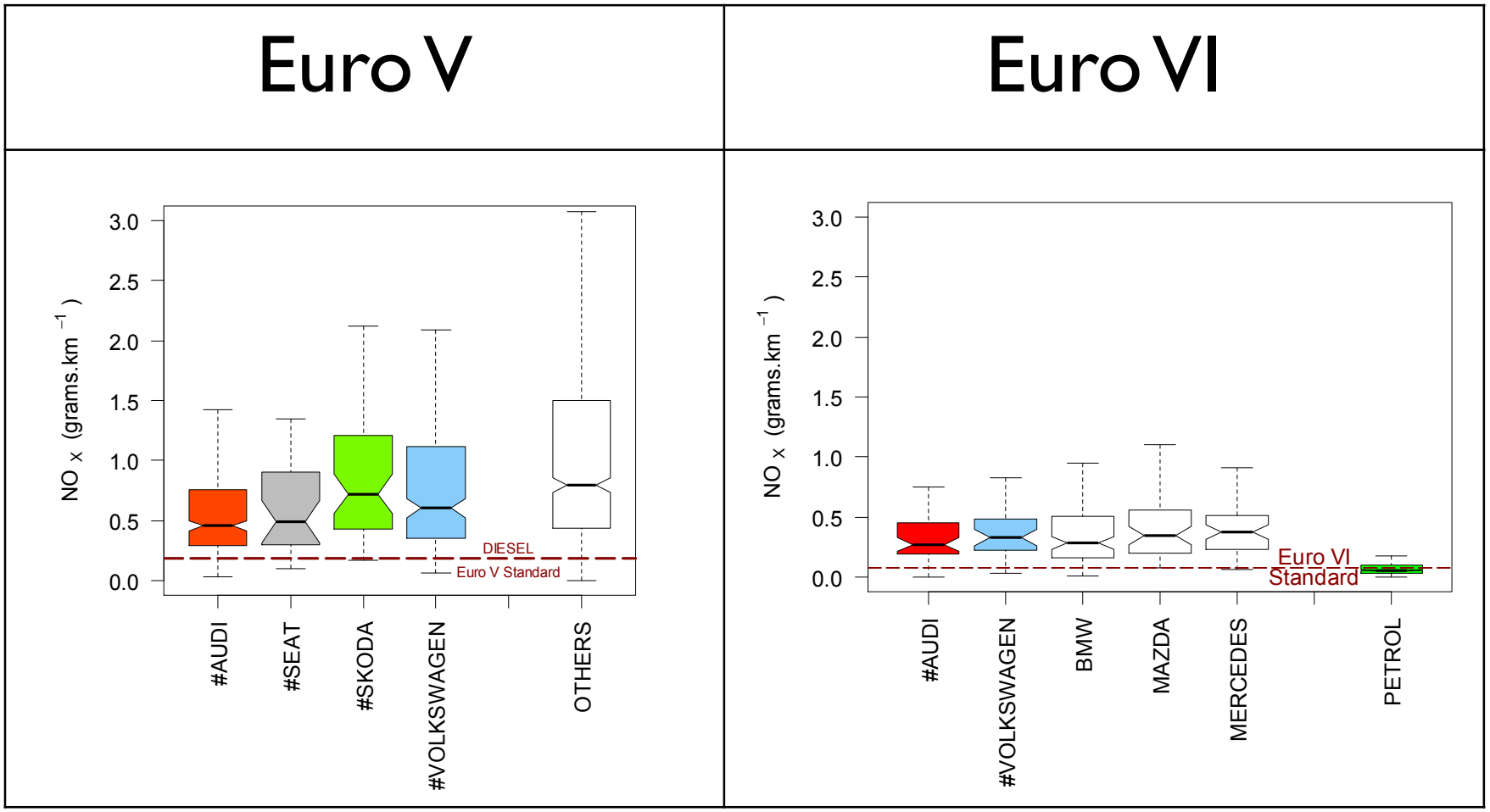
Euro V 2.0-litre diesel cars with EA189 engine



OTHERS:
2.0-litre diesel engines from other Marques
e.g.
BMW
FORD
KIA
TOYOTA
VAUXHALL

