

Scottish Air Quality Database and Website Annual Seminar
Tuesday 22nd March 2016, IET Glasgow

Remote Sensing Real Driving Emissions in Aberdeen.

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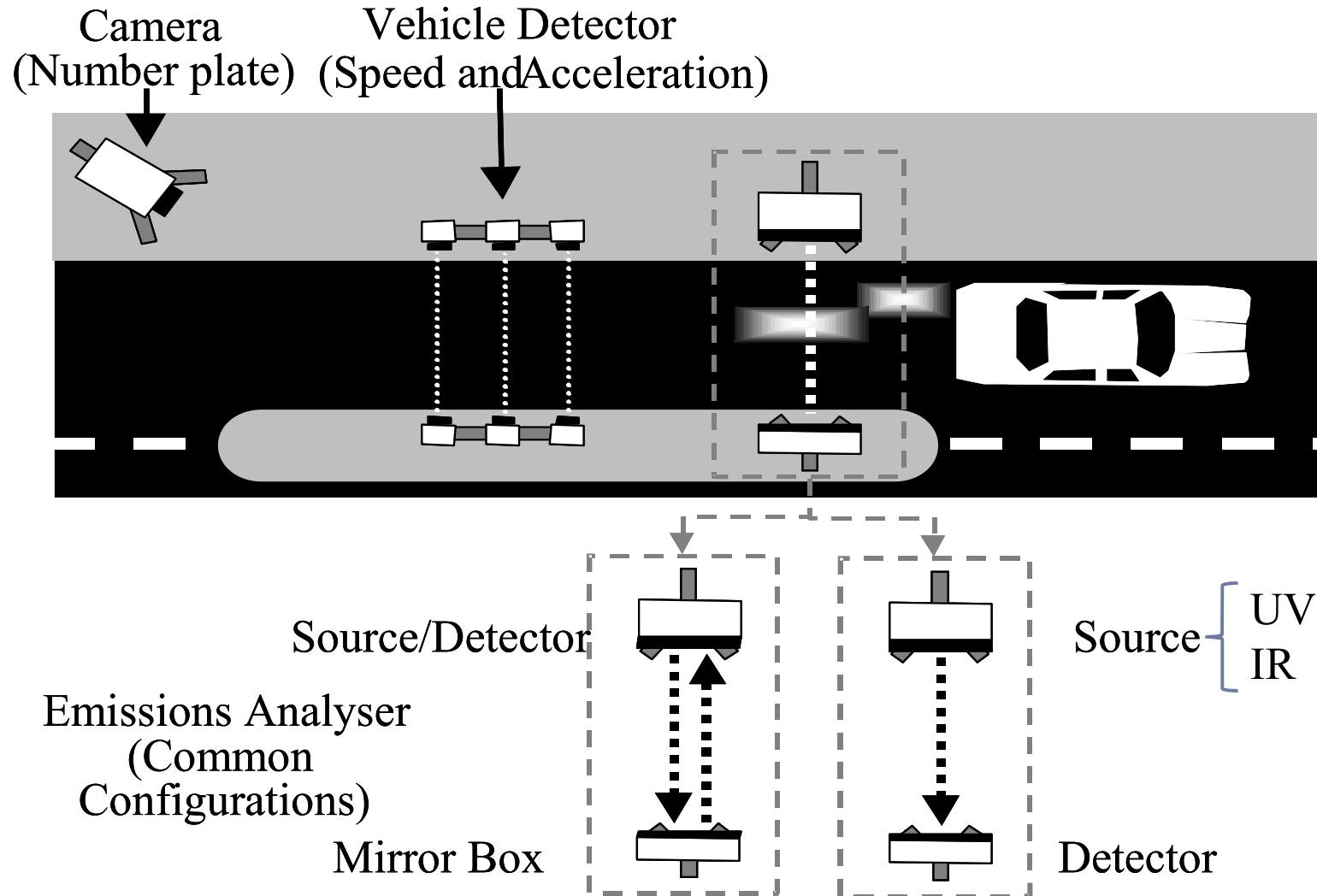
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 - ✗ Taxis
 - ✓ LGVs
 - ✓ HGVs
 - ✗ Buses
 - ▶ [#dieselgate](#) analysis
- ▶ Outlook & Recommendations

METHOD



REMOTE SENSING VEHICLE EMISSIONS

Surveying the vehicle fleet on the road

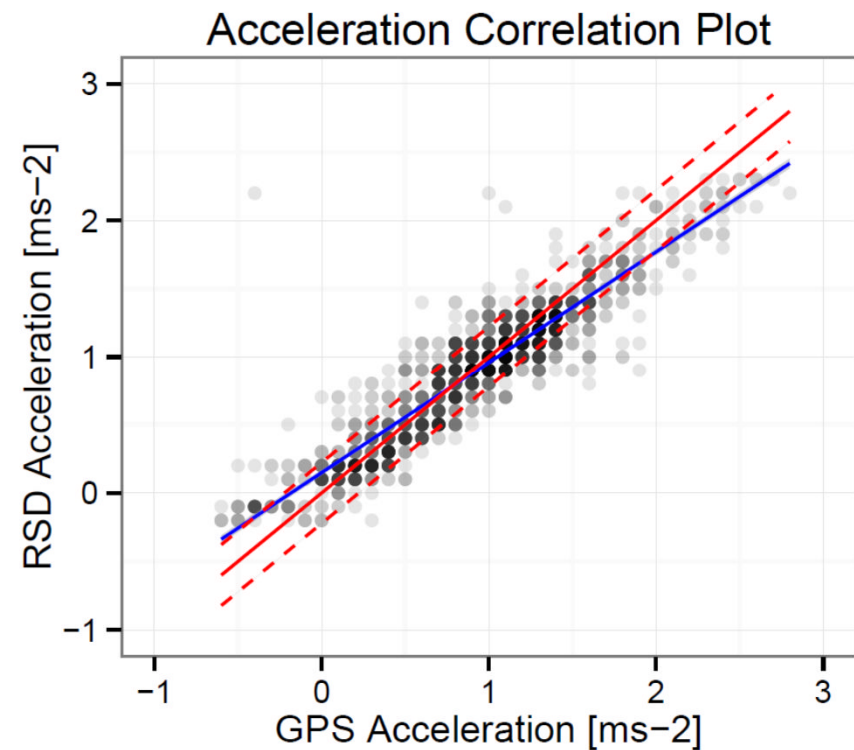
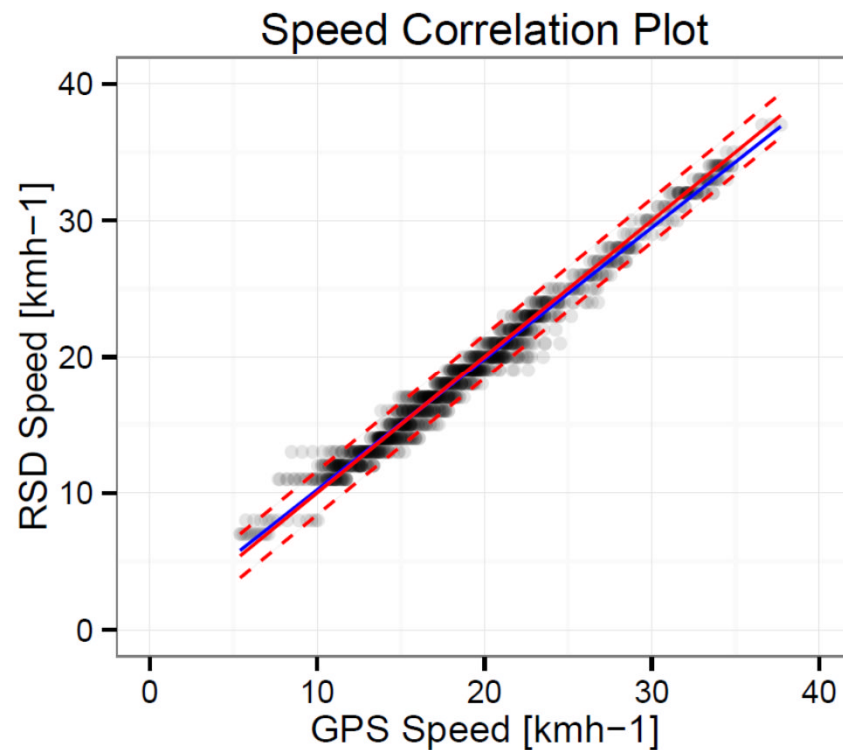


► **ESP RSD-4600 instrument** (www.esp-global.com)

