



**Atmospheric
modelling**

**Environmental
impacts**

An update on integrated assessment activities in Europe

NECD

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CLRTAP

**Projected emissions
SO₂, NO_x, NH₃,
VOCs, PM, GHGs**

**Potential
abatement
strategies**

Revision of EC's NECD and UNECE Gothenburg protocol

Linking up EC modelling activities

Current UNECE/IIASA scenarios/pollutants and status

Workshop on uncertainties

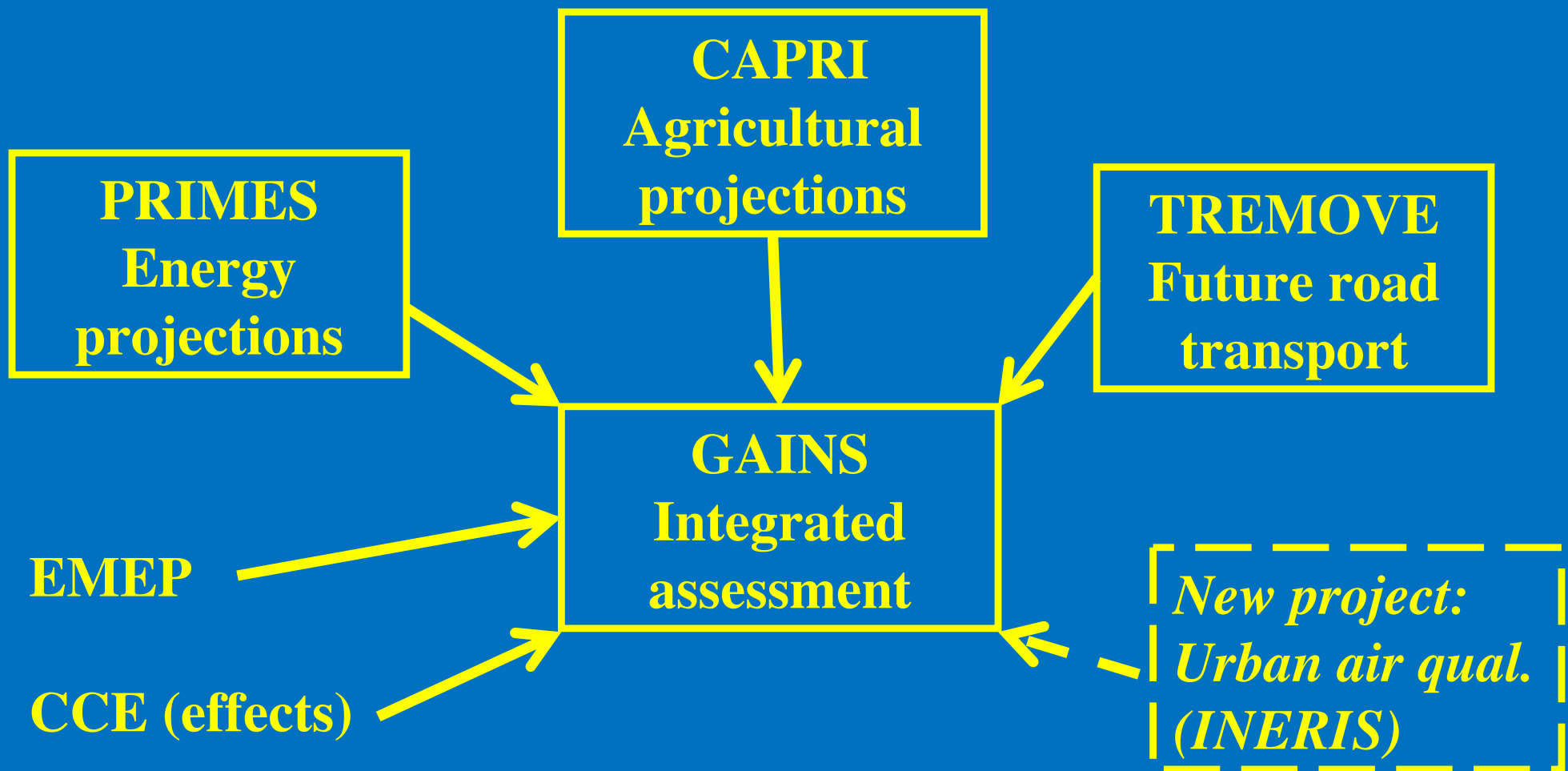
National scale IAM activities

Recent UKIAM work



EC4MACS (EC27 countries)

