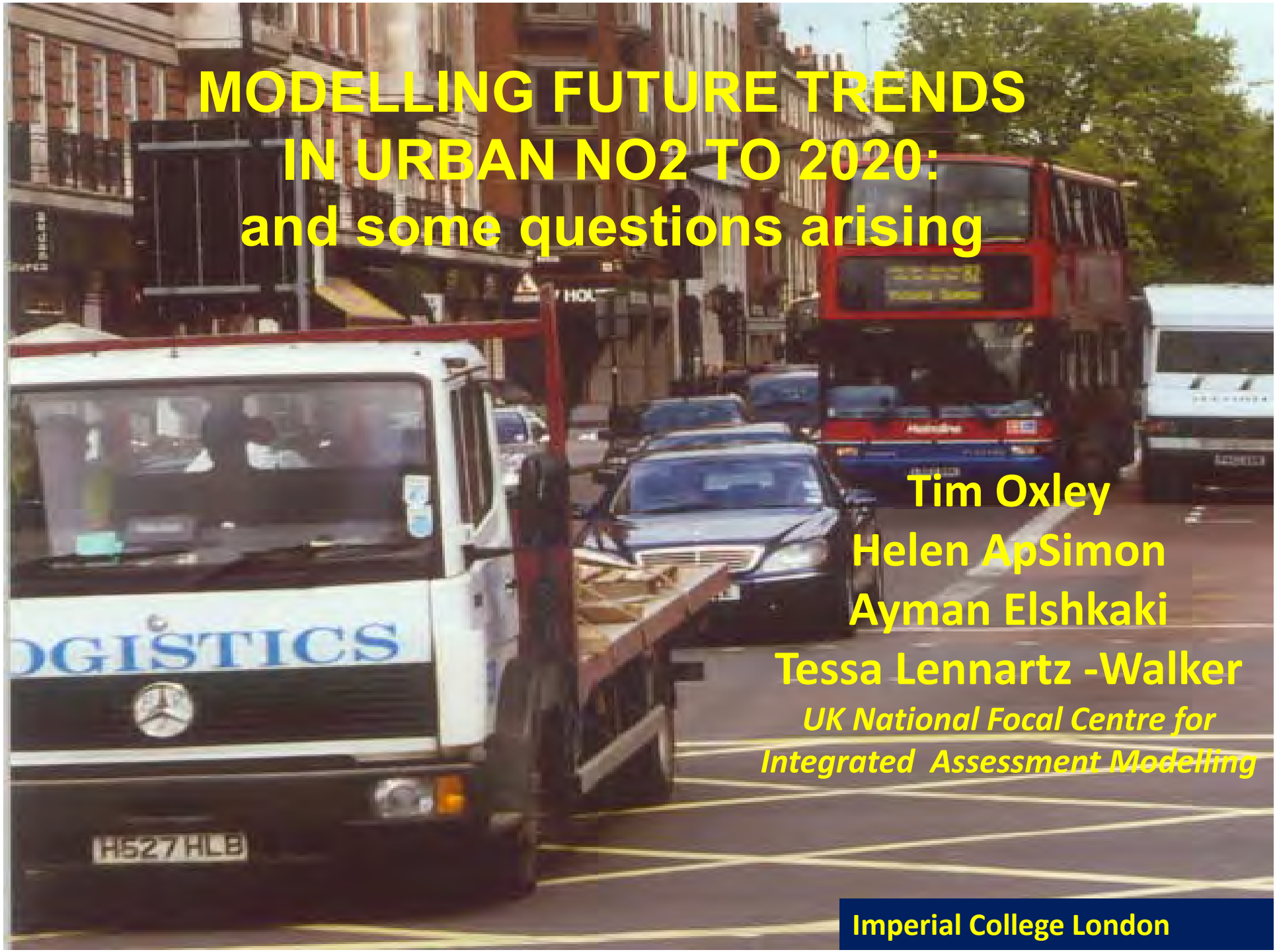


# MODELLING FUTURE TRENDS IN URBAN NO2 TO 2020:
## and some questions arising

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# Primary NO2 fractions (based on NAEI)

| | | 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 |

| Source | α-NO2 |
|---|---|
| Rail | 0.15 |
| Off-road (diesel) | 0.15 |
| Off-road (petrol) | 0.04 |
| Shipping | 0.15 |
| Aviation (LTO) | 0.14 |
| Aviation (cruise) | 0.15 |
| Nitric acid production | 0.605 |
| Chemical industry - nitric acid use | 0.605 |
| Stationary combustion | 0.05 |