METHOD VERIFICATION

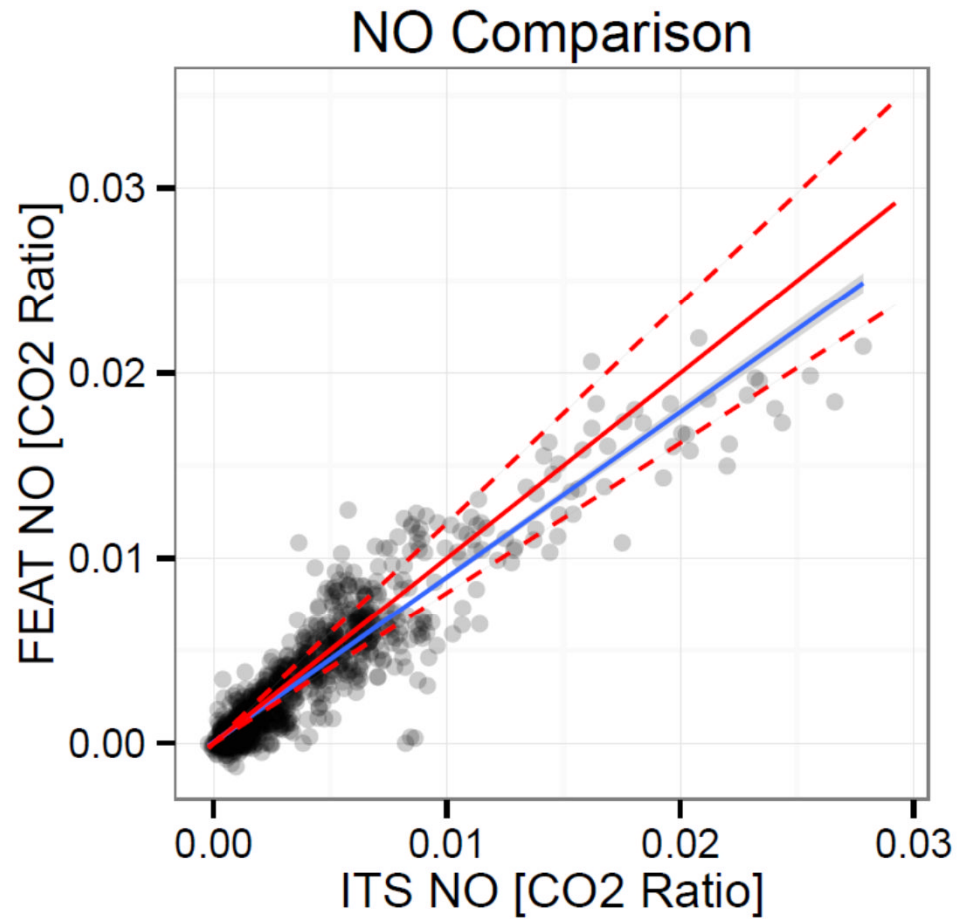
Speed & acceleration measurements

- ▶ Off carriage-way tests tracked vehicles (VBox: GPS, CAN bus)
- ▶ Repeated pass-bys



METHOD VERIFICATION

Inter-comparison of two Remote Sensing Devices



NO_x ESTIMATION METHOD

Passenger cars | Estimation of Emission Factors

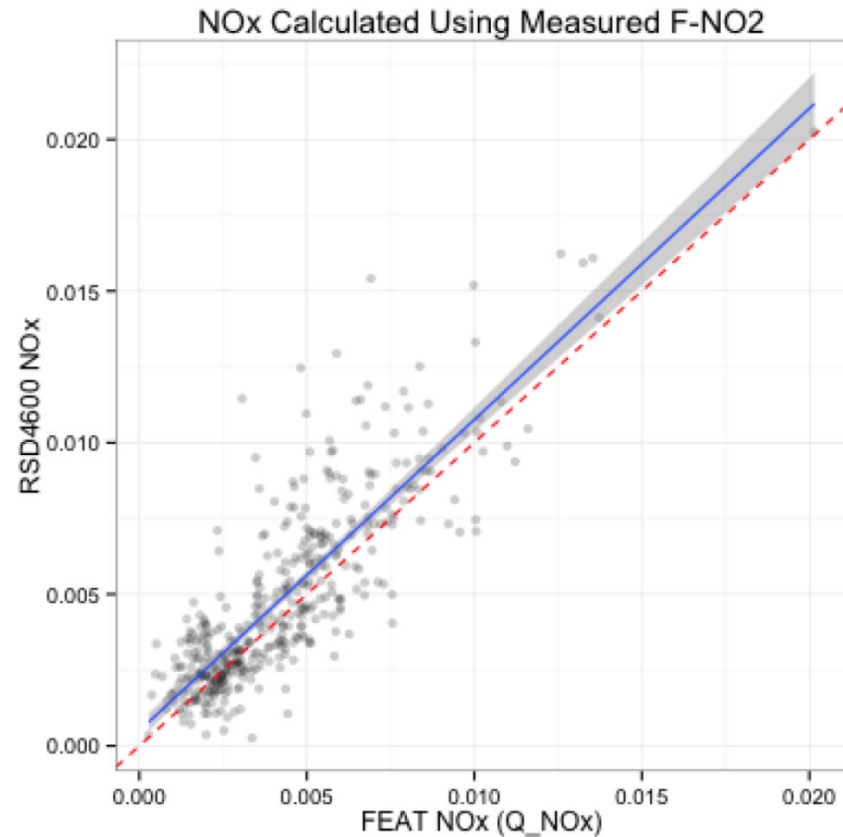
Measured Emission ratios

From peak exhaust plume conc.

$$\begin{aligned} CO/CO_2 \\ HC/CO_2 \\ PM_{OPACITY}/CO_2 \\ NO/CO_2 \end{aligned}$$

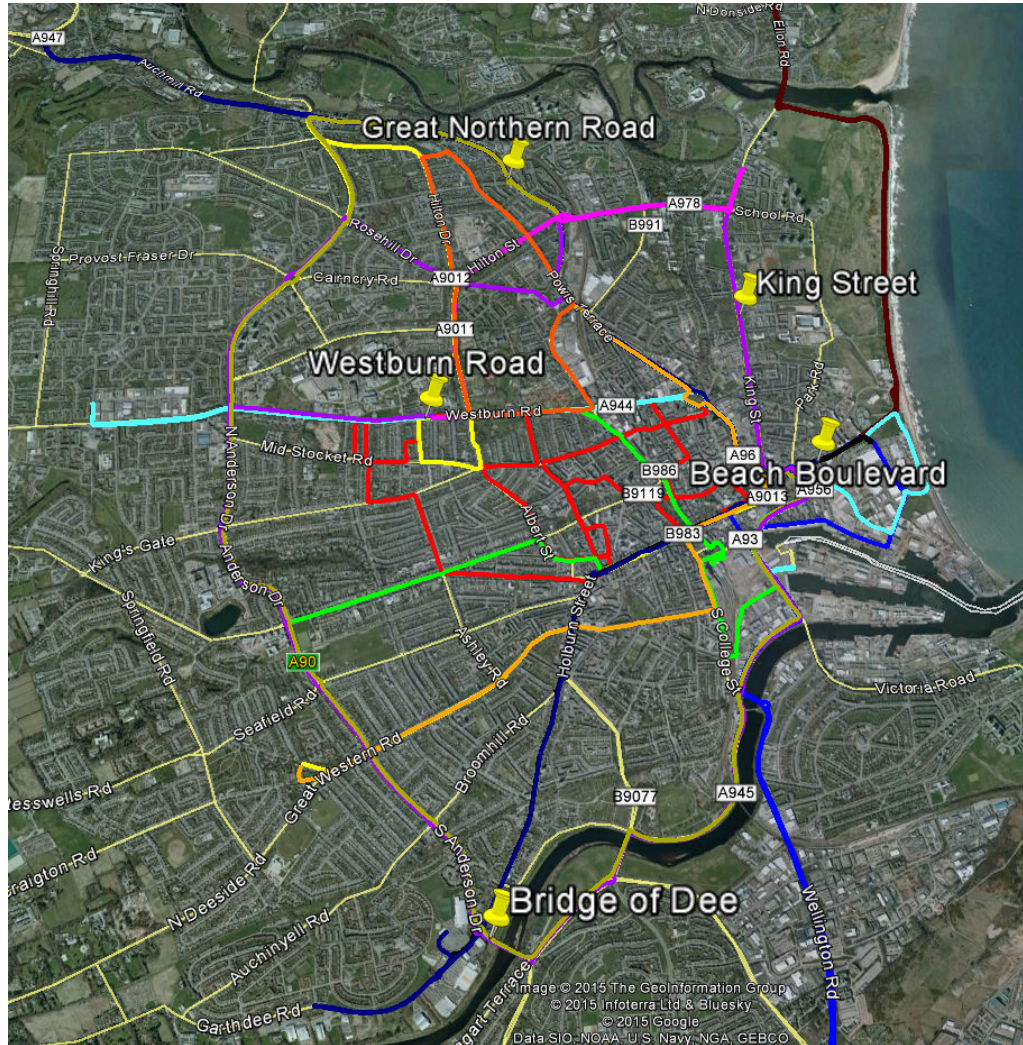
Predict NO₂ and total NO_x contribution using f-NO₂ reported by Carslaw (2013)

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



DATA COLLECTION | 2015

Remote Sensing & Vehicle Tracking



► Aberdeen campaign 2015:

