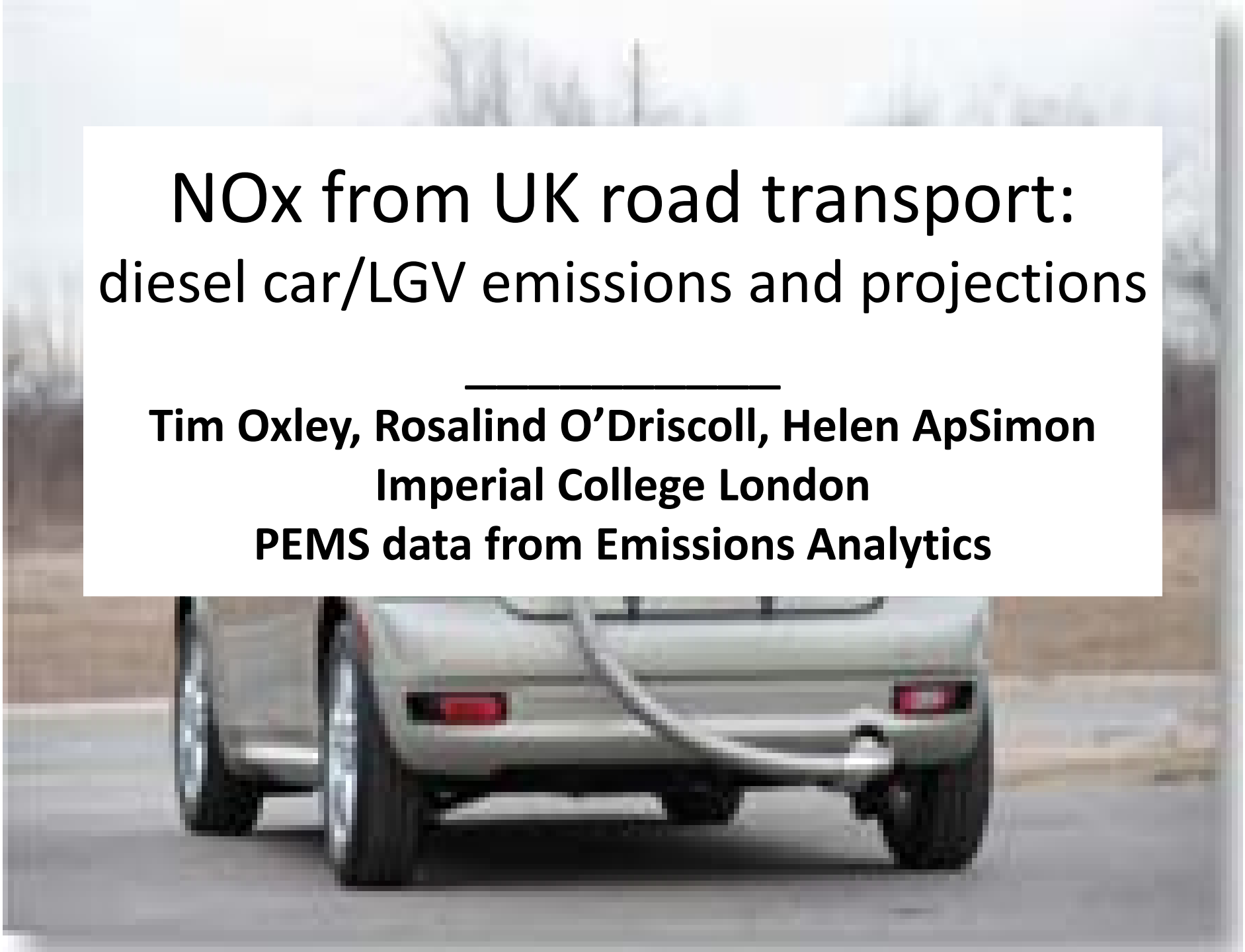


NOx from UK road transport:
diesel car/LGV emissions and projections

Tim Oxley, Rosalind O'Driscoll, Helen ApSimon
Imperial College London
PEMS data from Emissions Analytics