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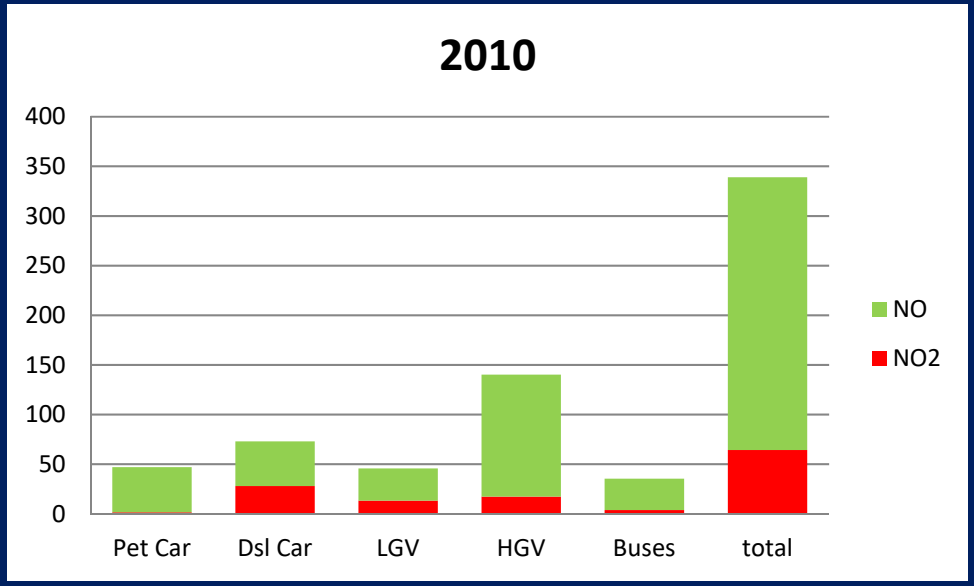
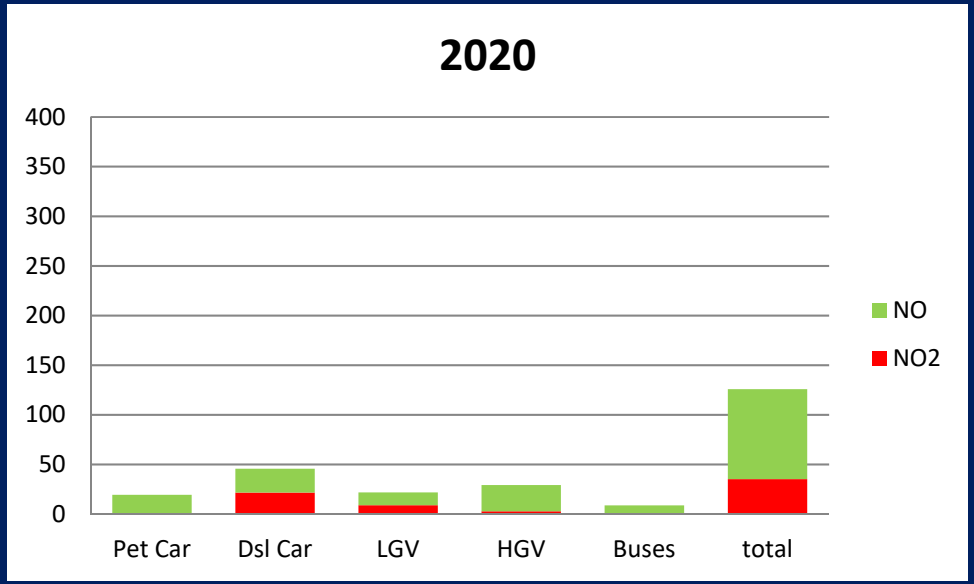