► REMOTE SENSING

- 10 survey days (08:00 – 18:00 hrs)
- 25,000 'valid' measurements
- 5 sites

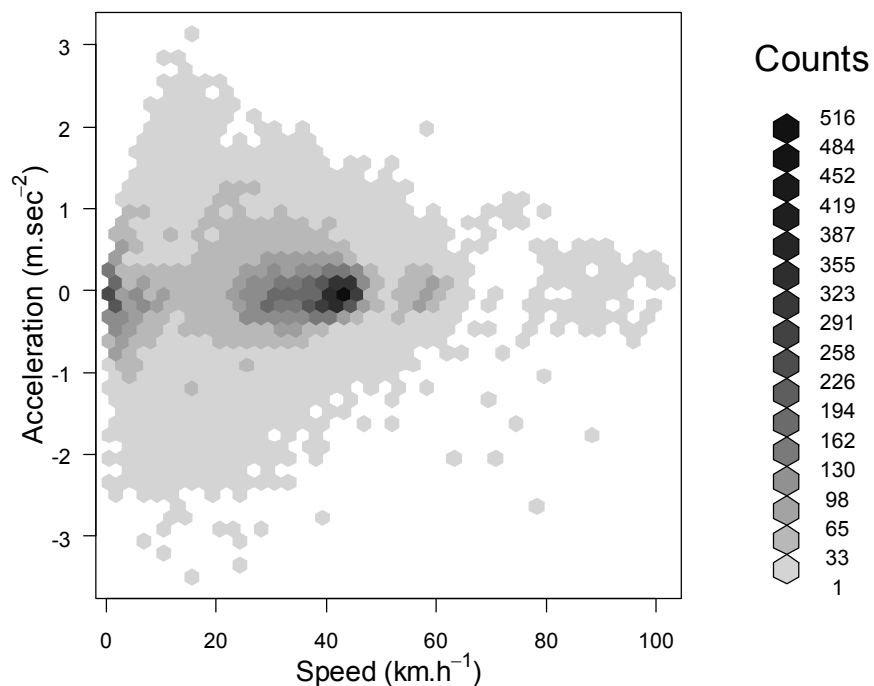
► CAR TRACKING

- Sample over 2-days
- **VBox** GPS, road speed (CAN Bus)
- 160 kms

RESULTS | 2015

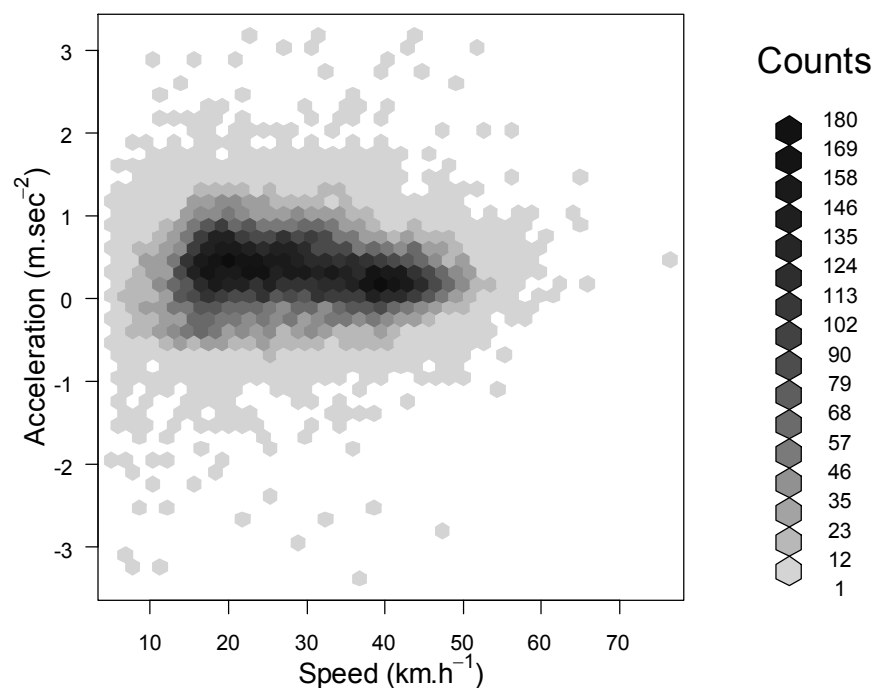
Speed & acceleration measurements

CAR TRACKING



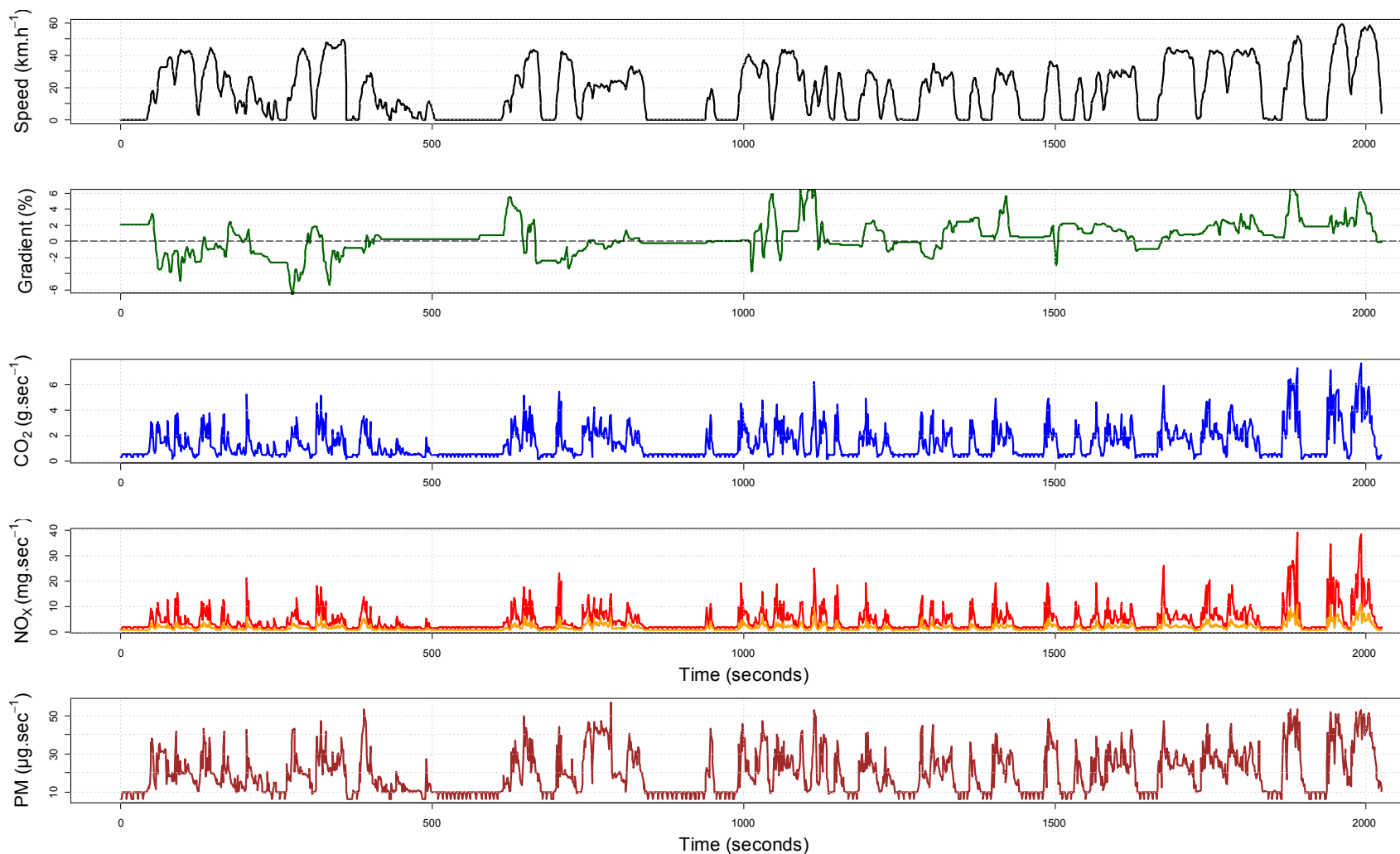
Time stationary = 26%

REMOTE SENSING



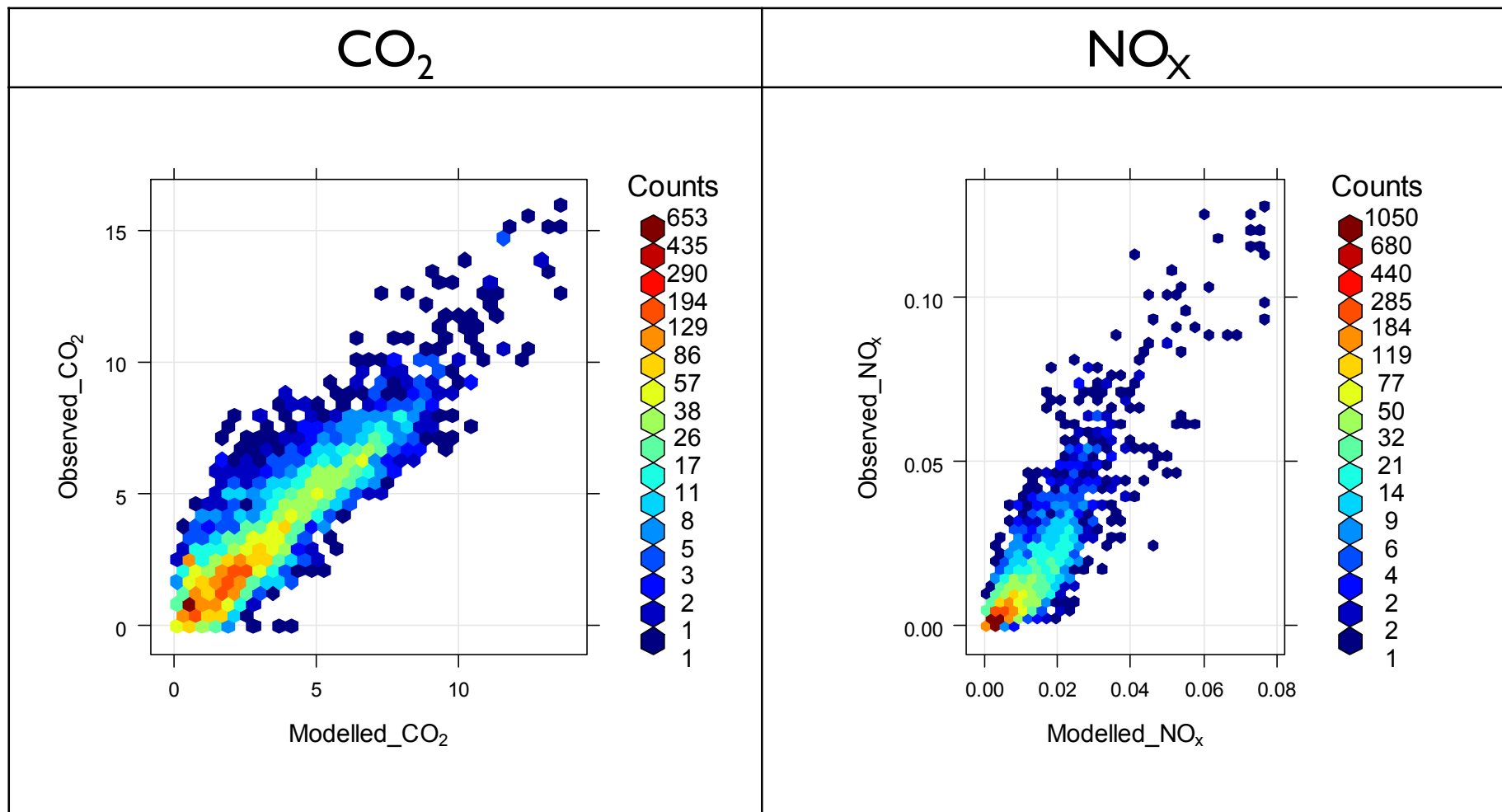
RESULTS | 2015