Project to develop and link EC modelling capabilities: _



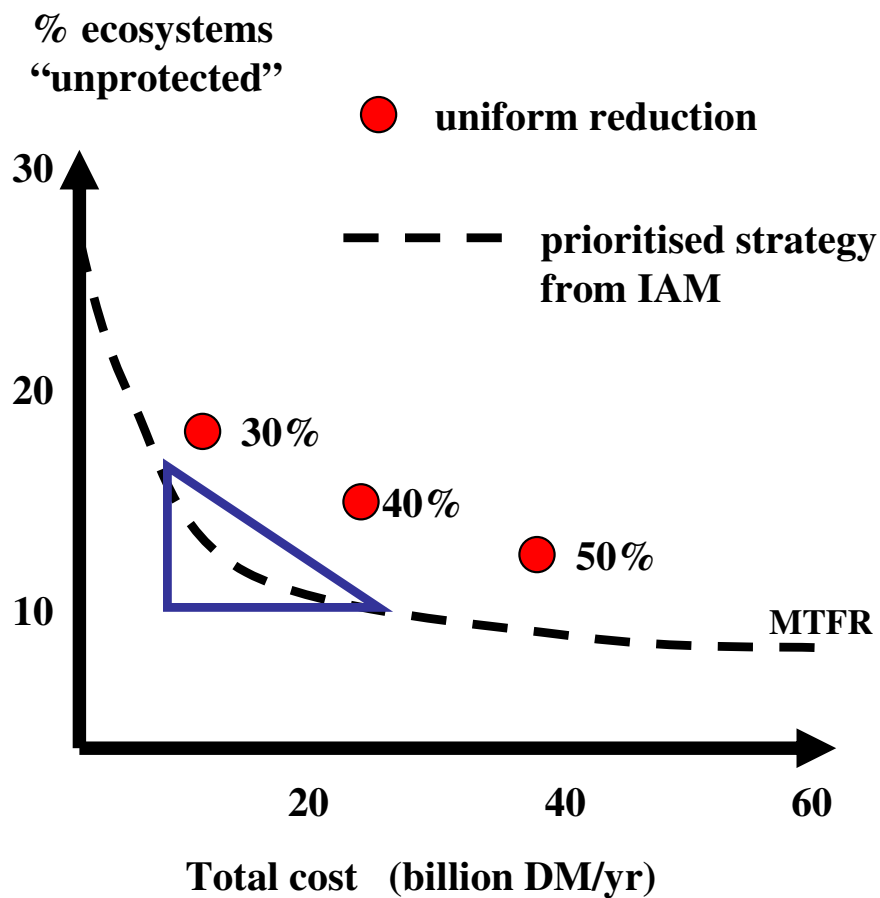
UNECE: Current scenario development

(Recent workshop to review uncertainties)

**Pollutants: SO₂, NO_x, NH₃, VOCs, PM_{2.5} (ceilings)
plus black/organic C and GHGs**

**GAINS scenarios: a) based on national projections
b) based on PRIMES and CAPRI projections**

*Current legislation (CLE), Current policy (CP),
Maximum technically feasible (MTFR)
→ Gap closure scenarios*



**Future emission ceilings
between CP and MTFR: but
where?**

**IAM to explore cost
effective intermediate
scenarios in this range**

**-> GAINS exploration of
least cost solutions to
achieve different
environmental targets/
levels of ambition**

How to set environmental targets for GAINS?

GAP closure options -> health, ecosystems etc

i) Uniform cap all countries (*e.g. months life lost PM*)

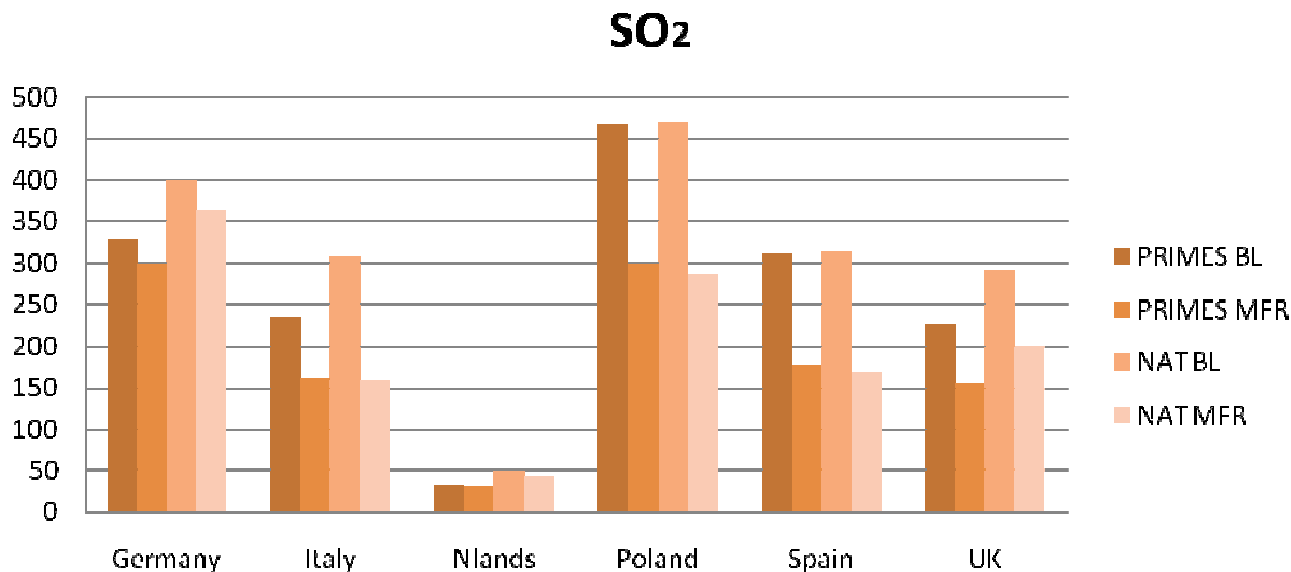
ii) Equal relative change all countries (*% improvement towards ultimate env. targets rel to base year e.g. 2000*)

iii) Gap closure between CP and MTR exceedances

There are problems with all these. OR

iv) Maximum improvement European scale (? *equity issues*)