**Road transport kt NOx**

**Reduces substantially from 2010 to 2020**

**But primary NO2 portion reduces less ~ 28 % in 2020**

***NB uncertainty real world NOx from HGVs e.g. TNO report : EuroV 3 times higher than projected in city driving conditions. (? Euro VI test cycle)***

# BRUTAL (UKIAM)-> modelling of urban air quality

*Road-side increment NOx, primary NO2*

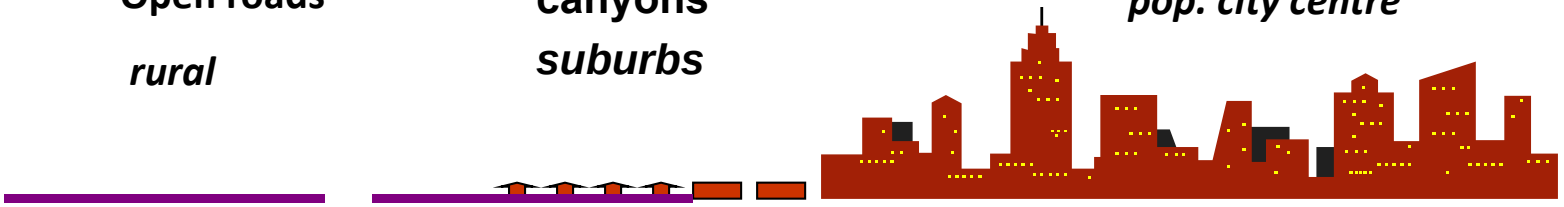
Open roads

*rural*

shallow canyons

*suburbs*

deep street canyons *dense pop. city centre*



Emissions each UK road link NOx,NO2,PM,CO2 etc *(iMOVE)*

Traffic flow, ave speed, vehicle mix+ data base emission factors

Grid 1x1 km emissions road transport

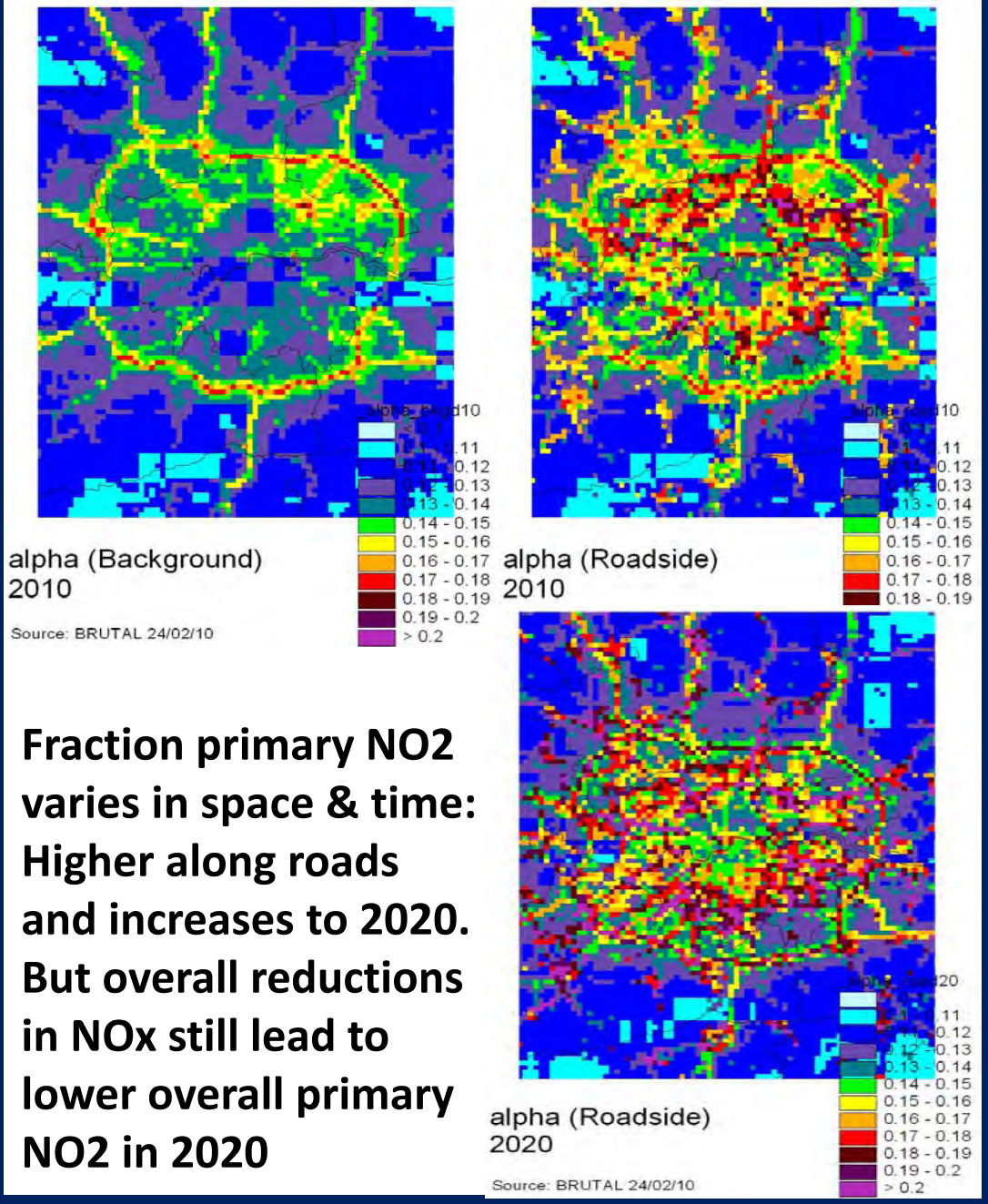
***Superimpose on background concentration NOx, primary NO2 from UK sources***