1. Emission trends and projections, and contribution from diesel cars and LGVs

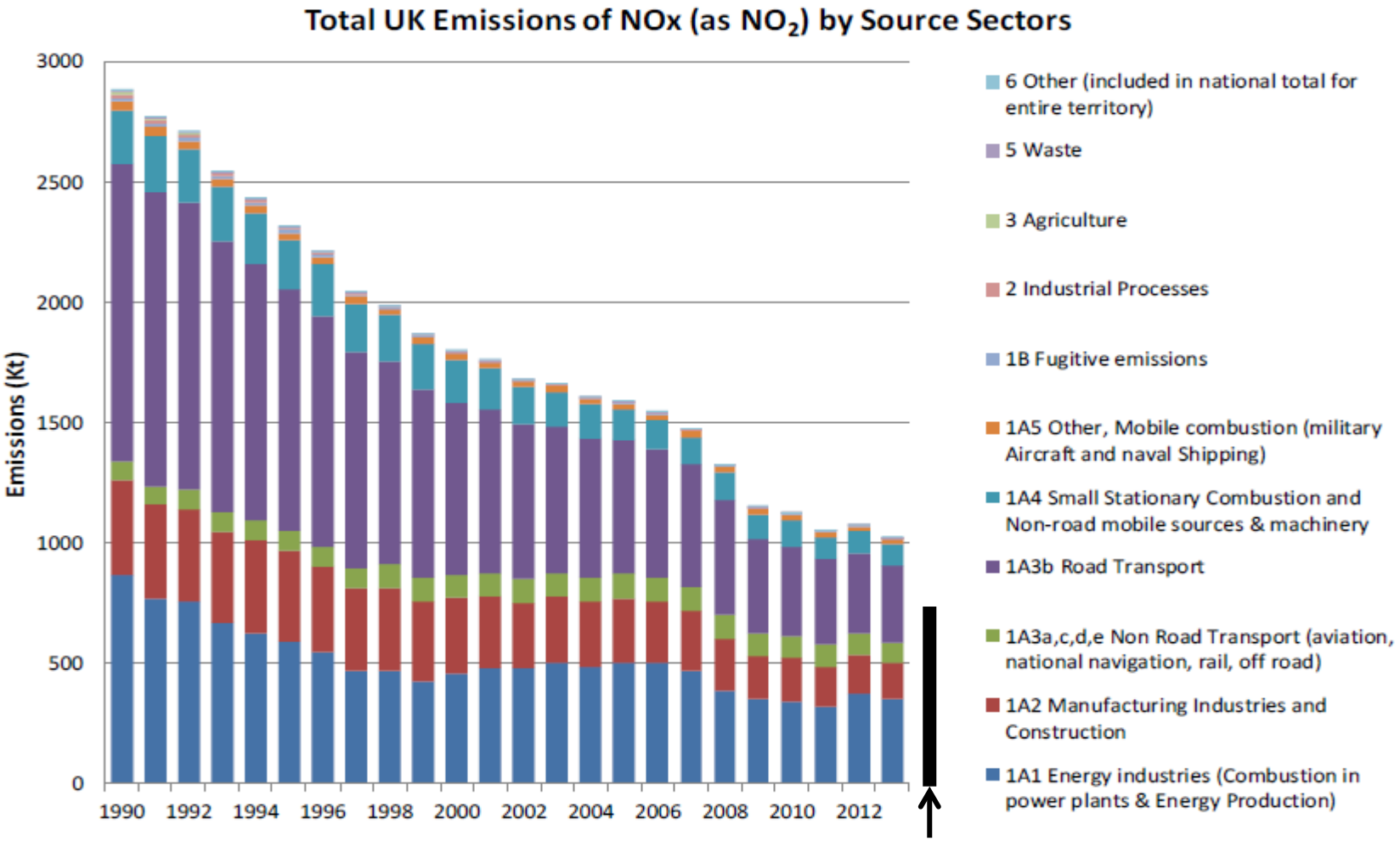
2. PEMS observations of new Euro 6 vehicle NOx and NO2 emissions

3. Conformity factors, Euro 6c and beyond

4. Sensitivity studies for NO2 concentrations

5. New technologies and further work

Transport large proportion: diesel cars/LGVs a major part



Gothenburg 2020

Euro 6 diesel cars

1. **Euro 6 standard (test cycle) 80mg/km Nox**

2. **COPERT 4.10 EFs used in NAEI/UKIAM for Euro 6a as introduced now -> urban ave 225 to 250 mg/km *conformity factor ~ 3.0***

