Evaluation of the BRUTAL/UKIAM model at urban background and road-side sites & sensitivity to changes in emission projections

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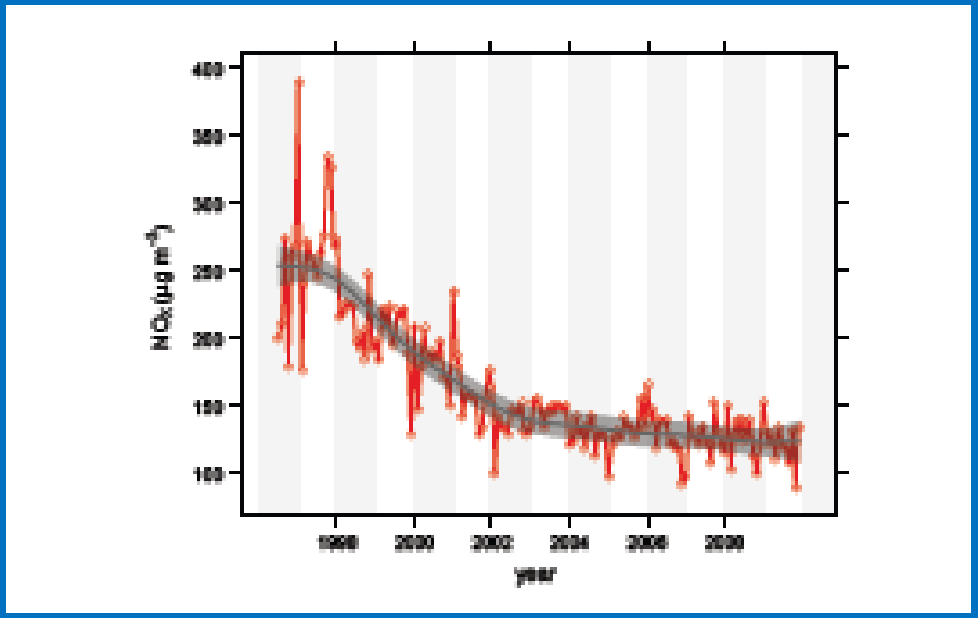
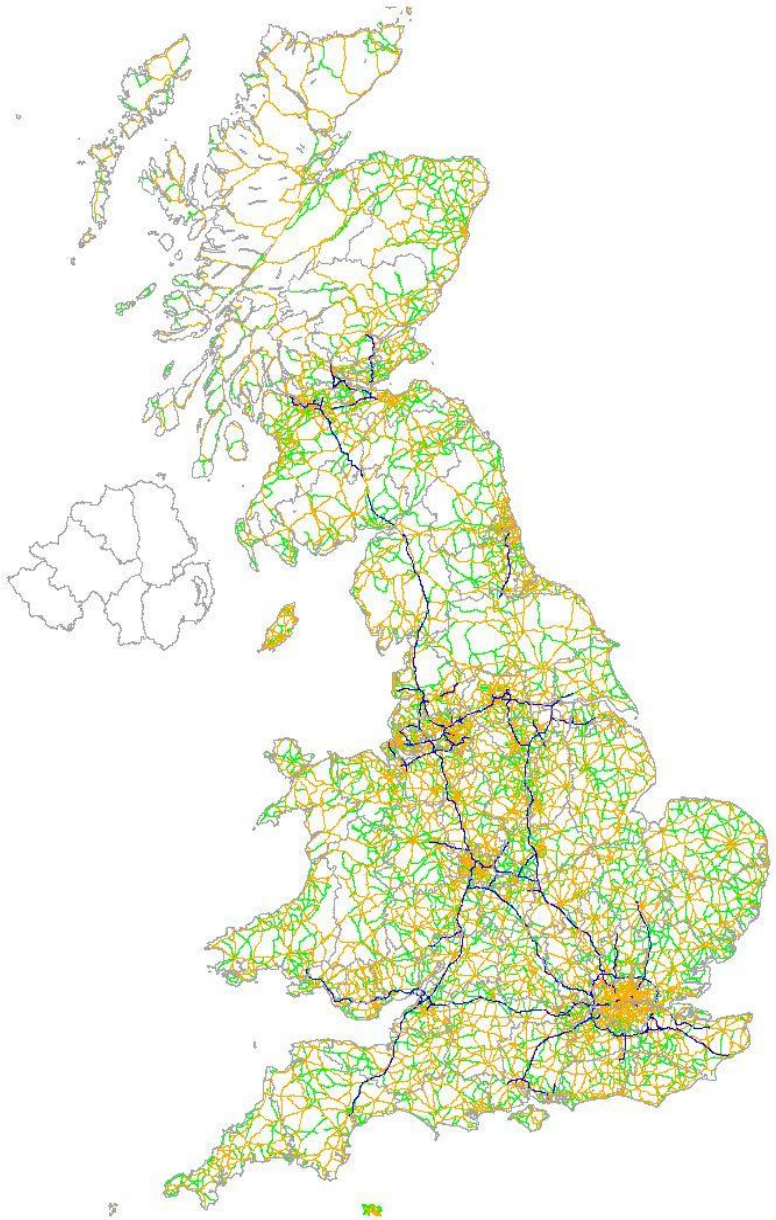
“Concentrations of NOx and NO2 in the UK have not decreased as anticipated.”