PPM model

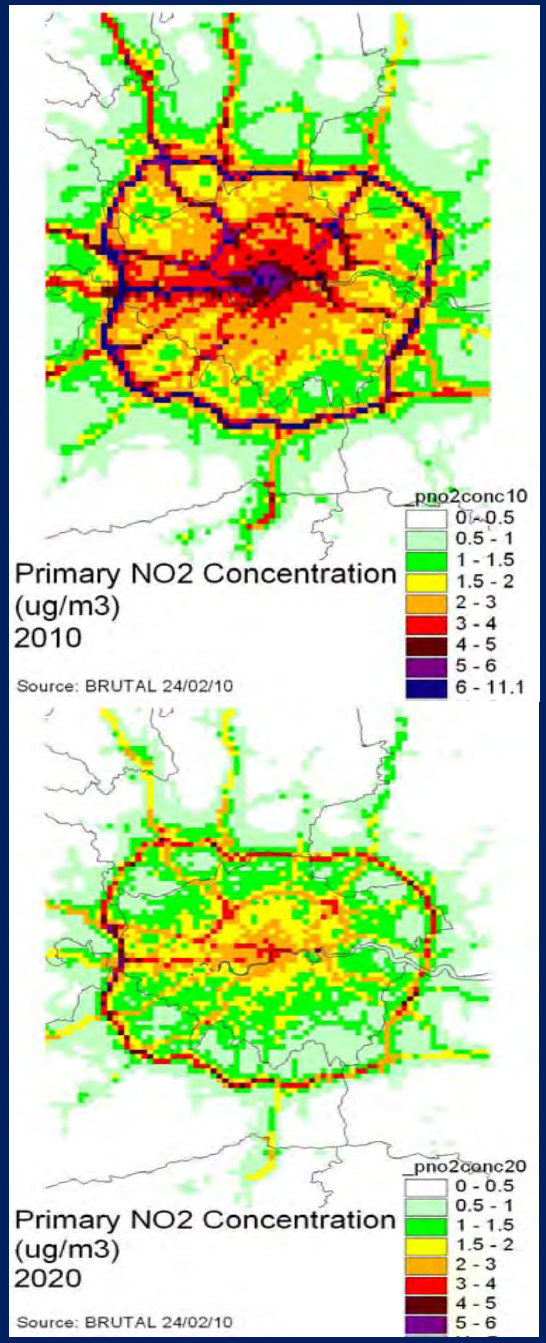
Other UK emissions

***Add contributions imported from non-UK sources including shipping***

***Calculate NO2 concentrations from total NOx allowing for primary ($\alpha$) frac***




**Fraction primary NO2 varies in space & time: Higher along roads and increases to 2020. But overall reductions in NOx still lead to lower overall primary NO2 in 2020**



# Relationship between NO2 and