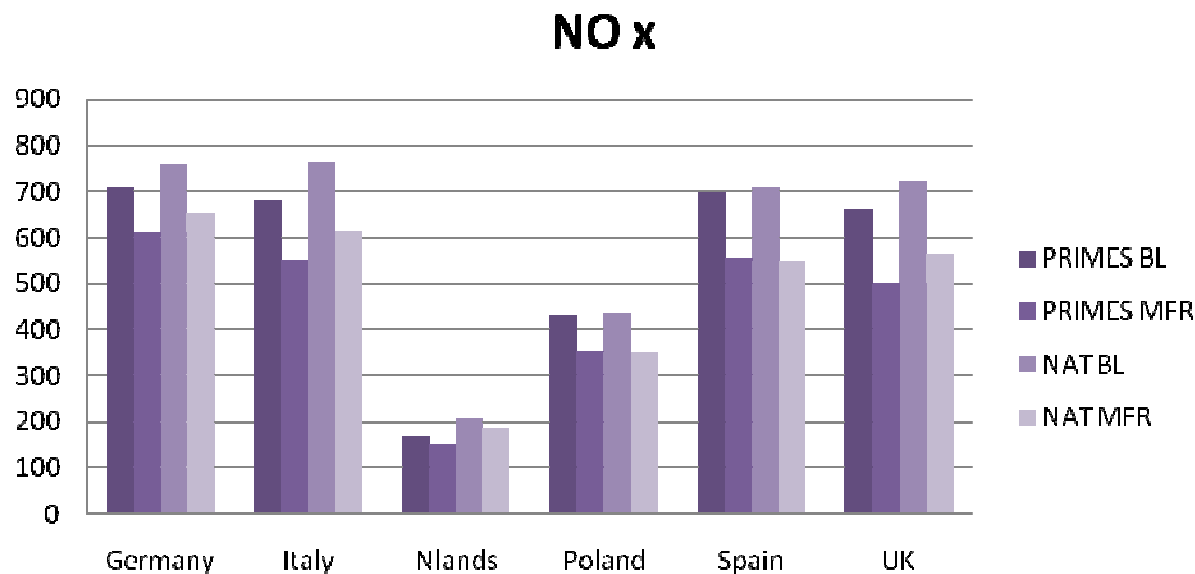
Future emissions SO₂ and NO_x



Similar emissions both national & PRIMES many countries.

BUT further reductions (baseline –MTR) smaller in comparison to totals

In some cases small or no overlap between range of emissions between scenarios.



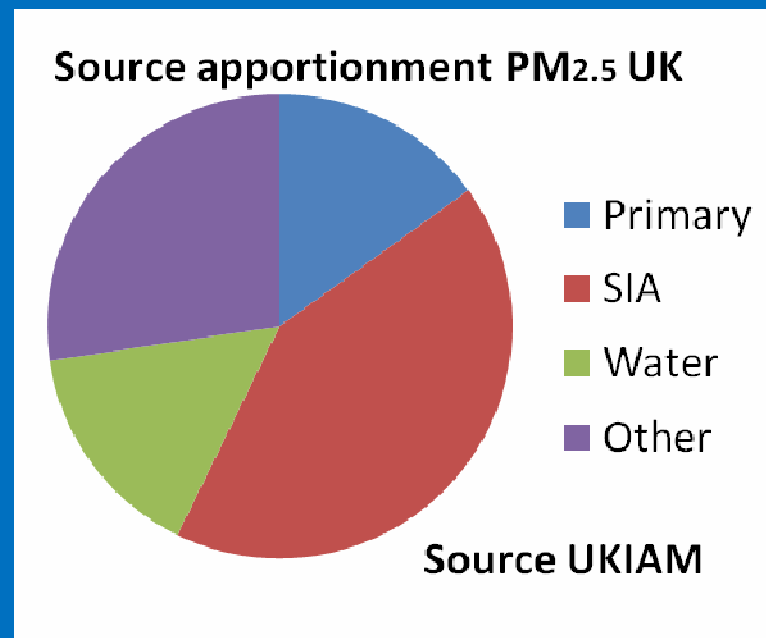
PM_{2.5} : targets health effects-> ceilings for primary PM_{2.5}

NB new EC objectives for urban popn. total PM_{2.5}

Uncertain/incomplete inventories

primary PM *e.g* *cooking, construction, road abrasion etc*

Primary only a fraction of total PM_{2.5}



Secondary SO₄,NO₃,NH₄:- cross-pollutant interactions, non-linearities. ? *How much is NH₃ a limiting factor? How much effect on health?*

Other components, SOA, mineral dust, water etc

Now need inventories for black C and organic aerosol too (radiative forcing, arctic snow)