1. **Modelling of urban background & road-side concentrations**

2. **Application to effect of evolving emission estimates of NOx and primary NO2 on exceedance of AQ limit values**

3. **Recent real world measurements, future questions, and challenges to 2020 and beyond**

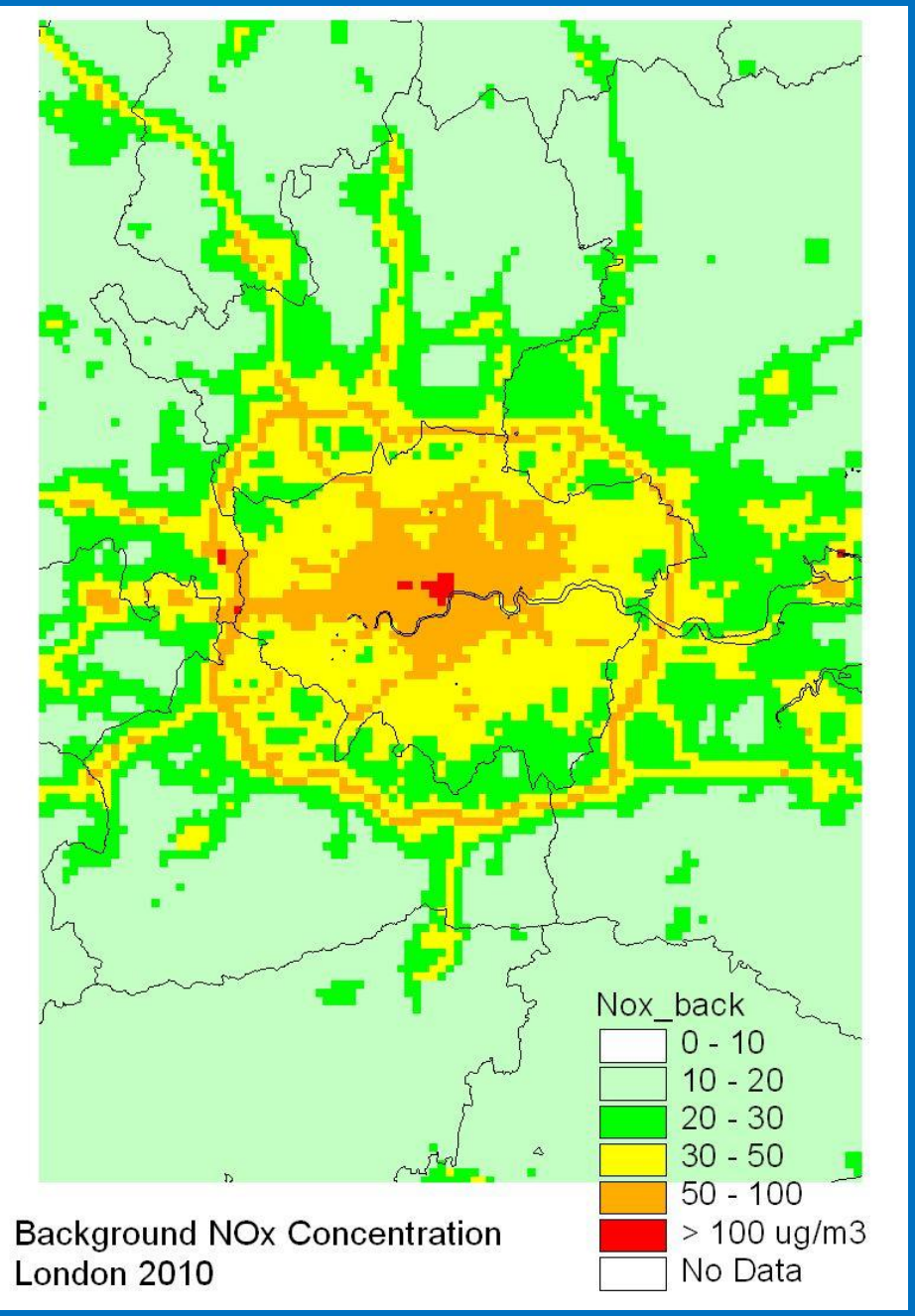


BRUTAL model:

Builds up emissions road by road for UK road network

Speed dependent emission factors
+ vehicle mix and age
+ traffic flow

Street canyon characteristics determined by population density -> calculation of road-side concentrations



Background concentrations

Emissions on 1x 1 km grid for NOx from road transport and for other UK sources

Dispersion based on PPM Gaussian model for point, area and volume sources

Also imported contributions e.g. Shipping from emissions on 5x5 km grid for sea areas surrounding UK

		α-NO2
Petrol cars and LGVs	**Pre-Euro 1**	**0.04**
	Euro 1	**0.04**
	Euro 2	**0.04**
	Euro 3	**0.03**
	Euro 4	**0.03**
	Euro 5	**0.03**
	Euro 6	**0.02**
Diesel cars and LGVs	**Pre-Euro 1**	**0.11**
	Euro 1	**0.11**
	Euro 2	**0.11**
	Euro 3	**0.25**
	Euro 3 with DPF	**0.35**
	Euro 4	**0.55**
	Euro 5	**0.5**
	Euro 6	**0.5**
HGVs and buses	**Pre-Euro I**	**0.11**
	Euro I	**0.11**
	Euro II	**0.11**
	Euro III	**0.14**
	Euro IV	**0.14**
	Euro V	**0.1**
	Euro VI	**0.1**
Motorcycles	**All**	**0.04**