NOx concentrations -> secondary NO2 formation

**Rural/suburban:** ***time for equilibrium fast chemistry->"photostationary state"***

**Roadside:** ***adjust for short-time for chemistry to increase NO2***

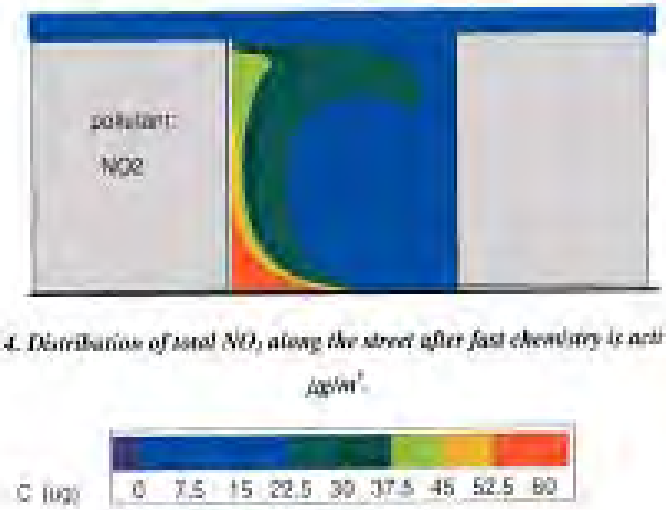
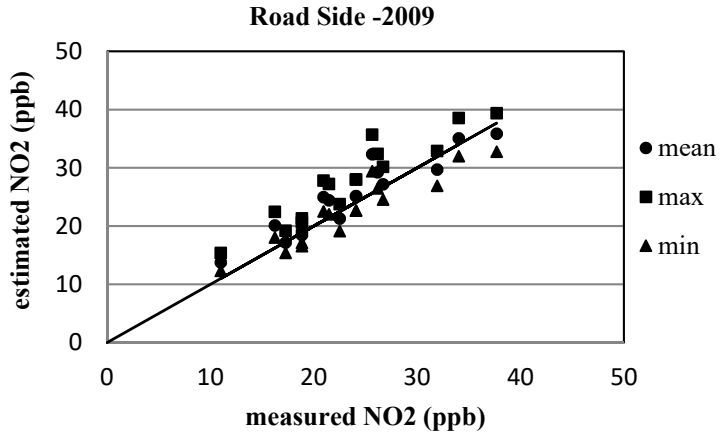


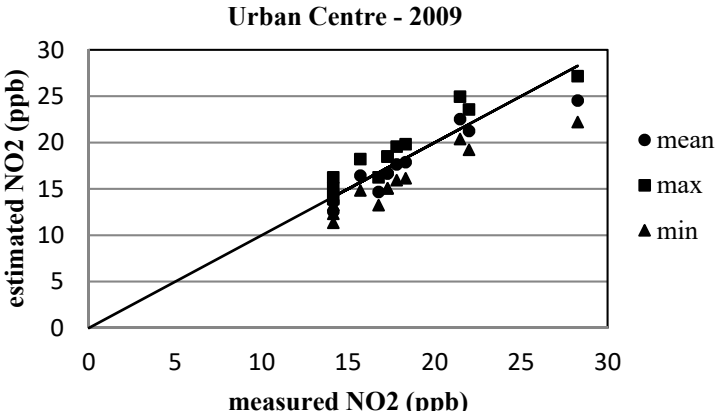

*Figure 5.4. Distribution of total NO, along the street after fast chemistry is activated C in ug/m³.*