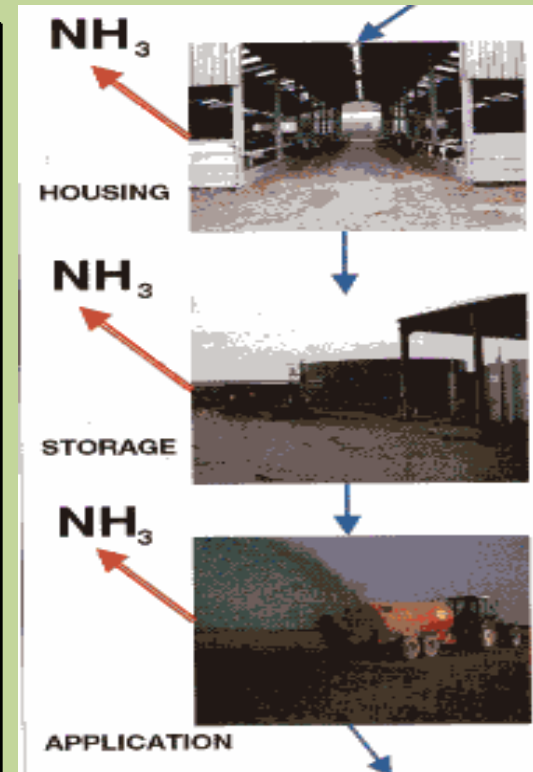
NH₃: TFRN workshop on abatement costs Oct 2010

NEW COST ESTIMATES LOWER; when as low as 1 eu/kgN then reduced need for fertilisers may make total cost zero or negative

Illustration from sub-group on spreading of slurries and manures:

-> spread sheet for costs with default values for key factors; transparent tool for use by countries, and by IIASA to use with GAINS modelling

High efficiency measures	Eu/kg NH ₃
Slurry application techniques (e.g. deep injection)	1-3
Immediate incorporation (arable only)	0.1 - 5
Medium efficiency	
Slurry application techniques (e.g. trailing shoe, hose)	1-7
Rapid incorporation <24 h (arable only)	0.3 - 9



Depends on TAN content of slurries and manure types. NB high efficiency can be cheaper but may be limited by applicability



National IAM activities -> TFIAM

www.niam.scarp.se

GAINS being applied in growing number of countries at national scale

Other countries independent IAM models e.g. UKIAM

Collaborative projects: e.g. Sweden and Russia

NB Next TFIAM is hosted by Sweden in 23-25 Feb 2011 with special session on IAM in EECCA countries

Next NIAM meeting at IIASA in March with focus on meeting urban air quality requirements, followed by joint meeting with EC4MACS partners

UKIAM (supported by Defra)