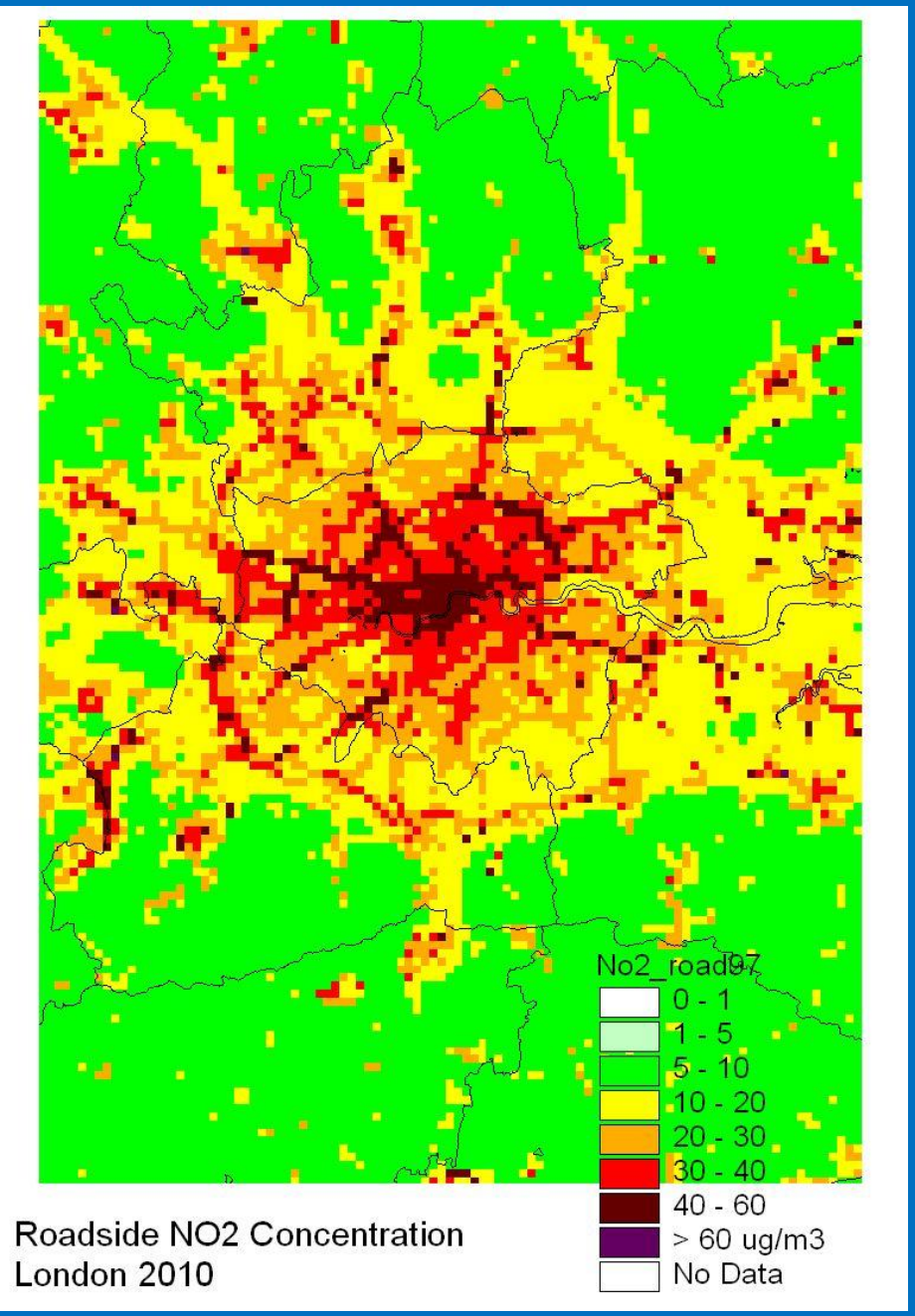
Primary fraction of NOx as NO2

10 years ago taken as ~5 to 10 %

But now ~20% on many roads

-> primary NO_2 emissions calculated in parallel with Nox

+ sub-model allowing for fast chemistry distinguishing between rural, suburban, urban background and road-side sites to derive NO_2 concentrations *(uncertainty range to allow for high and low photo-oxidant /ozone years)*



Road-side exceedance of AQ limit value for annual NO_2- 40 μg/m3

Identify 1x1 km squares where combination of busiest road plus background concentrations > limit value.

Other roads in these squares may intersect, so assume may also have local exceedance.