Instantaneous Emission Modelling (IEM) using Car tracking data



RESULTS | 2015

IEM verification – Transport for London Laboratory Data



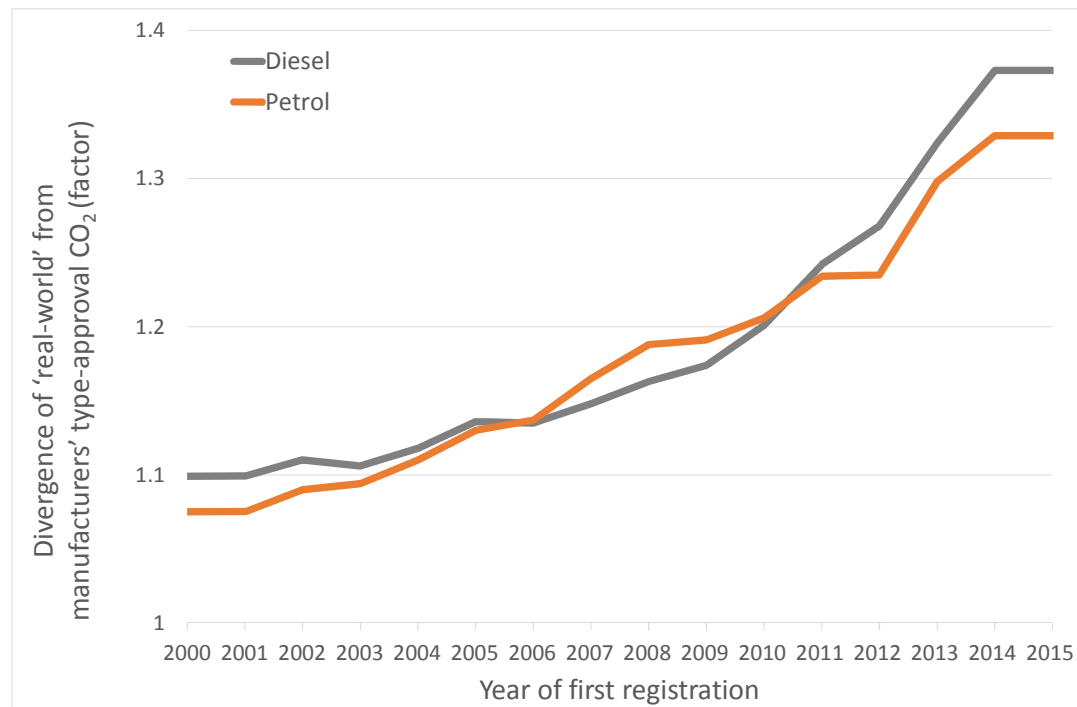
Euro 5 MPV over the 140 km London Drive Cycle (Urban, suburban & motorway)

EMISSION FACTOR (EF) ESTIMATION METHOD

Passenger cars

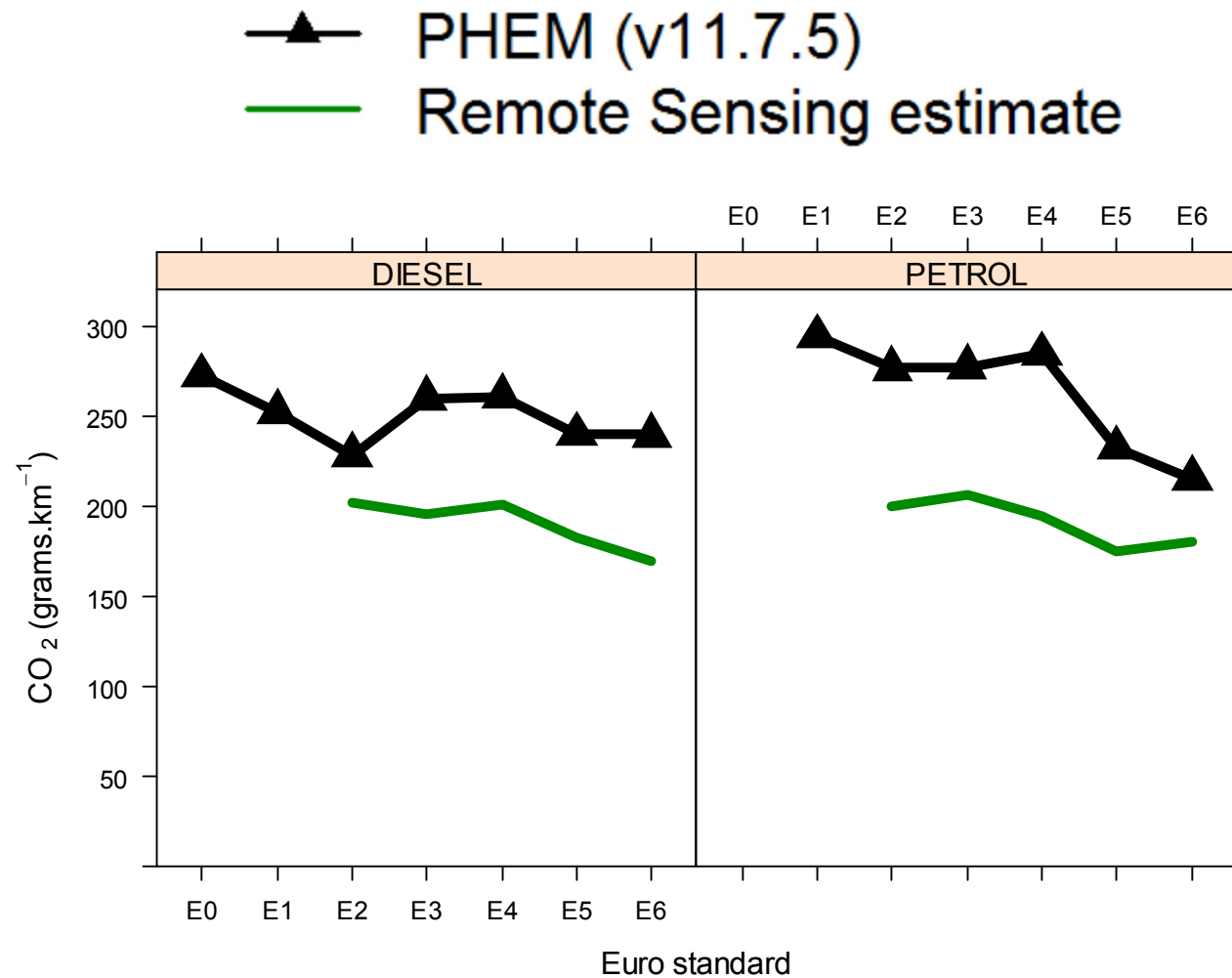
$$CO_2 EF (gr.km^{-1}) = \left(\frac{CO_2}{km} \right)_{MANU} \times (Correction Factor)_{ICCT}$$