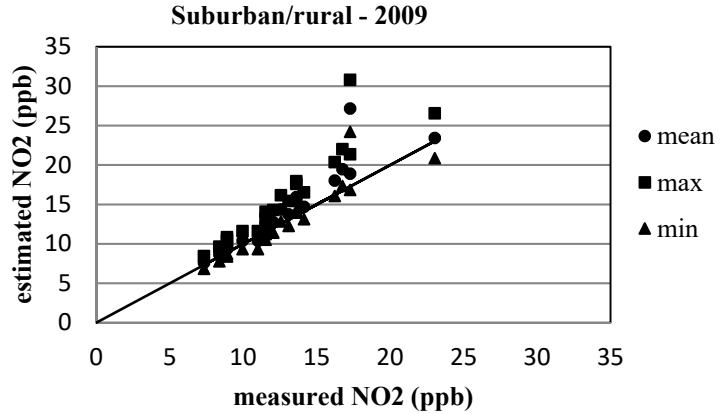
**Urban centre (background) :**
***intermediate case***

***Also allow for interannual variations; high and low ozone/oxidant***

***→Alternative approach to Jenkin et al empirical relationship. Quadratic equation for NO2 as a function of NOx, with parameters dependent on location (roadside etc), primary NO2 fraction , background oxidant/O3 -> best estimate and high and low values***