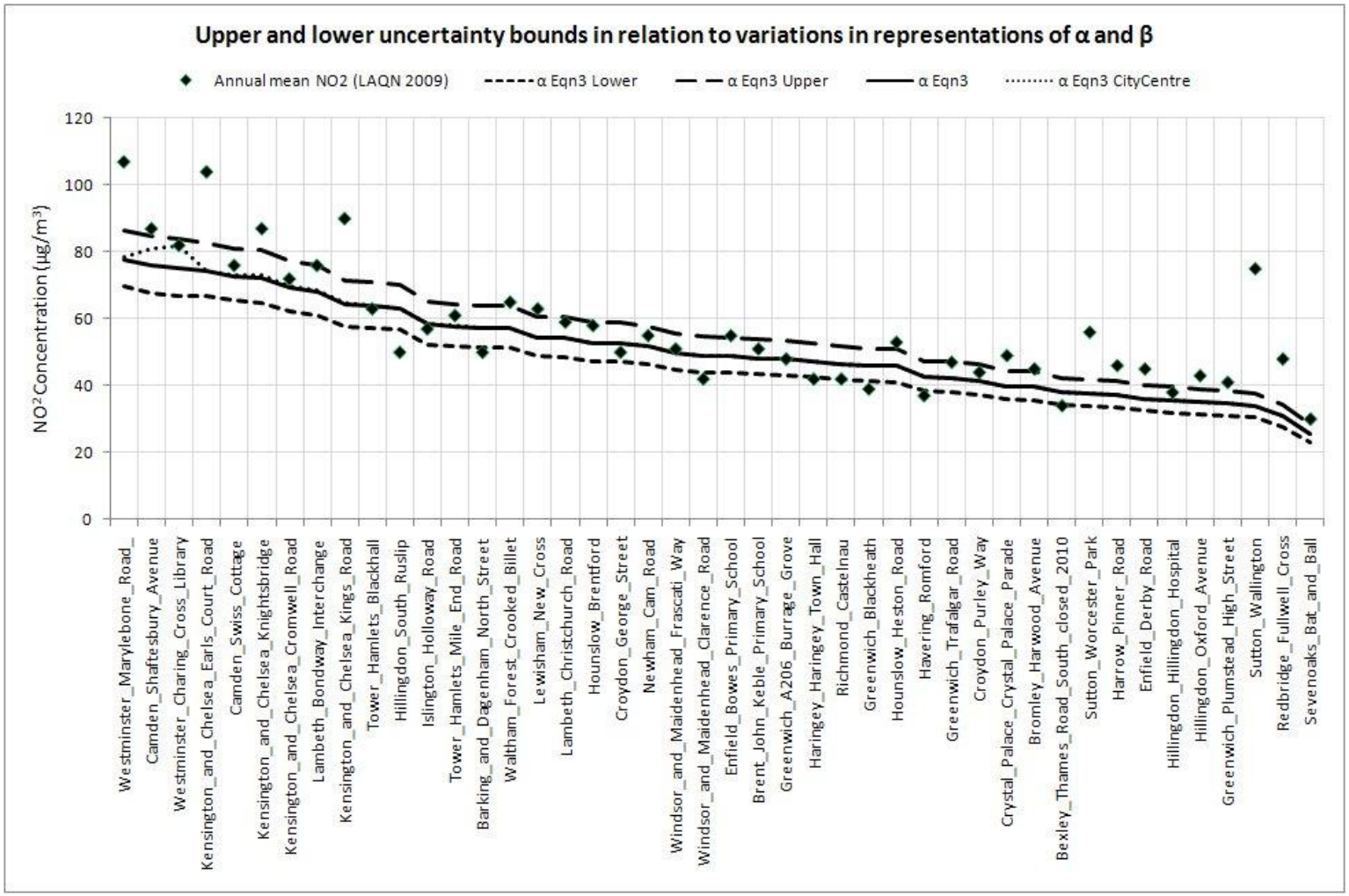
Sum total road lengths in squares identified as indicator for "at risk of exceedance" –

may be pessimistic-> more detailed modelling

But may underestimate for junctions and stop-start traffic

Submitted urban modelling NO2 and PM10 to Defra model inter-comparison

Included updated modelling of road-side NO2



	Current	Original
Petrol car	42.8	116.5
Diesel car	69.7	14.3
All cars	*112.5*	*130.8*
Petrol LGV	2.8	1.0
Diesel LGV	38.6	11.3
All LGV	*41.4*	*12.3*
Artic HGV	79.5	58.8
Rigid HGV	63.7	45.9
All HGV	*143.2*	*104.7*
Buses	33.3	28.3
M Cycle	1.5	0.5
All DERV	*285*	*158*
All petrol	*47*	*118*
TOTAL	**332**	**276**

Estimated UK emissions of NOx in 2010 have changed over the last decade

Lower from petrol but much higher from diesel

Expectations of Euro standards not realised + greater trend to diesel cars than anticipated