Aims: investigate scenarios that

i) Reduce emissions=> compliance with emission ceilings

ii) Reduce exceedance of critical loads for ecosystem protection

iii) Reduce human exposure re human health

iv) Achieve compliance with air quality legislation

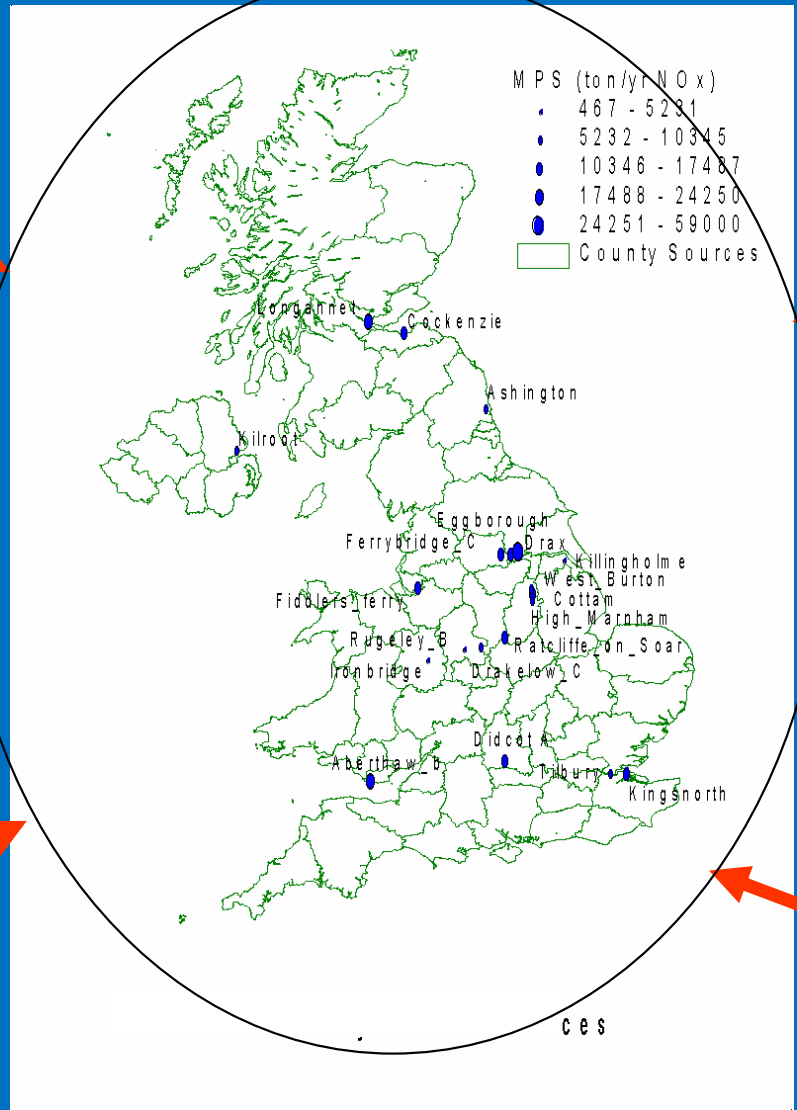
v) Are cost-effective

UK Integrated Assessment Model (UKIAM)

UK SOURCES
Projected UK emissions:
AEA (NAEI)
+DECC, DfT etc

Mitigation measures and costs
ENTEC
IGER/AEA

SHIPPING
AEA/ENTEC

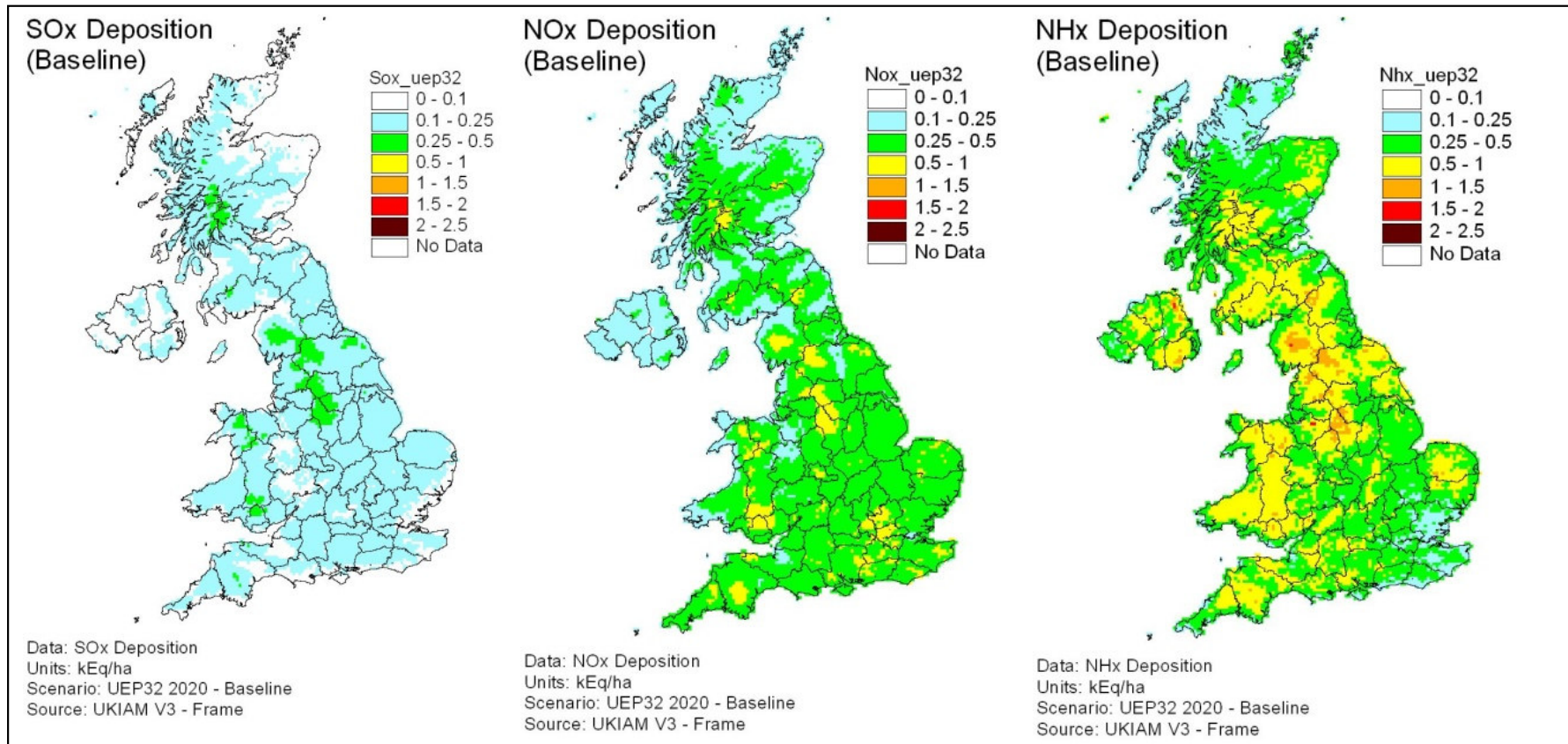


ATMOSPHERIC MODELLING:
FRAME(CEH)
PPM(Imperial)
BRUTAL (Imperial)
Imported: EMEP
+ ASAM tool
Global: Met Office

ENVIRONMENTAL CRITERIA:
Ecosystems: CEH
Human health &
Urban air quality
GHG emissions