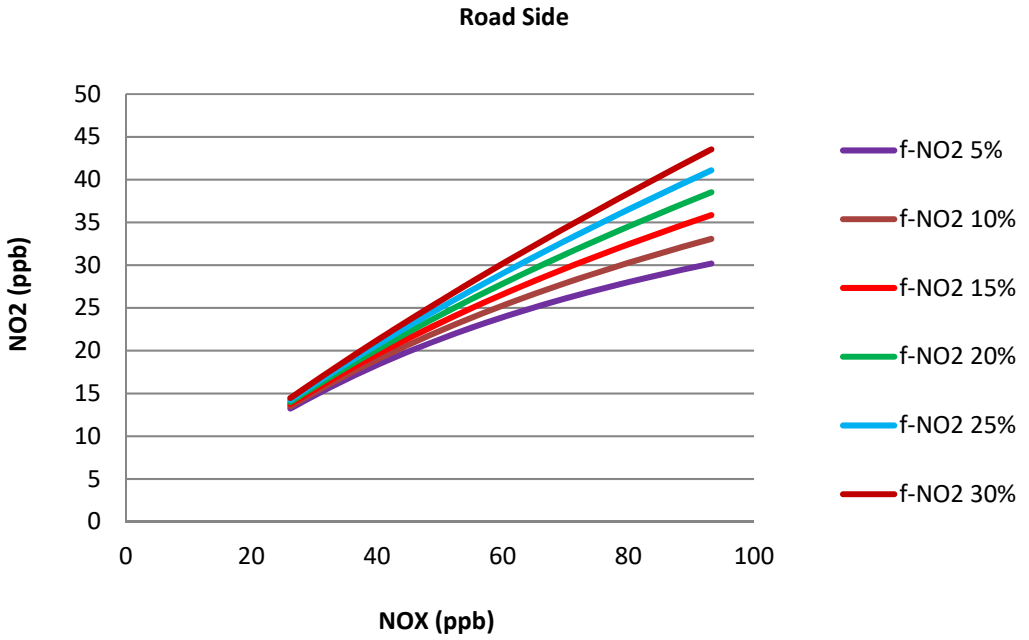



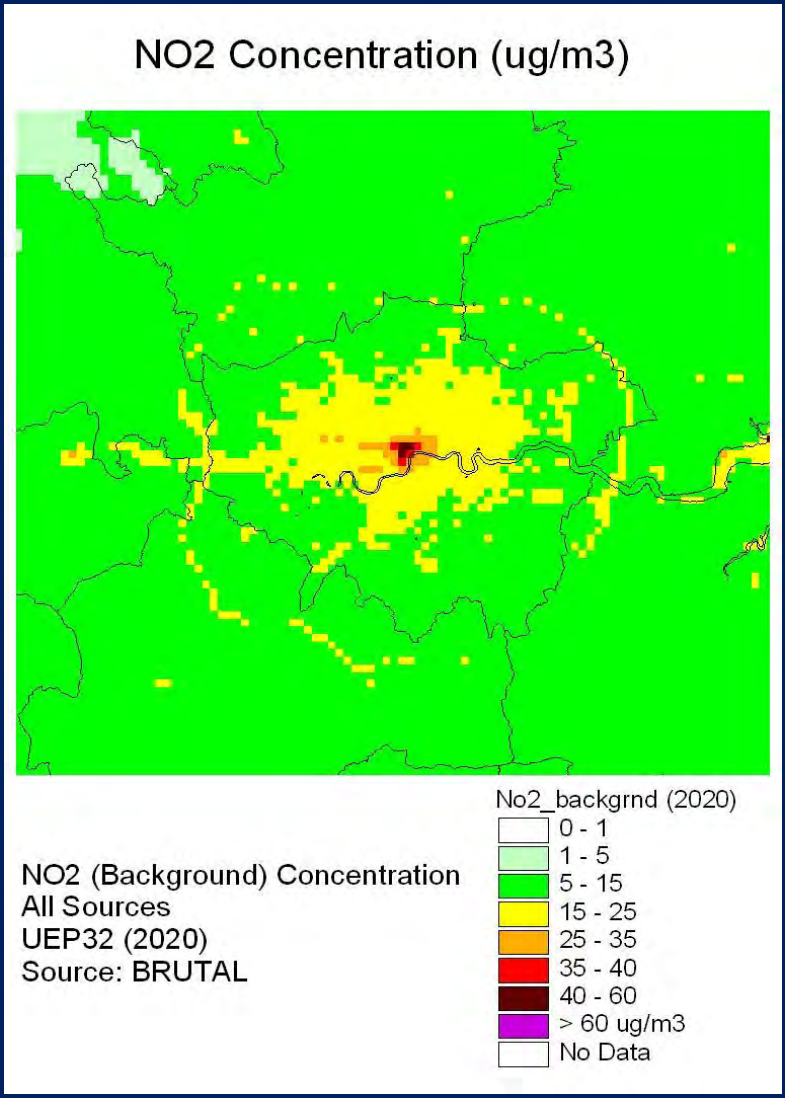




Compared against data 2005, 2009,2010

Generally represents measured data well (i.e.within min-max range) except for occasional sites where pessimistic