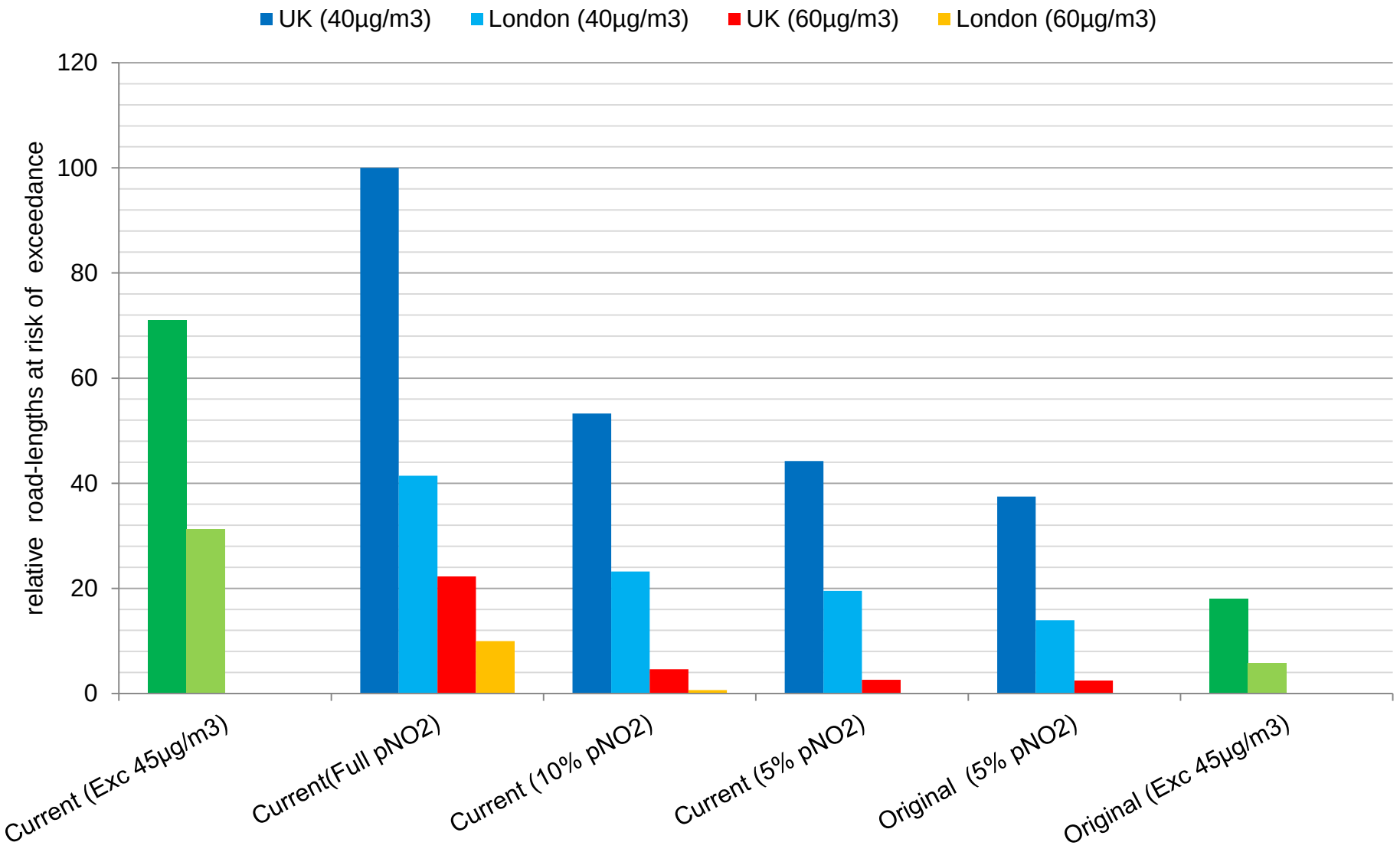
scenarios for 2010

1) **Current estimates of NOx and revised fractions as NO_2**

2) **Current estimates of NOx and**
   - **a) 10% as primary NO_2**
   - **b) 5% as primary NO_2**