3. COPERT 4.11 EFs for tighter Euro 6c standards from 2017/2018 (based on PEMS testing) -> urban average ~120 mg/km

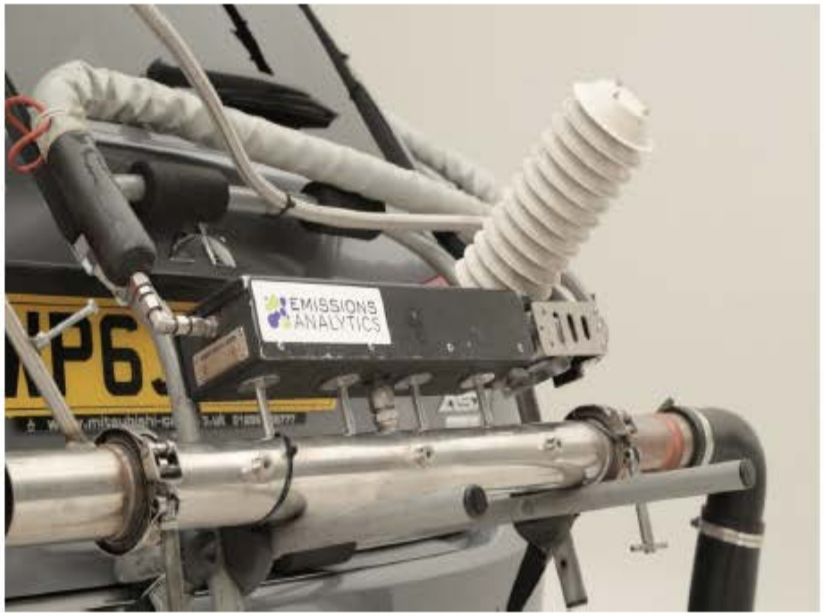
i.e. conformity factor 1.5

Benefits of PEMS

EMISSIONS ANALYTICS

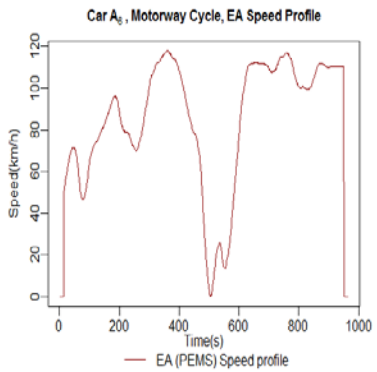
- Real on-road testing using PEMS is a powerful research method
- Authentic and cost effective
- Works on all vehicle types
- No permanent vehicle modification required
- Flexible location
- High rate of data acquisition – 1 Hertz