Sensitivity of NO2 v NOx to primary fraction α



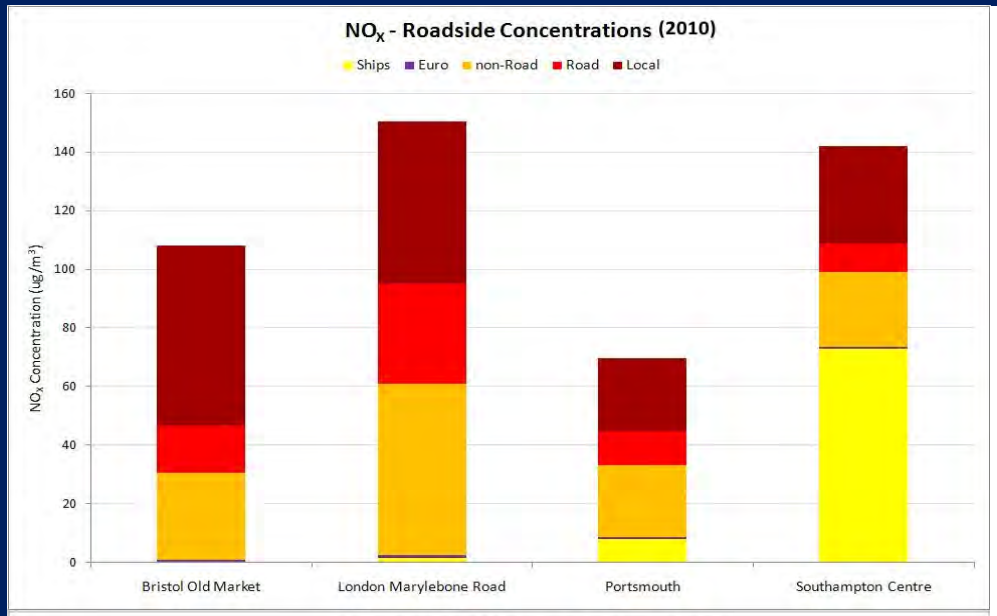


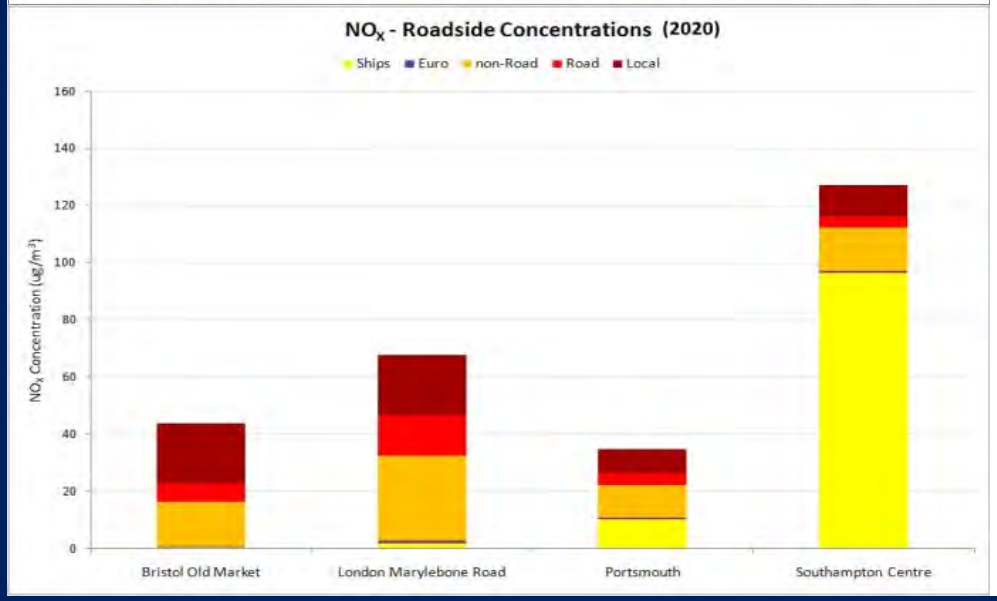

## Projections to 2020

**Big reduction in $NO_2$.**

**But still one or two roads close to AQ limit value.**

**Hence need to look at uncertainties- e.g. re HGV emissions.**




## SOURCE APPORTIONMENT

**Contributions from non-road sources reduce as well as from road traffic.**

**Imported contributions from non-UK emissions small except for some ports where shipping may be increasingly important: needs to be investigated with more detailed modelling**

## CONCLUSIONS RE FUTURE NO2

Projections imply large reduction in NOx and hence reduction in $NO_2$ despite increasing proportion primary $NO_2$ from traffic

Real-world measurements (e.g. TNO) imply higher NOx emissions Euro V HGVs (? and buses) in urban conditions than in current emission projections

For some ports shipping may be increasingly important

Model evaluation-> more uncertainty road-side concentrations where traffic mix crucial