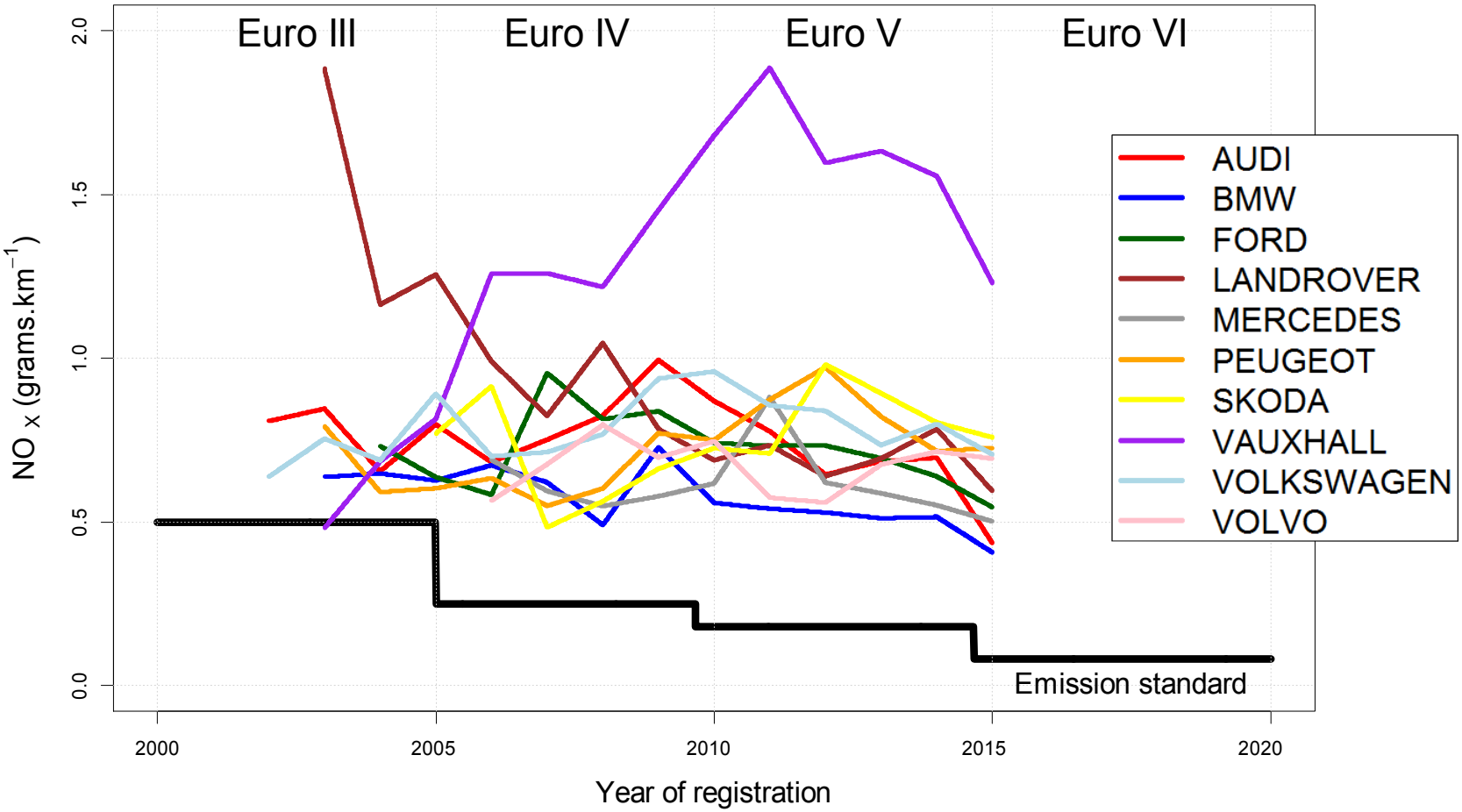
Manufacturer comparison

Euro VI



Manufacturer comparison – Diesel cars

NO_X emissions by manufacturer & Year of 1st registration



Euro VI

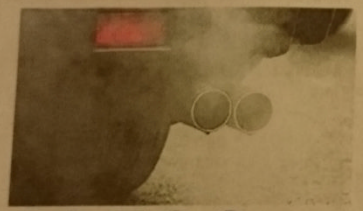
Diesel cars emit more toxic pollution than buses, data shows

Damian Carrington

A modern diesel car pumps out more toxic pollution than a bus or heavy truck, according to research, a situation described as a "disgrace" by one MEP.

The revelation shows that effective technology to cut nitrogen oxides (NOx) pollution exists, but car manufacturers are not implementing it in realistic driving conditions.

Diesel cars tested in Norway produced quadruple the NOx emissions of large buses and lorries in city driving conditions, according to a report from the Norwegian Centre for Transport Research. A separate study for Transport for London



23,500

The number of people NOx pollution is thought to kill in Britain each year. The issue was highlighted by the VW scandal

showed that a small car in the "supermini" class emitted several times more NOx than most HGVs and the same amount as a 40-tonne vehicle.

"It is crackers," said emissions expert James Tate, from Leeds University. His research, which uses roadside equipment to measure passing traffic, also shows the latest diesel model cars produce at least as much NOx as far heavier buses and trucks.

The issue of NOx pollution, thought to kill 23,500 people a year in Britain, gained prominence when VW diesels were discovered to be cheating official US emissions tests. The scandal led to revelations that the diesels of many car manufacturers produce far more NOx on the road than in EU lab tests, though not by illegal manipulation of software.

The government says the failure to keep NOx from vehicles low in the real world means road transport is "by far the largest contributor" to the illegal levels of NOx in many parts of the country.

"It is disgraceful that car manufacturers have failed to reduce deadly emissions when the technology to do so is affordable and readily available," said Catherine Bearder, a Lib Dem MEP and a lead negotiator in the European parliament on the EU's new air quality law.

"The dramatic reduction in NOx emissions from heavier vehicles is a result of far stricter EU tests, in place since 2011, that reflect real-world driving conditions. If buses and trucks can comply with these limits, there's no reason cars can't as well."

Greg Archer, of the green thintank Transport & Environment, said: "Car makers' claims [that] new diesel cars are clean are preposterous. Governments must ignore the bleating of carmakers for lenient limits and fix the problem for good."

Tate said the reasons car manufacturers were not implementing the NOx reduction technology on cars were convenience and cost. The most common technology requires a chemical compound known as urea to be squirted into the exhaust gases, but a large urea tank would be heavy while a small one would require frequent refills.

RECOMMENDATIONS

- **RDE regulations**
  - Sooner rather than later i.e. before Jan 2017
  - Transparency in RDE testing
  - In-service RDE testing (deterioration emission controls, SCR dosing, DPF removal)
  - Independent + Open data
  - ? Environmental labelling for CO_2 and air quality pollutants ? A marketing incentive ?
- **Shift in Tax landscape to include NO_x penalty**
  - Price fuel e.g. Belgium Diesel +10cts per litre 2016-2017
  - VED
  - Company car Benefit in Kind (BiK) tax
- **Car free City centres**
  - Sustainable mobility & Active travel & Green space
  - Noise

And finally…. improving air quality

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