Integrated analysis of either specified scenarios, or optimised selection of measures converging to achieve environmental criteria at least cost

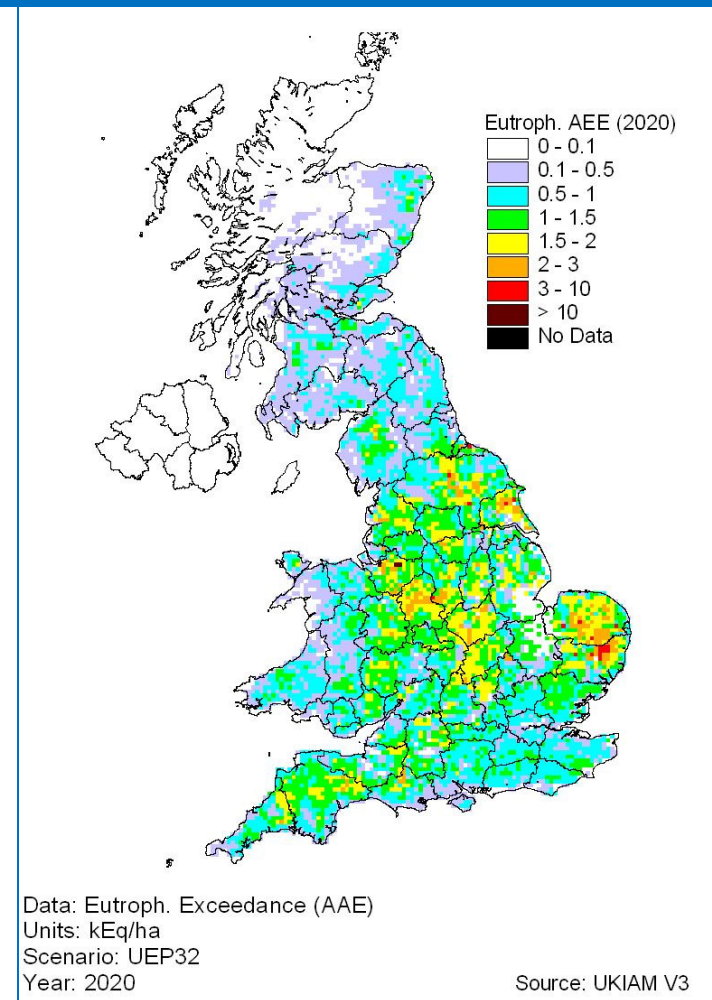
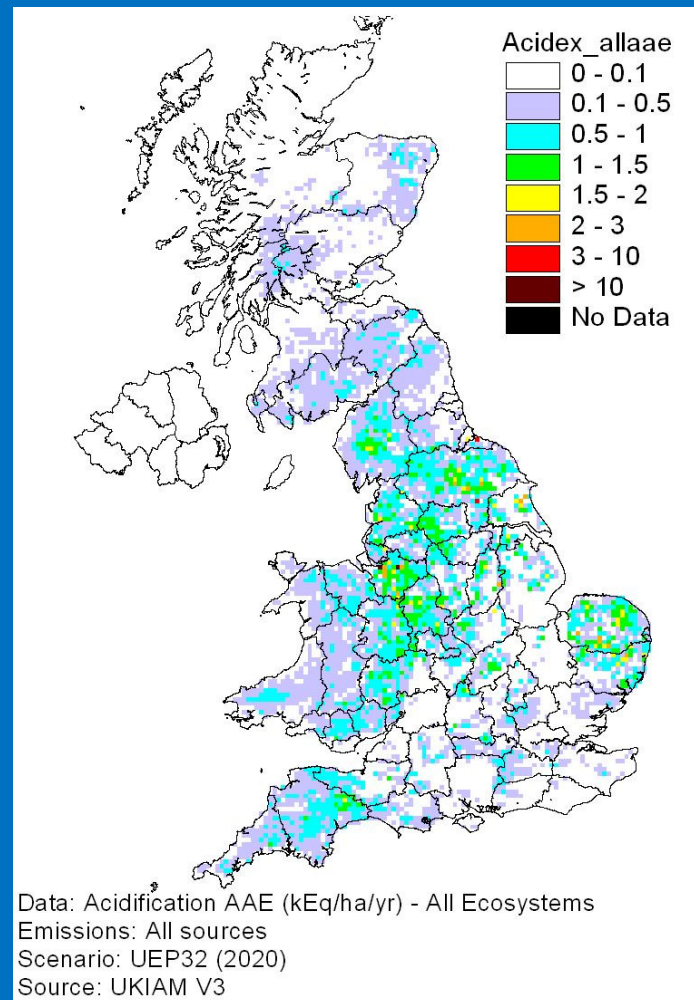
Forecast future deposition: acidification units keq/ha baseline scenario 2020 (UEP32+BAUIII)