- Measures CO, CO_2, NOx, NO_2 and THC



Analysis:comparison PEMS & COPERT

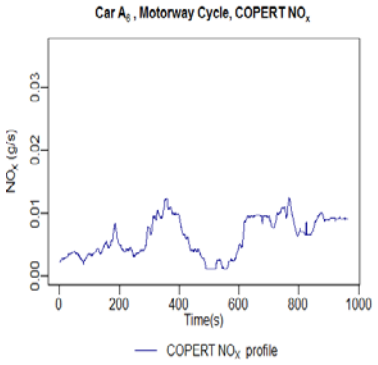
1. Cycle selected by GPS



2. Test cycle speed profile fed into iMove

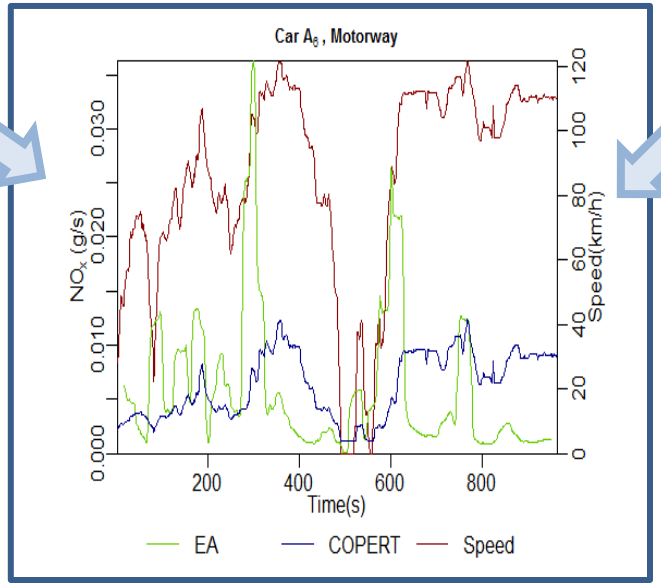
iMove

3. iMove generates CO_2/NO_x profile from COPERT v.4.10



PEMS CO_2/NO_x profile

COPERT CO_2/NO_x profile



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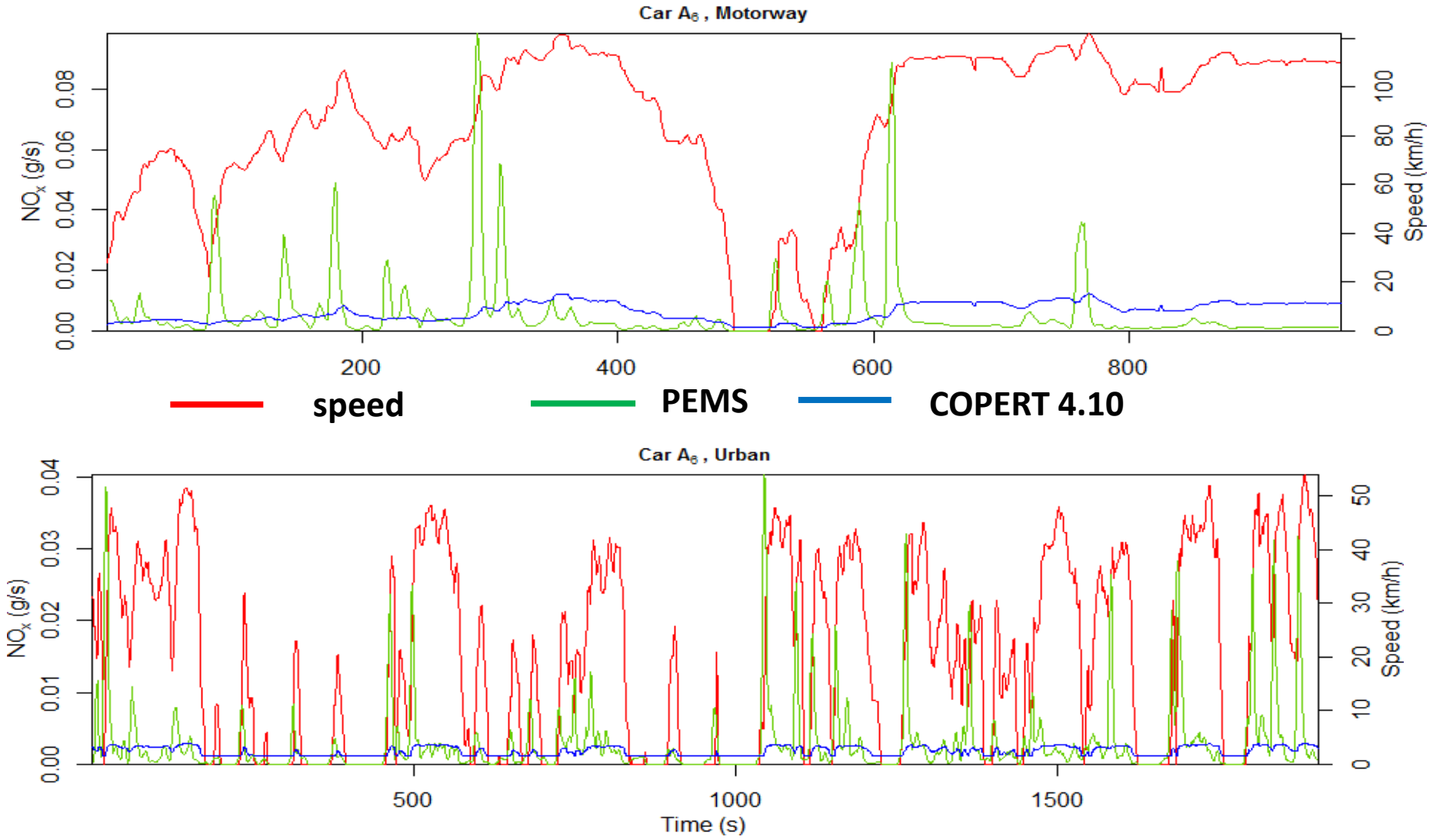
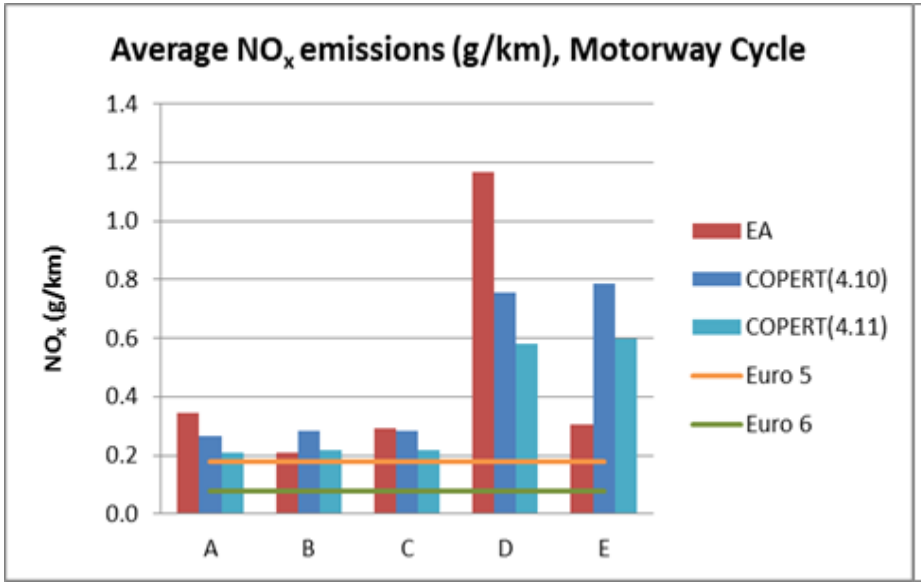