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



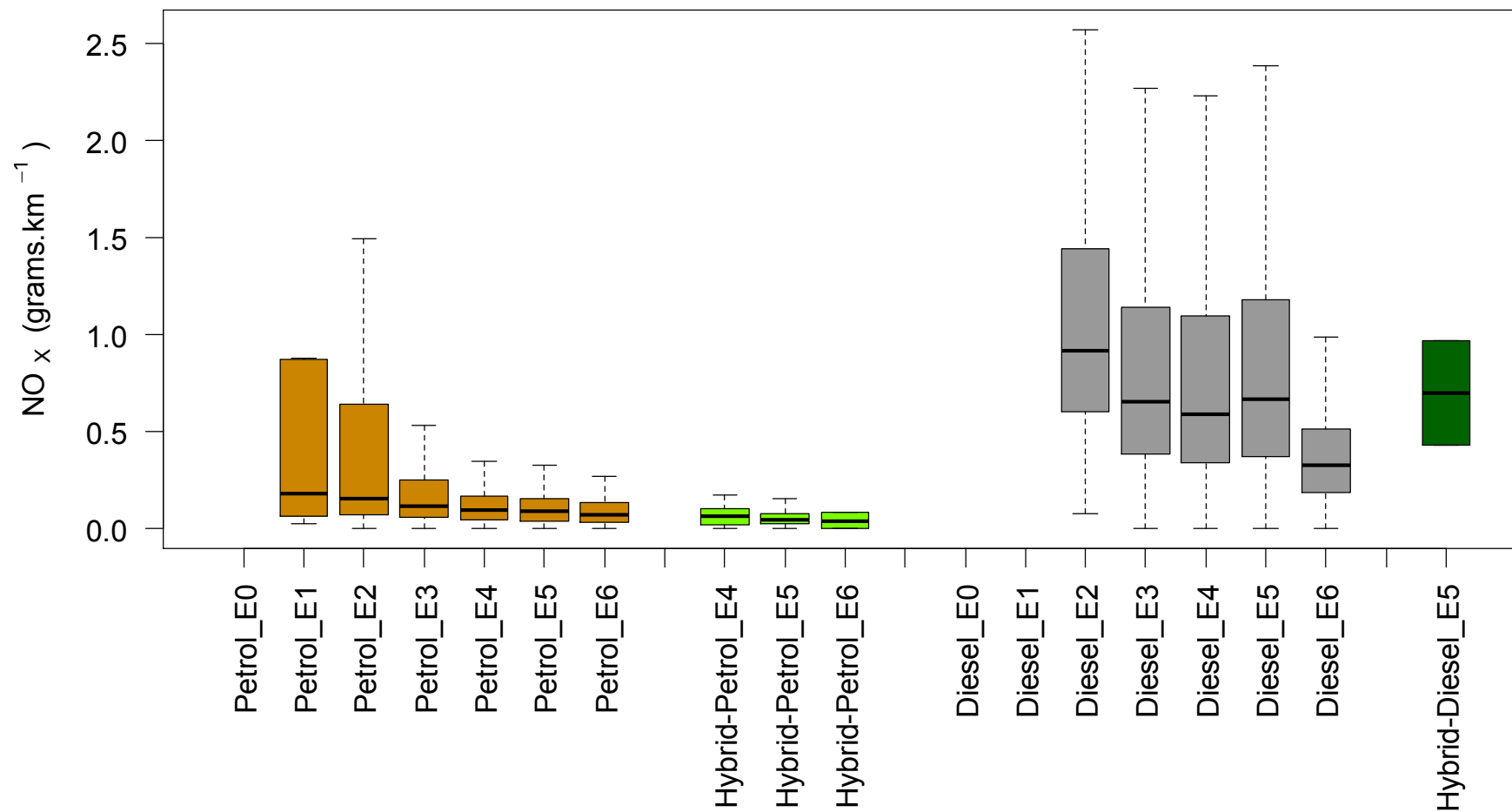
PASSENGER CARS | CO₂

Results Spring/ Summer 2015



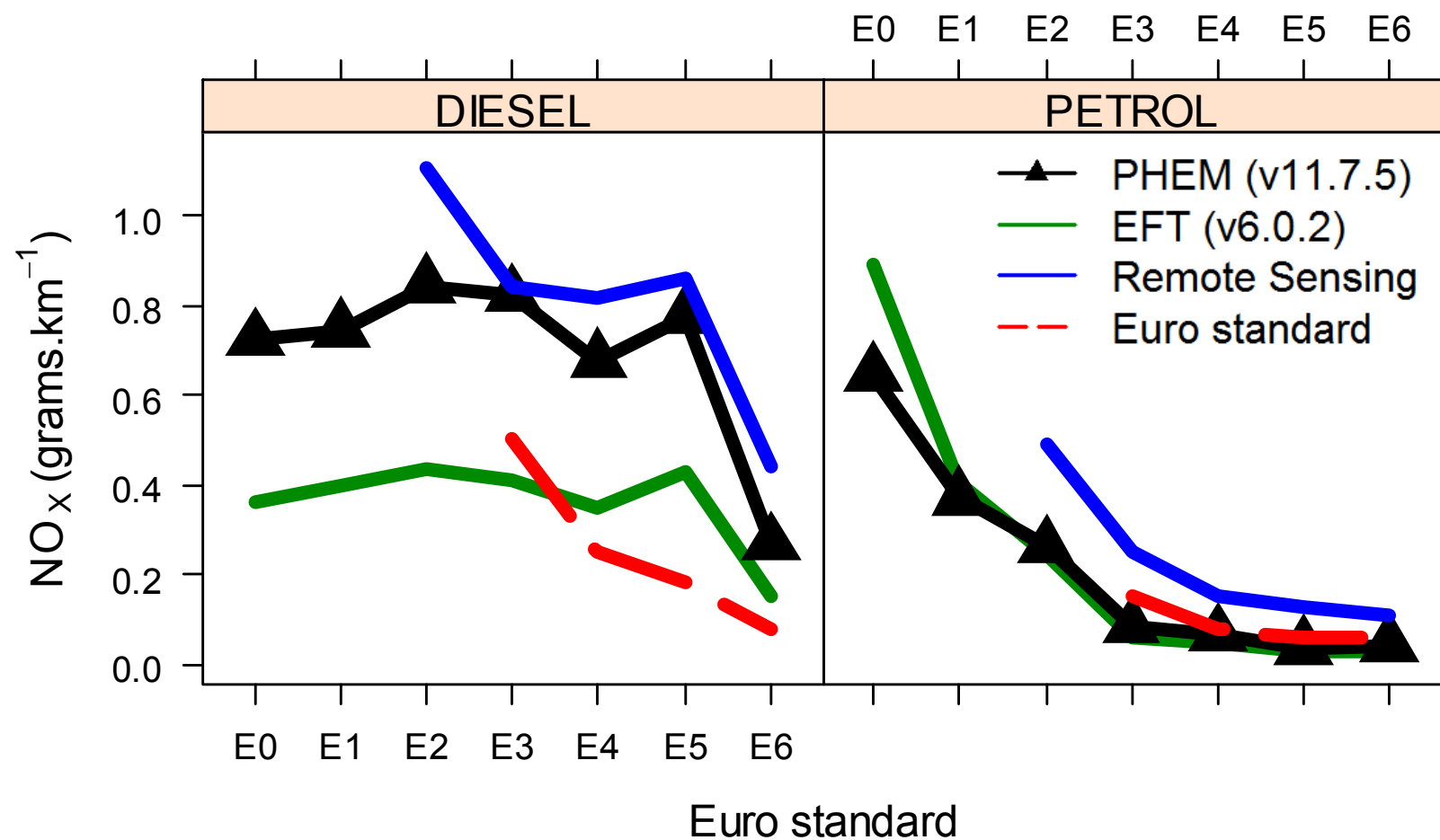
PASSENGER CARS | NO_x

Results Spring/ Summer 2015



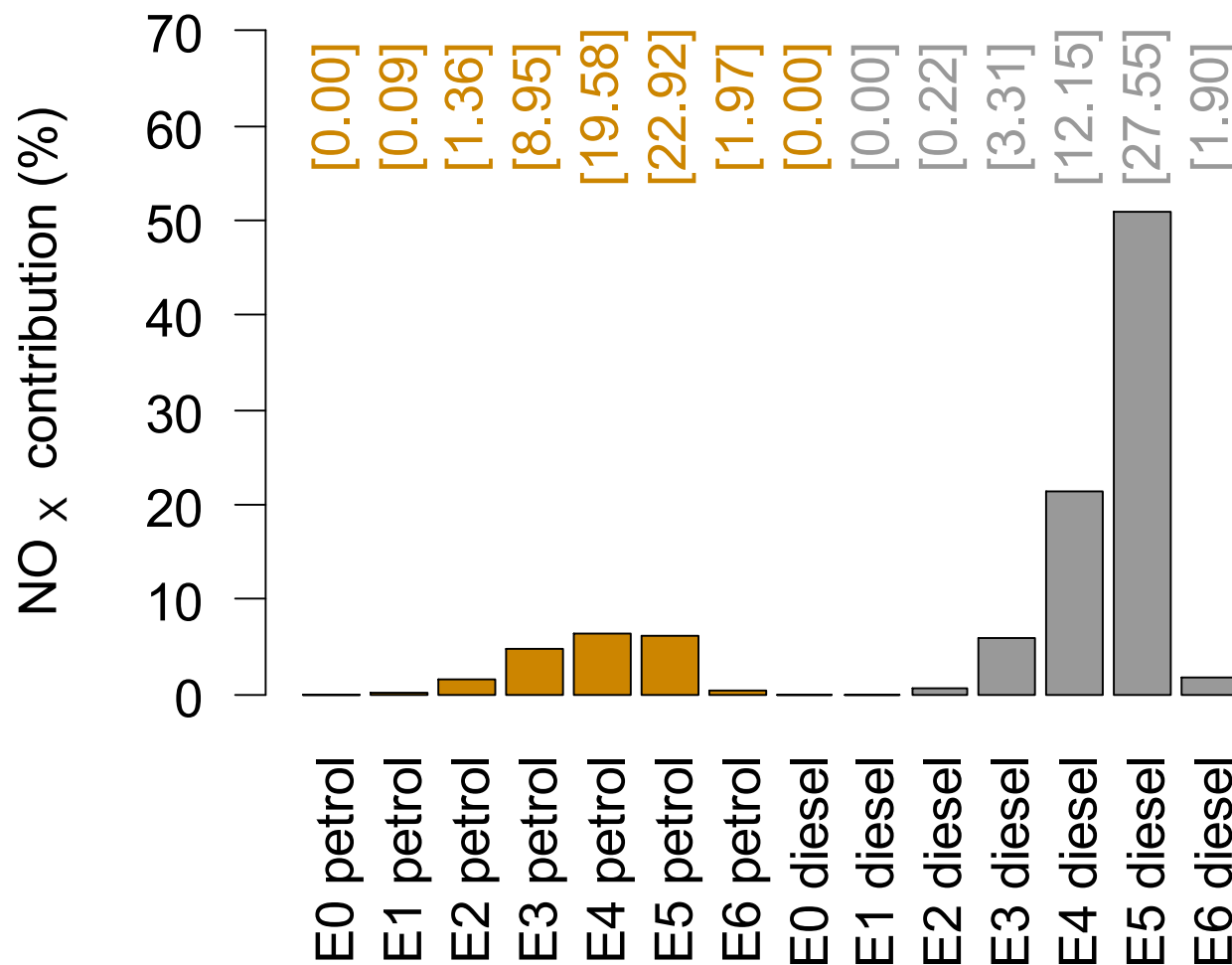
PASSENGER CARS | NO_x

Results Spring/ Summer 2015