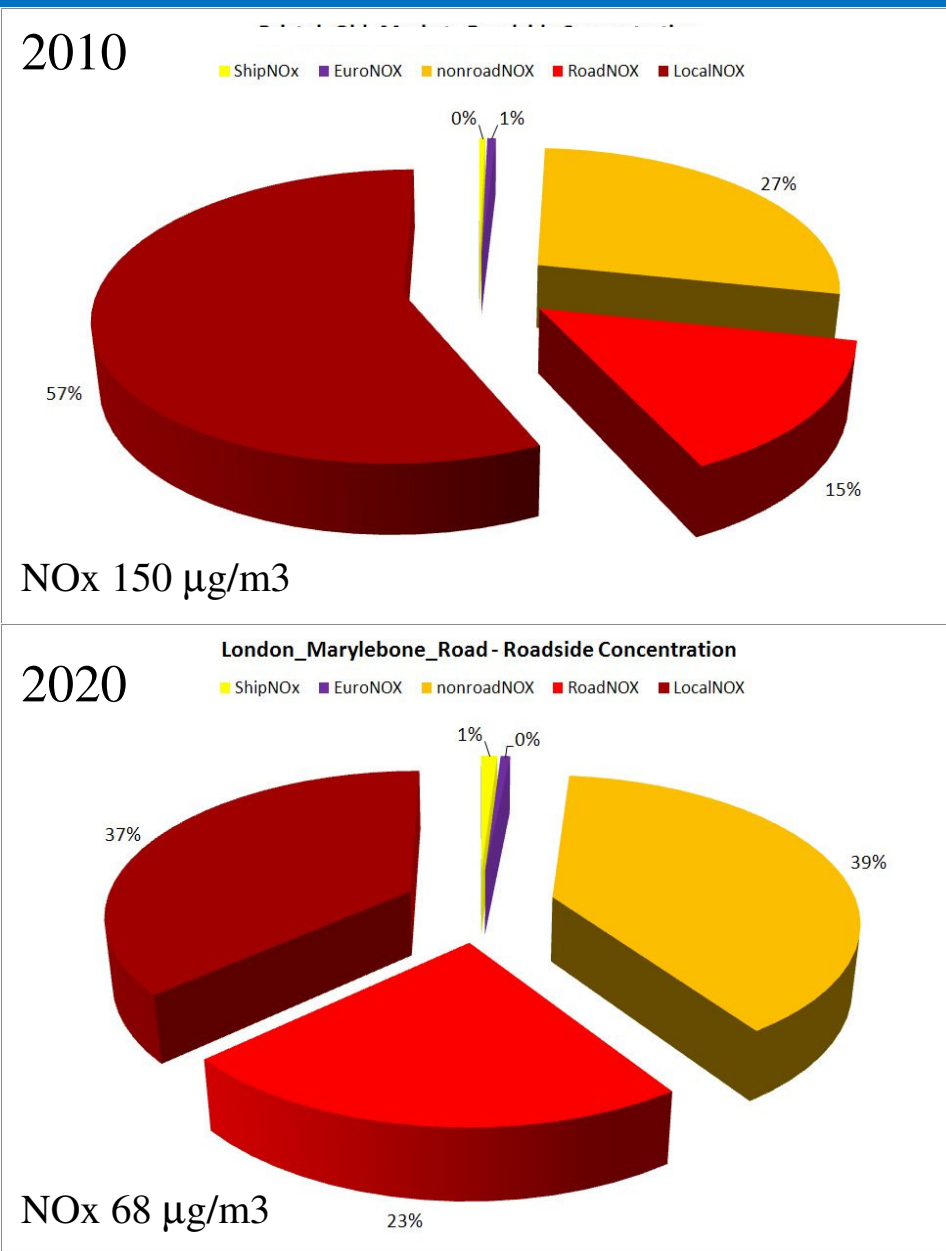
NB S deposition reduced significantly by MARPOL agreement re shipping

Projected exceedance of critical loads in 2020 (UEP32)

**NB very different picture from GAINS;
spatial resolution and atmospheric modelling e.g. orographic enhancement not reflected in EMEP model**