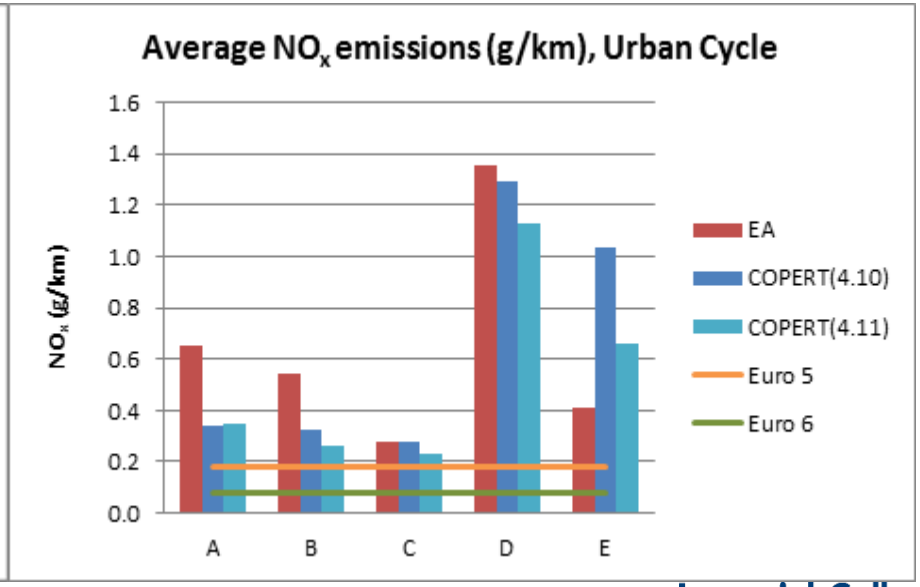
Temporal pattern: poor correlation with speed; coincidence of peaks with acceleration

-> comparison with more detailed model such as EnViVer

Average NO_x Emission

- Diesel cars: A,B,C Euro 6, D&E Euro 5: No vehicle met the Euro Standard (? even tighter Euro 6c standard feasible?)
- Seemed to be improvement from 5 -> 6 (especially on motorways)
- COPERT returned reasonable estimates for NO_x, sometimes overestimate, sometimes underestimate