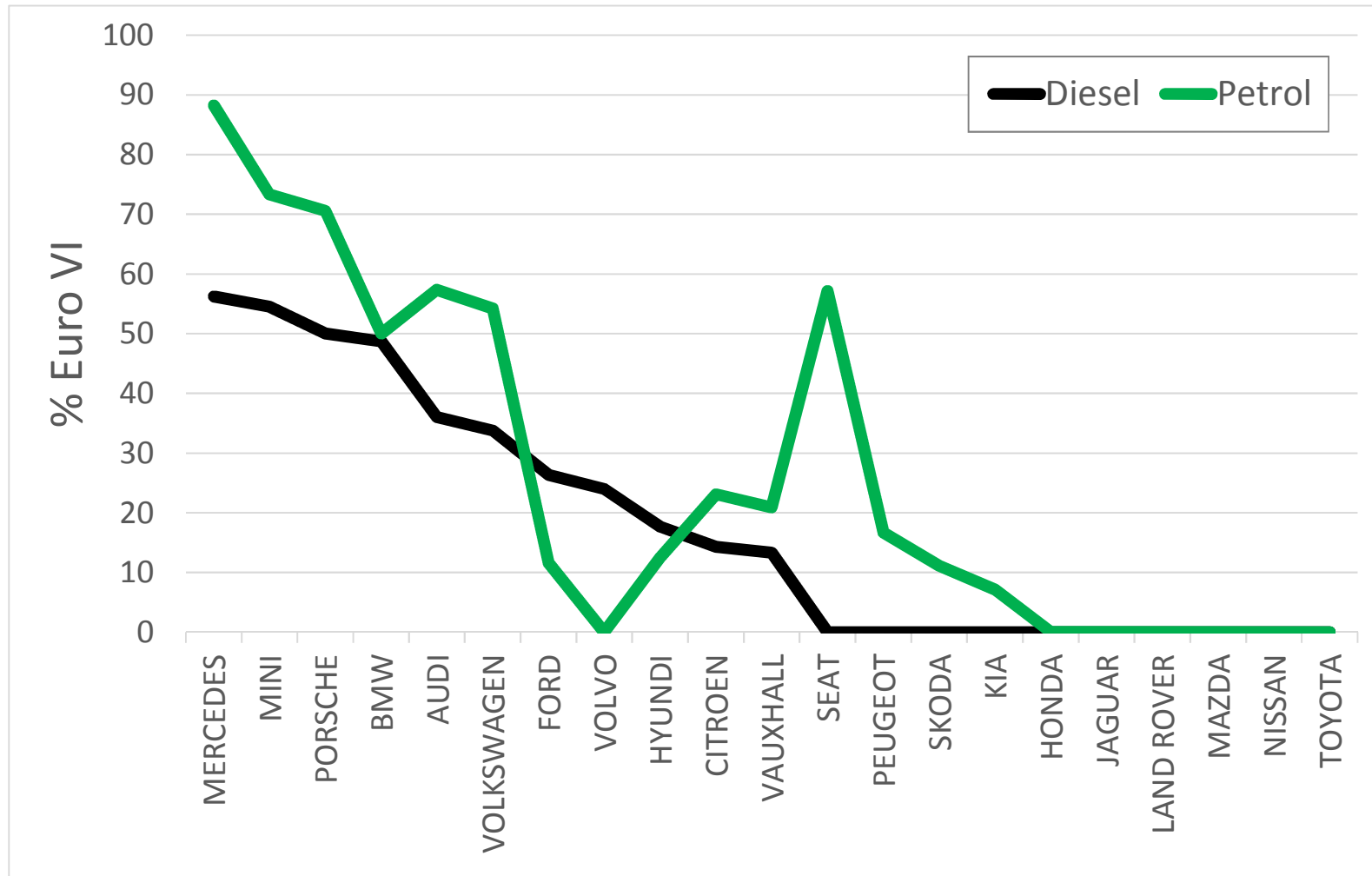
PASSENGER CARS | NO_x contributon

Results Spring/ Summer 2015



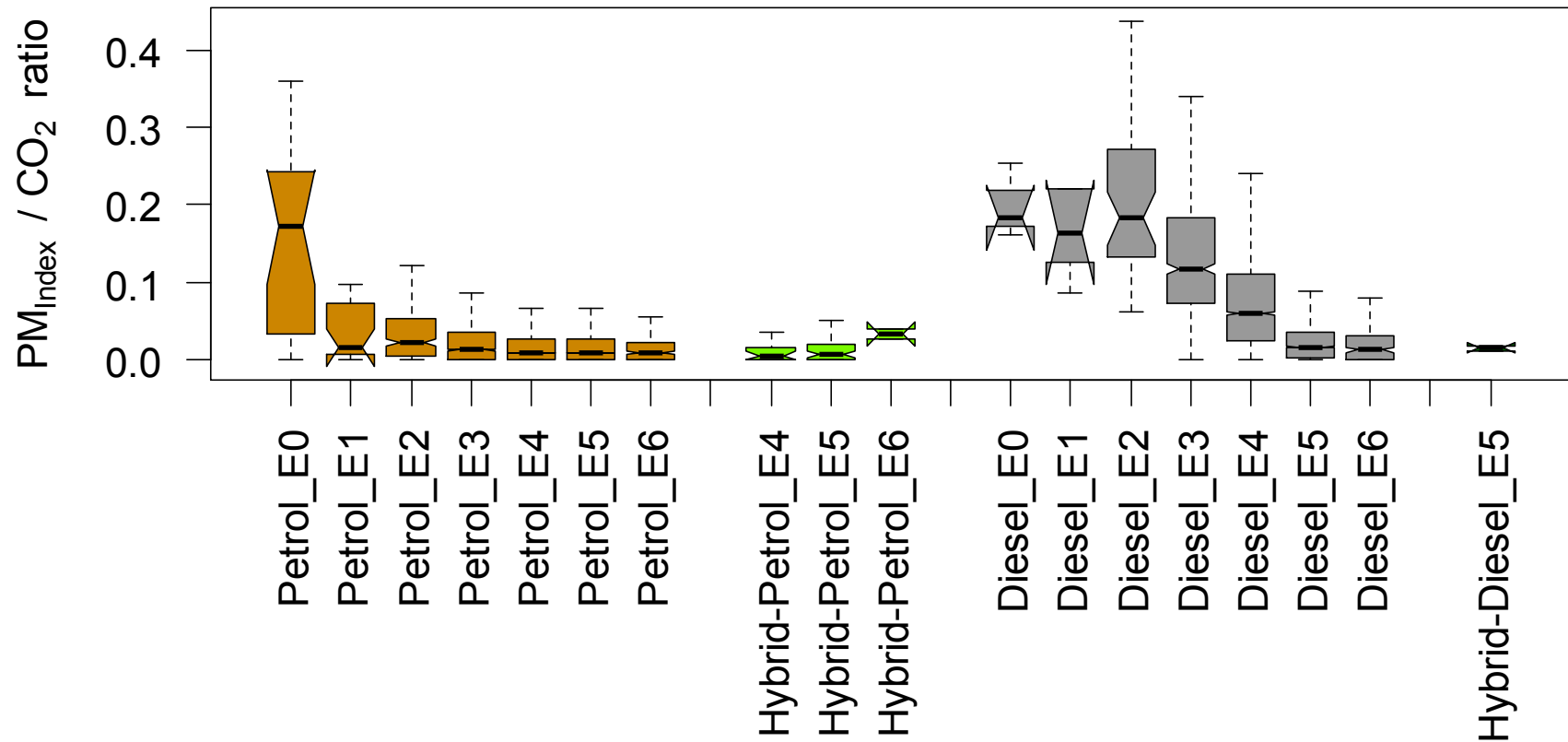
PASSENGER CARS | Euro 6

% of Passenger cars registered since Sept 2014 that are Euro 6



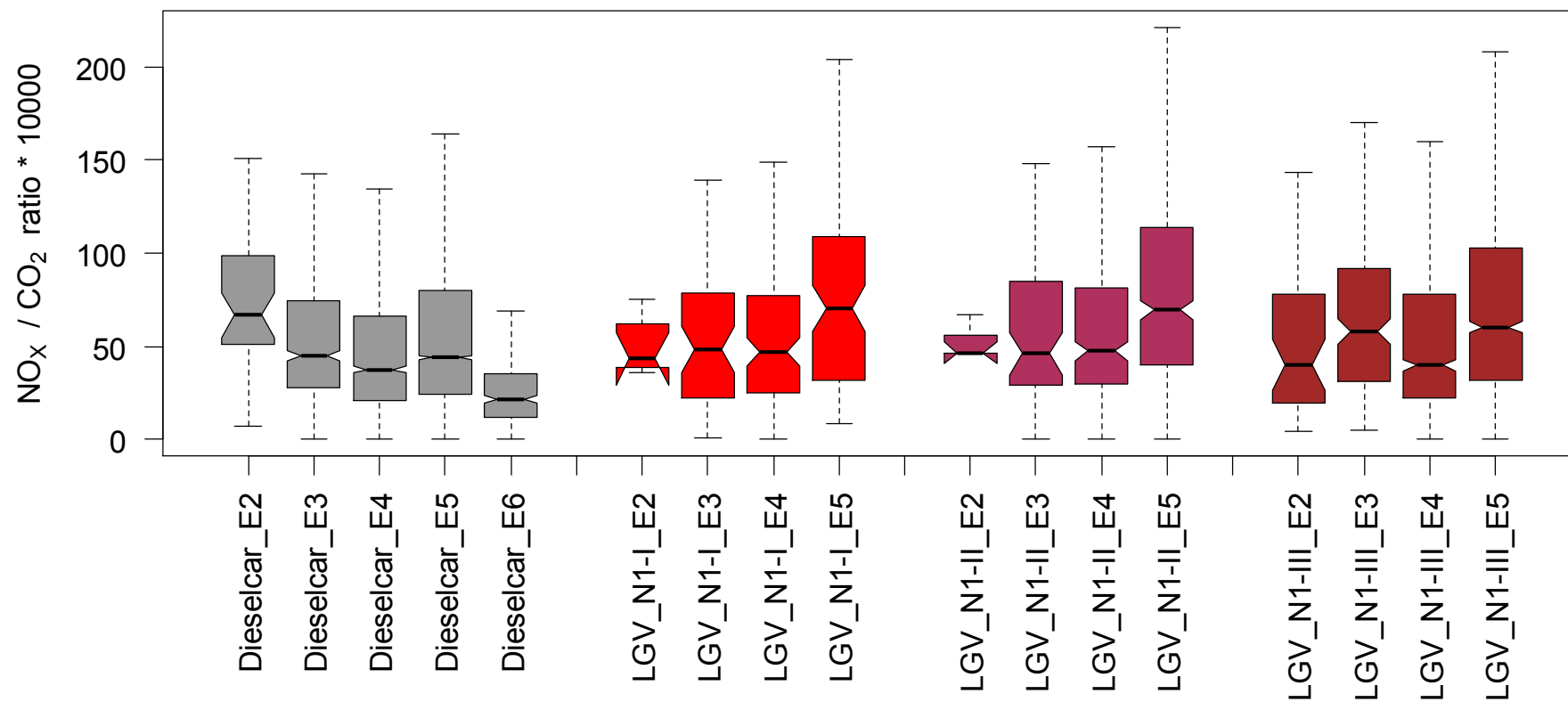
PASSENGER CARS | PM (opacity)