3) **Original estimates of NOx and 5% as primary NO_2**

Comparison of BRUTAL for current estimates and past projections for 2010

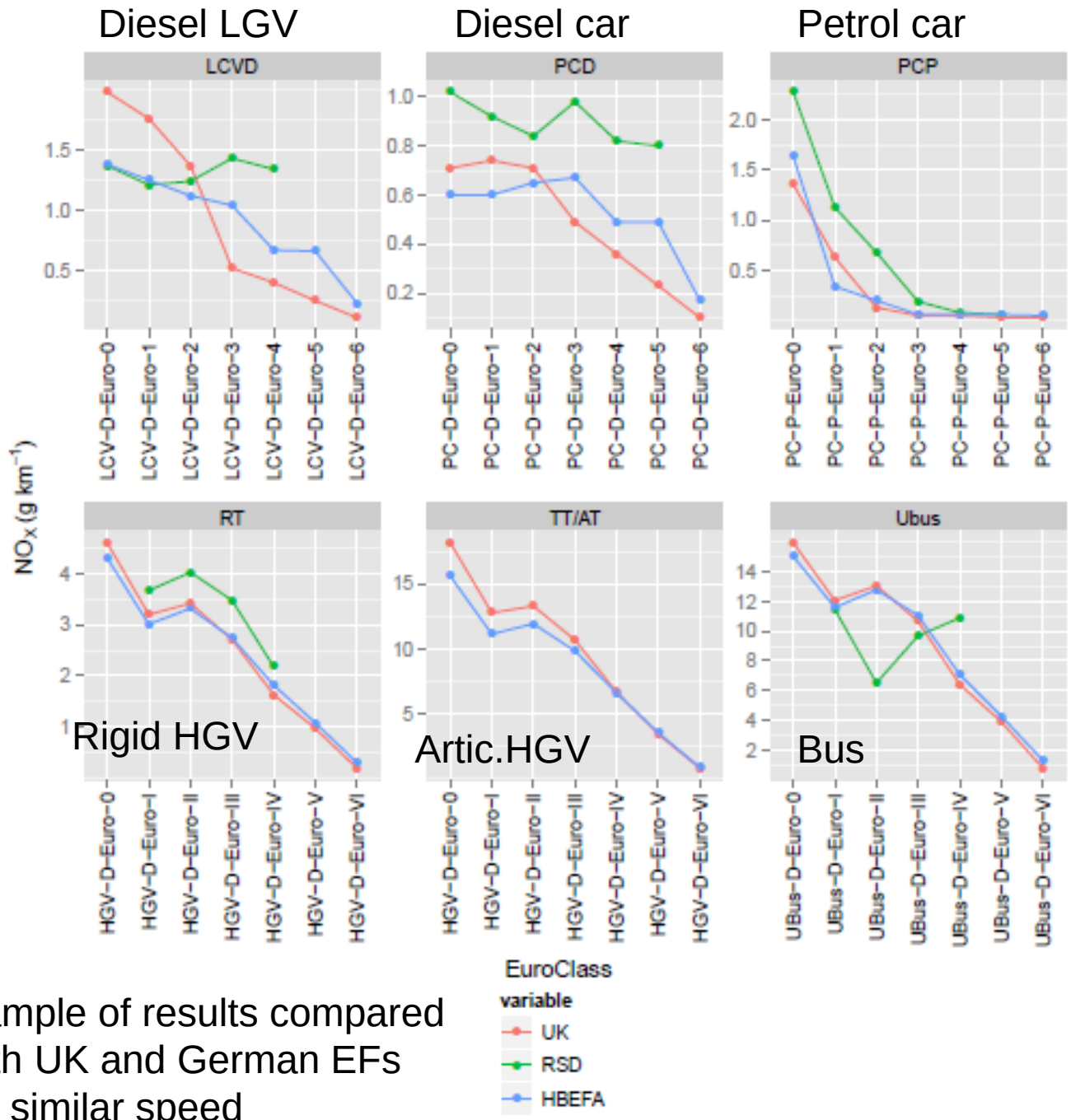


Real world measurements raising further questions:-

Emissions data from ~72000 vehicles by remote sensing (representative of urban speeds and locations)

Report (draft) : Trends in NOx and NO_2 emissions and ambient measurements in the UK. Leeds University, Kings College London, and AEA Technology