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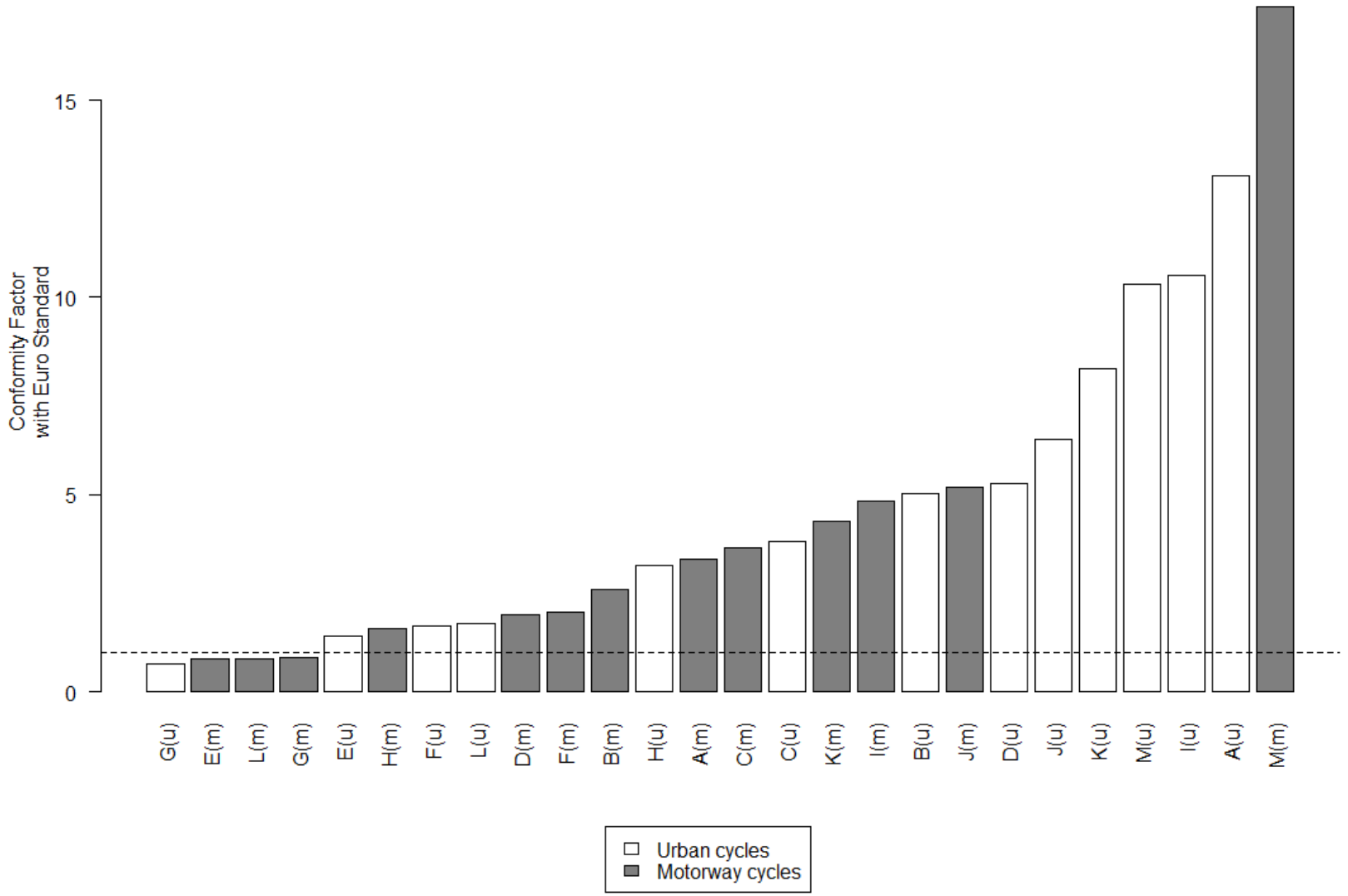
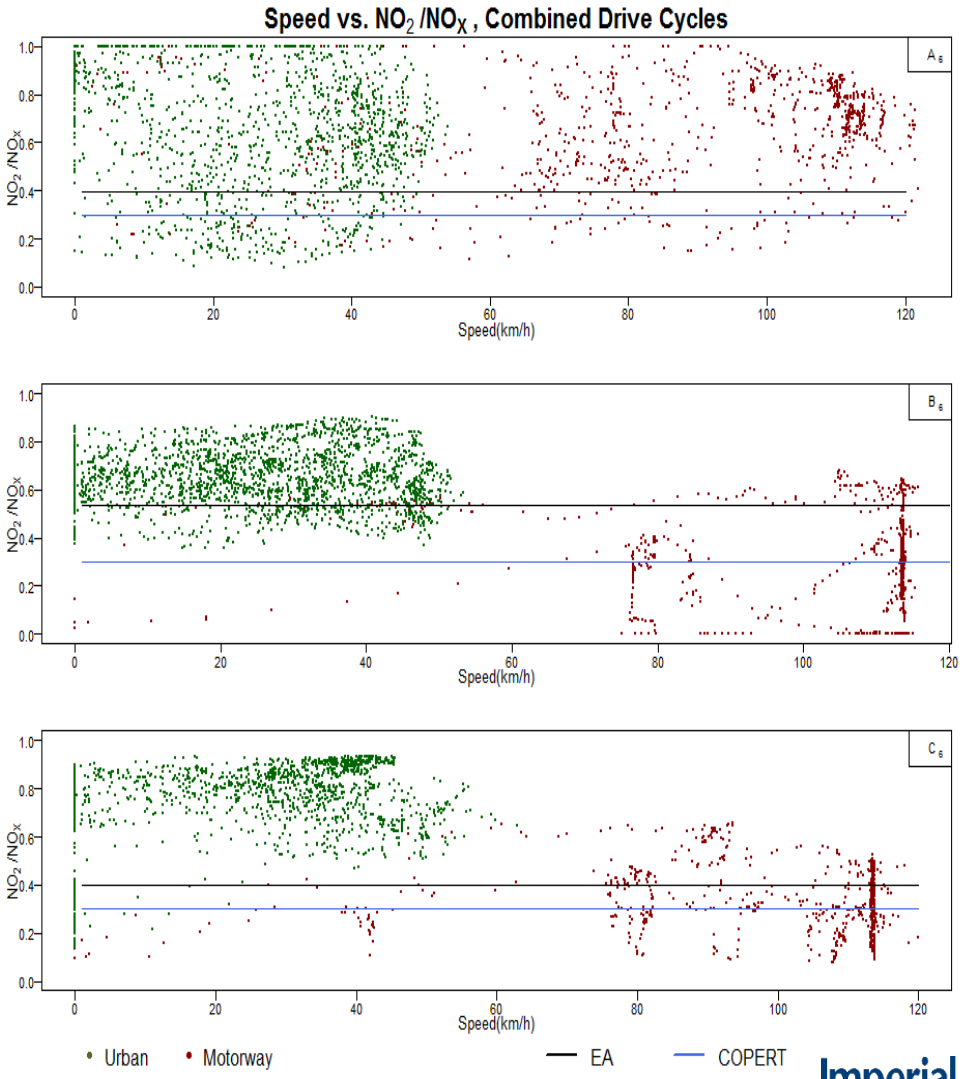
Variation in conformity factors Euro 6 diesel cars