Results Spring/ Summer 2015



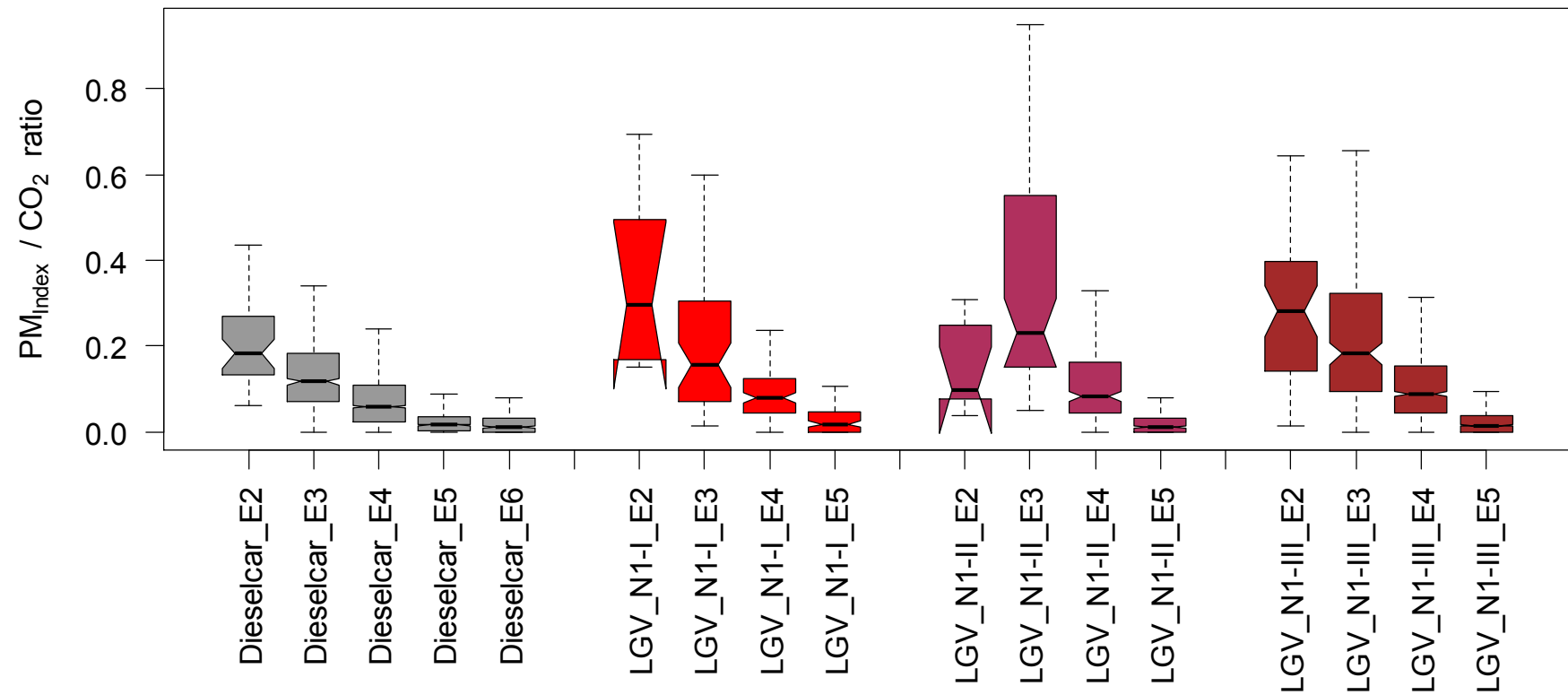
LGVs | NO_x

Results Spring/ Summer 2015



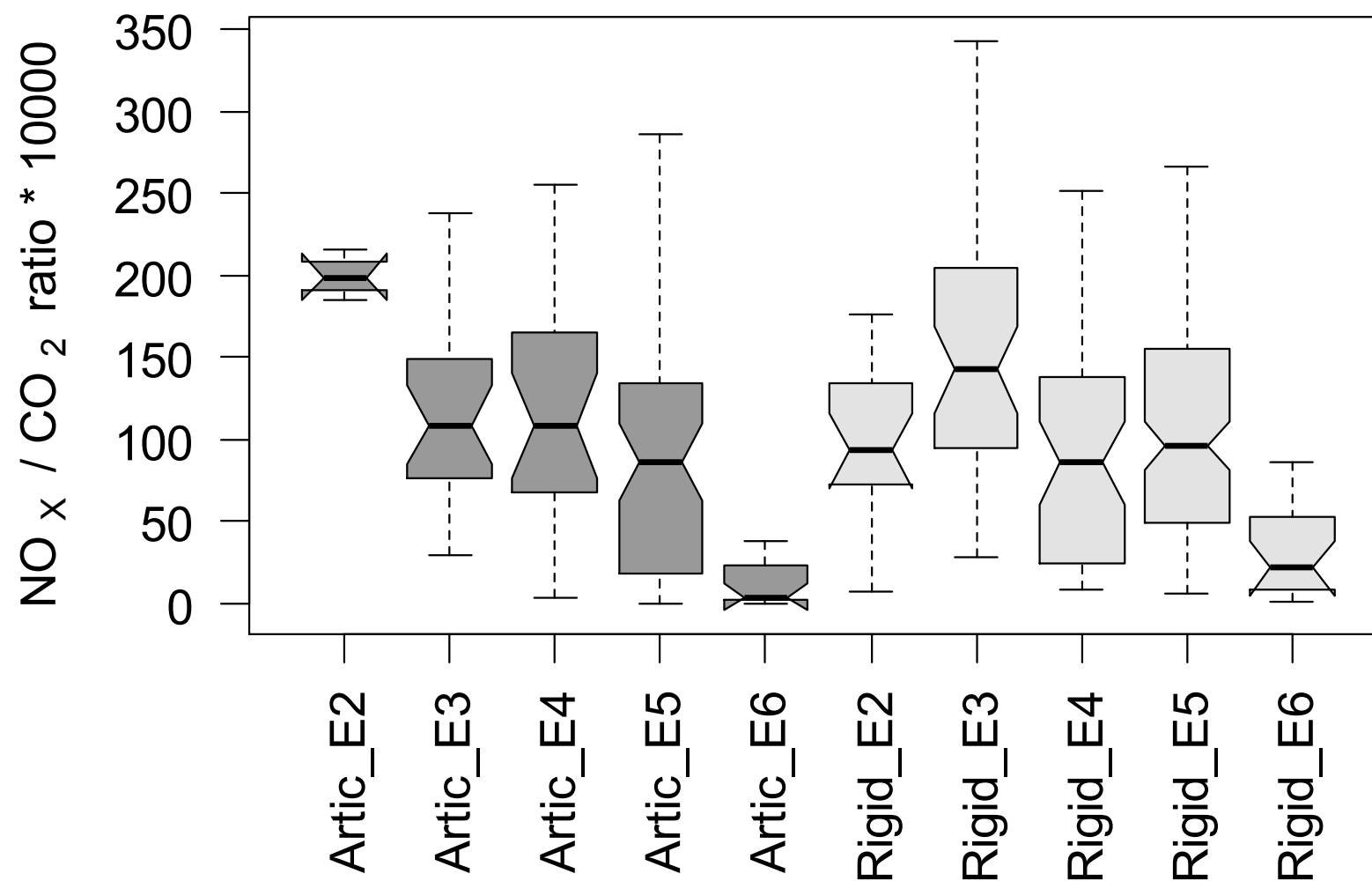
LGVs | PM

Results Spring/ Summer 2015



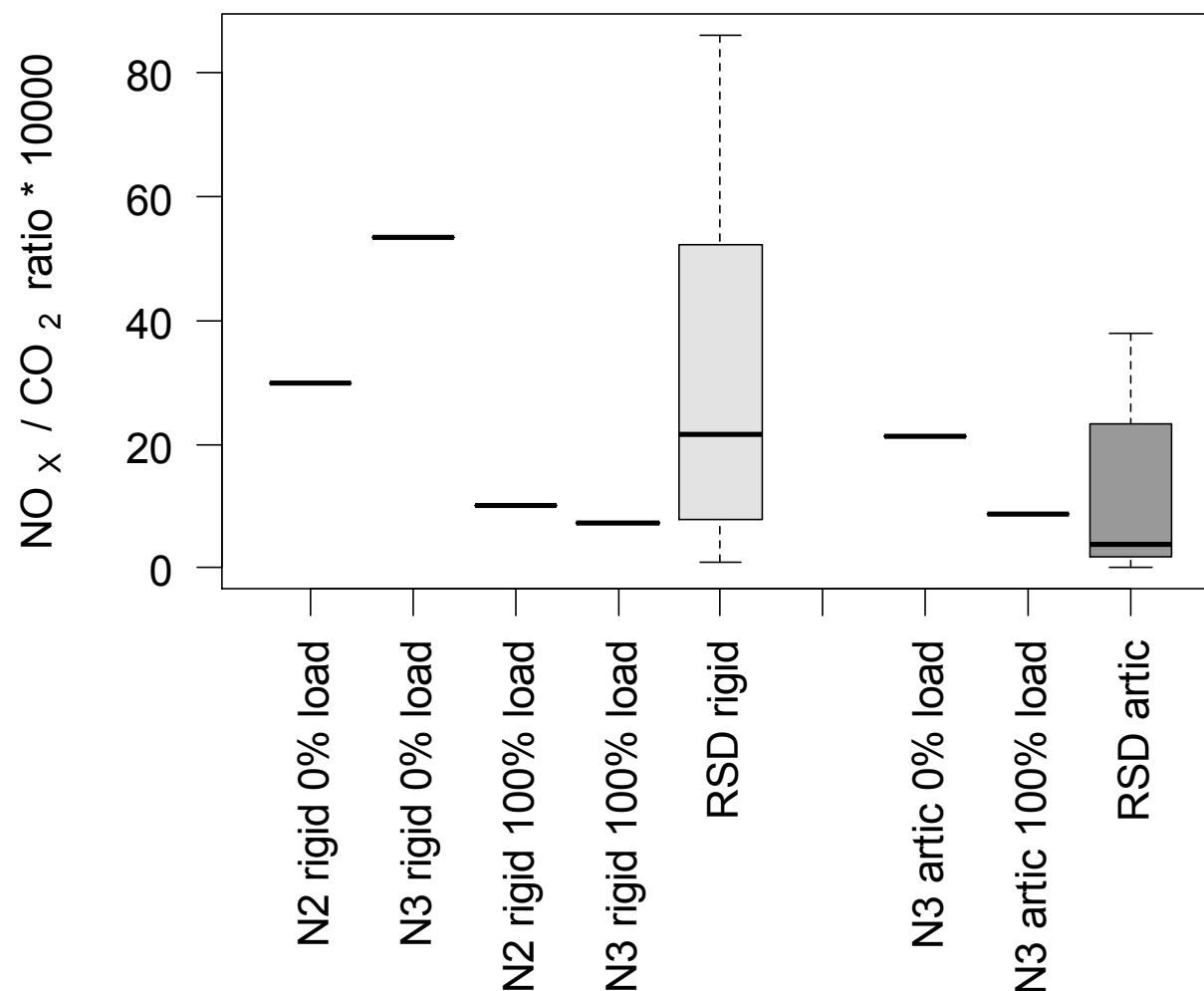
HGVs | NO_x

Results Spring/ Summer 2015



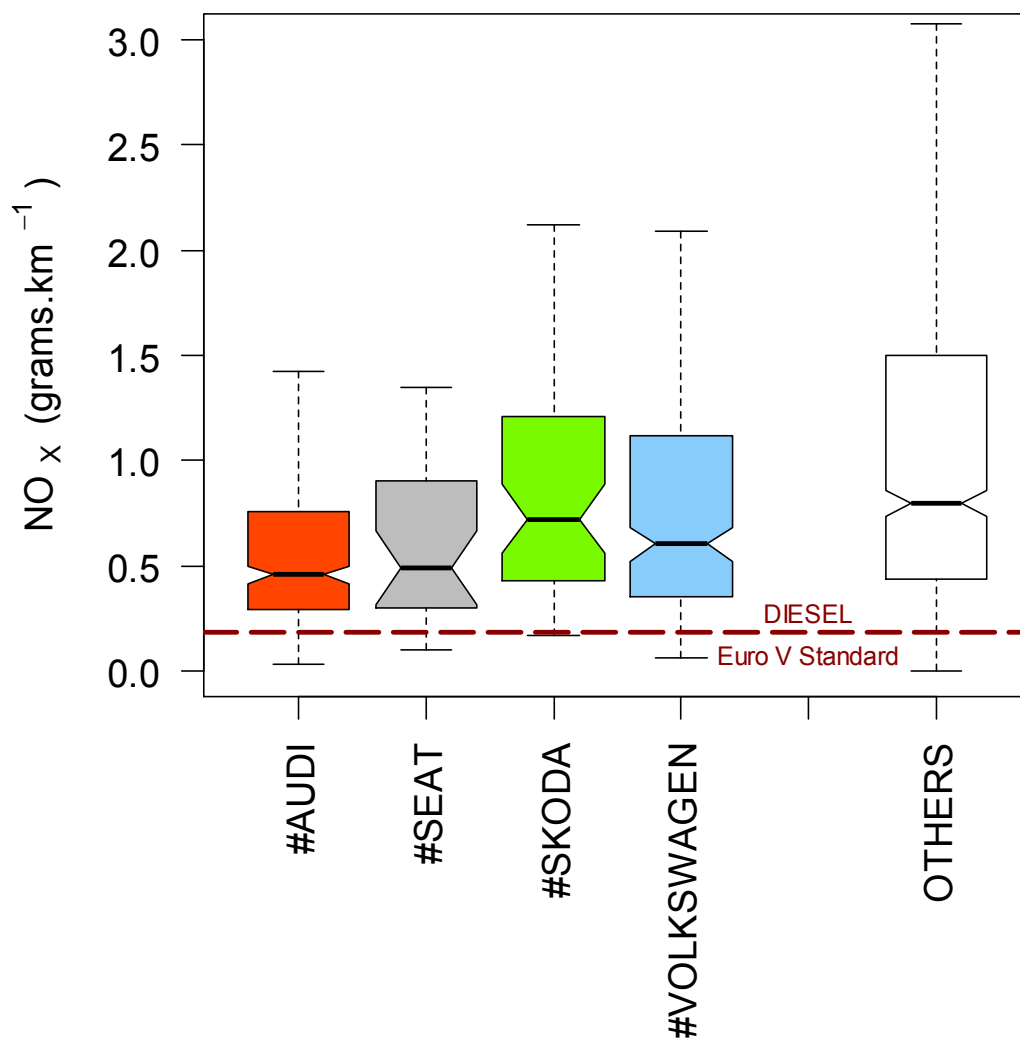
HGVs | NO_x

Corroboration TfL data



#DIESELGATE

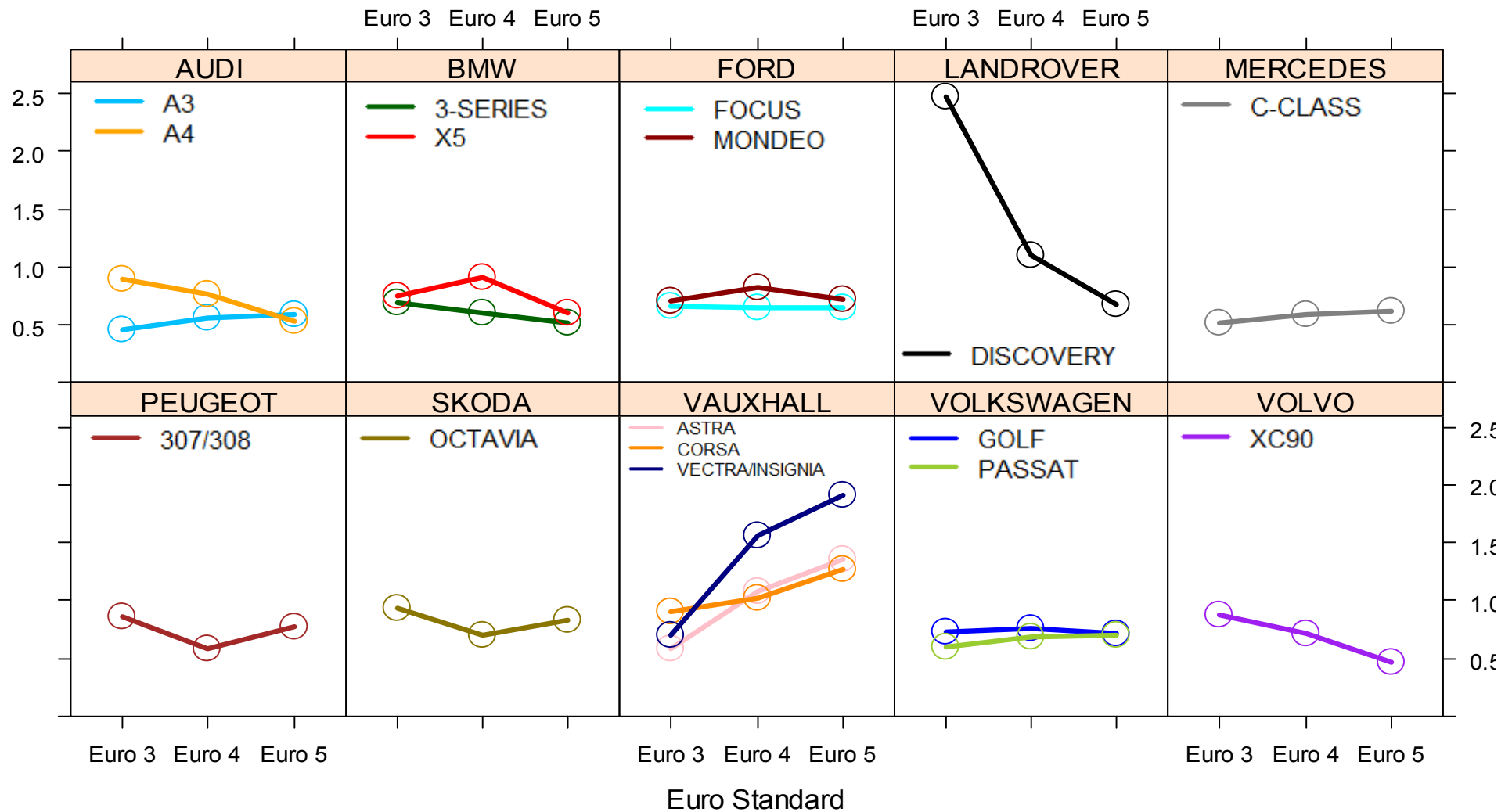
Euro 5 2.0-litre diesel cars with EA189 engine



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

#DIESELGATE

NO_x emissions of common marques & models



OUTLOOK

10

National

The Guardian | Thursday 22 October 2015

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



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 thinktank 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.

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ACKNOWLEDGEMENTS

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Scottish Government

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