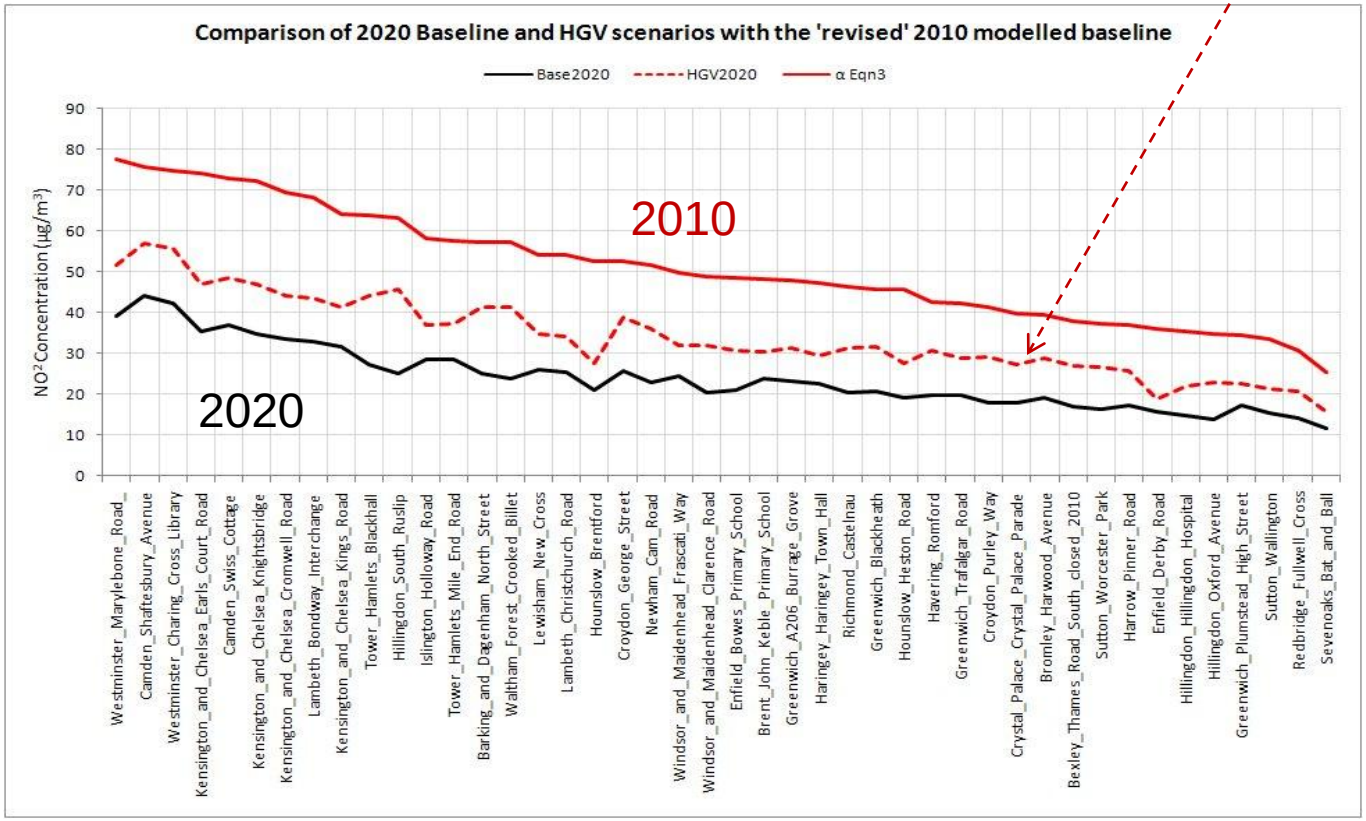
See UK Air Information Resource(UKAIR) web-site: http:UK-air.defra.gov.uk/



Sample of results compared with UK and German EFs for similar speed

? What about future projections to 2020?

? HGV V and VI?



SUMMARY

NOx emissions/concns have not decreased as expected

Primary NO2 fraction increased

Combined effect-> greater NO_2 concns. And exceedance AQ limit values

FURTHER WORK

Review emission factors, ? Degradation-> more scenarios

$PM_{2.5}$ and population exposure in agglomerations