NO_2/NO_x ratio as a function of speed

- No consistent relationship is found between NO_2/NO_x ratio and speed
- COPERT underestimates primary NO_2 emissions in urban areas where public exposure is greatest
- Some cars very high % of primary NO_2 in urban areas
- COPERT v4.11 assumes a ratio of 0.3 for diesel passenger Euro 6 cars



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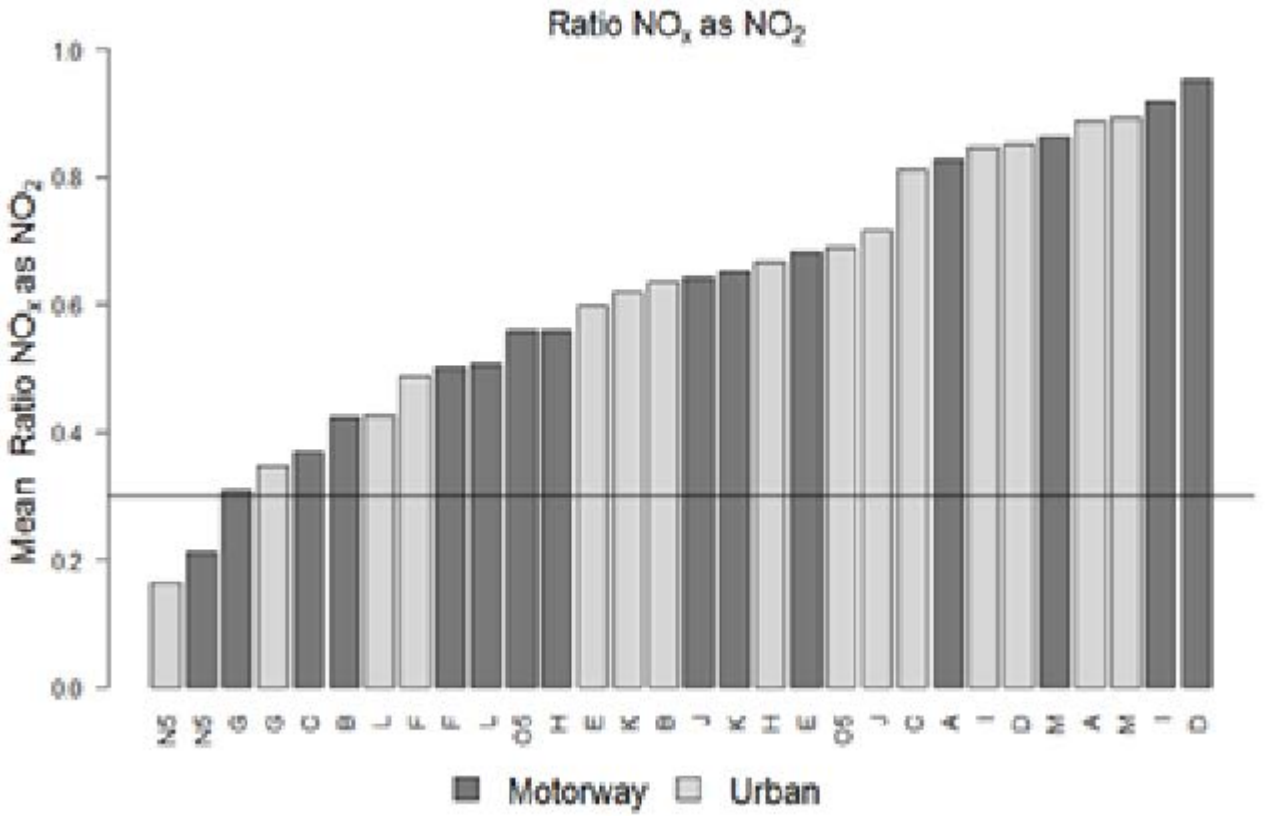
Average fractions primary NO_2: motorway/urban



Scenario analysis: road side NO_2

Assembly of urban roads: different traffic flows, vehicle mixes, speeds and background modelled by UKIAM/BRUTAL

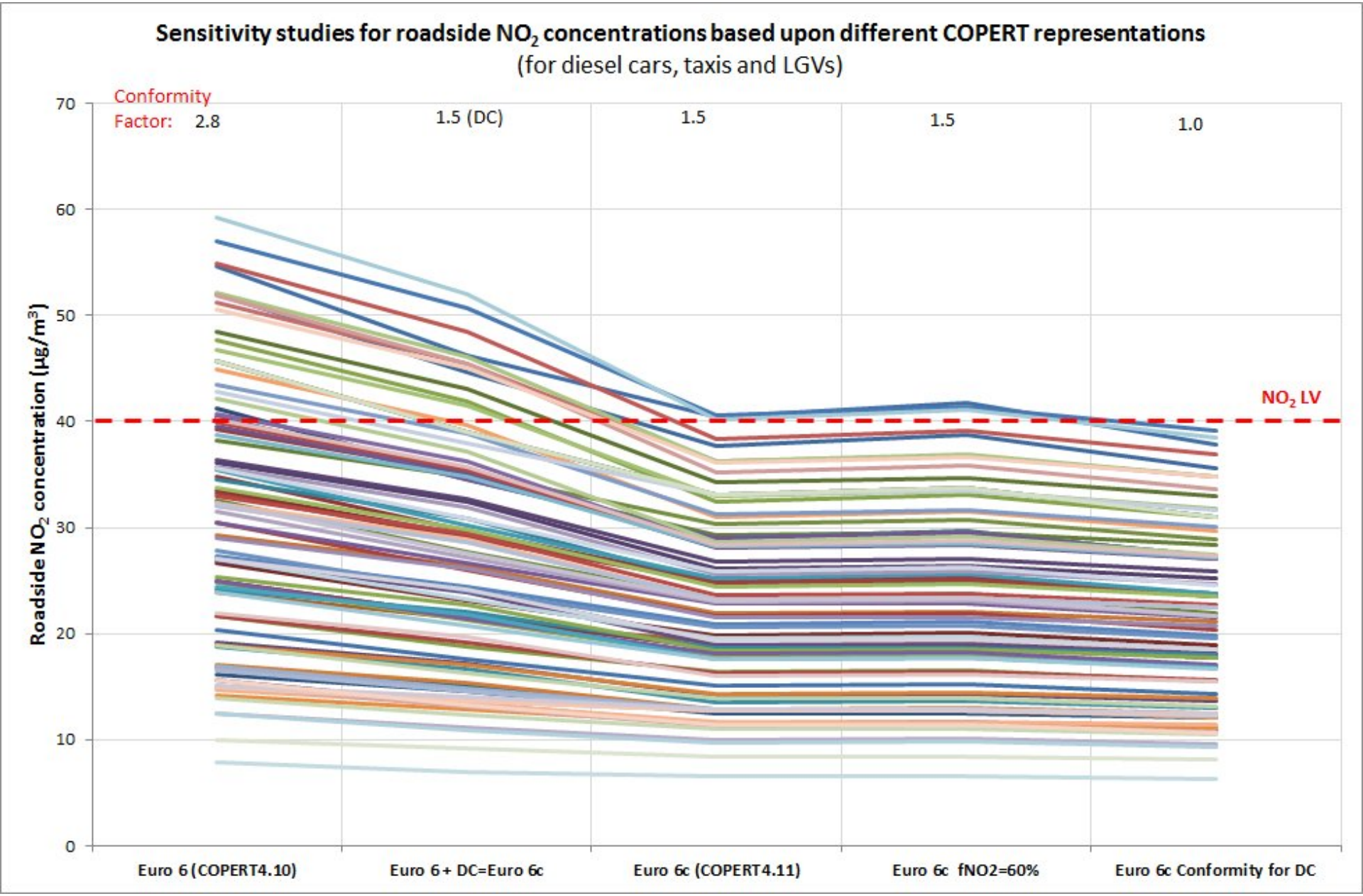
1. **Baseline assuming Euro 6a emissions from COPERT 4.10.**

2. **Diesel cars in 1 changed to Euro 6c emissions from COPERT 4.11**

3. **All diesel cars, taxis, LGVs with Euro 6c emissions COPERT 4.11**

4. **As 3 but with higher fNO2 of 0.6 instead of 0.3**

5. **As 3 but assuming further scaling of diesel emissions to CF =1.0**


Sensitivity studies for roadside NO2 concentrations based upon different COPERT representations
(for diesel cars, taxis and LGVs)
Conformity Factor:
2.8
1.5 (DC)
1.5
1.5
1.0
Roadside NO2 concentration (µg/m3)
70
60
50
40
30
20
10
0
NO2 LV
Euro 6 (COPERT4.10)
Euro 6 + DC=Euro 6c
Euro 6c (COPERT4.11)
Euro 6c fNO2=60%
Euro 6c Conformity for DC

Conclusion: big concern about future Euro 6

Further work

PEMS: differences in control technologies
other vehicles including hybrids
driver behaviour, stop-start, congestion
comparison instantaneous emission models e.g. PHEM, EnViVer,AIRE

UKIAM/BRUTAL: preliminary results->
NO_2 sensitivity studies for selection of roads, including modelling of roadside NOx/NO_2 relationship, canyon effects etc.
Microscale modelling junctions etc.