Urban modelling; the BRUTAL sub-model of UKIAM



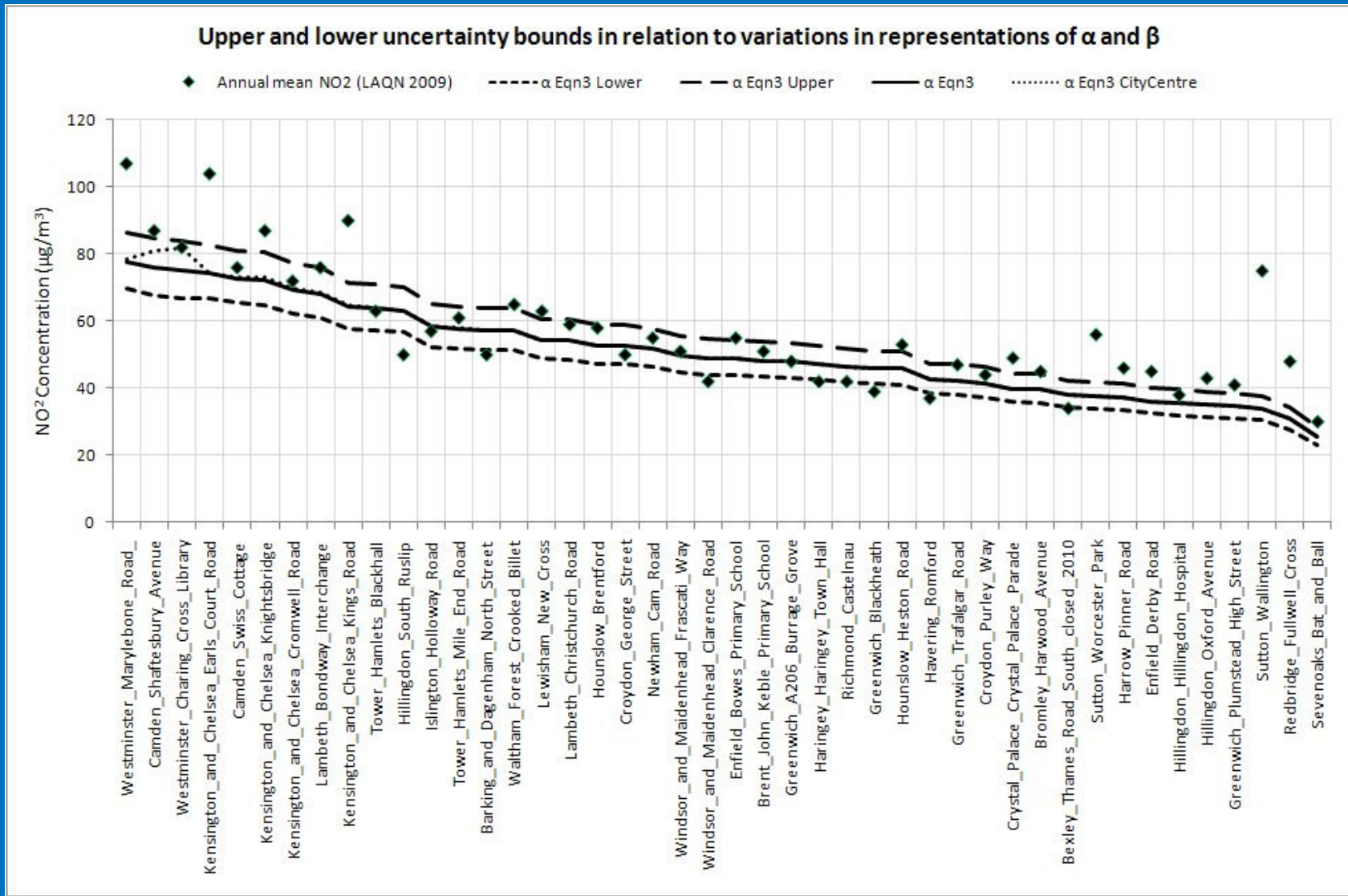
Builds up road transport emissions road by road across UK network; traffic flow and mix + speed dependent EFs (NAEI)

Superimposes on 1x 1 km gridded concentrations other sources and minor roads

-> lengths of road that “may be at risk” of exceeding limit values PM10, NO2

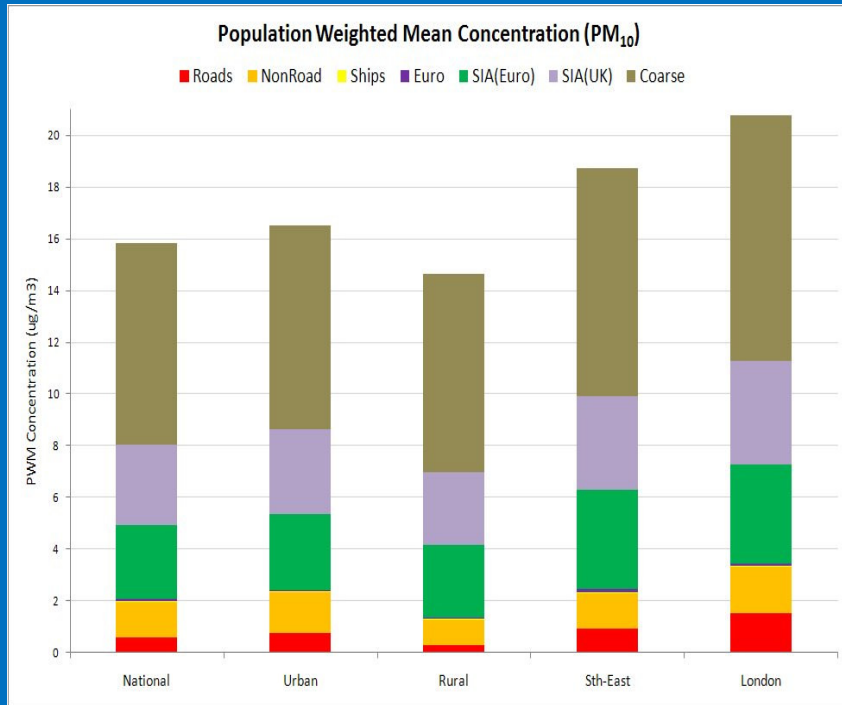
Recently revised treatment of primary NO2

Model comparison with measurements -> *input to Defra model validation exercise.*



UK POPULATION EXPOSURE; popn. weighted mean concentrations

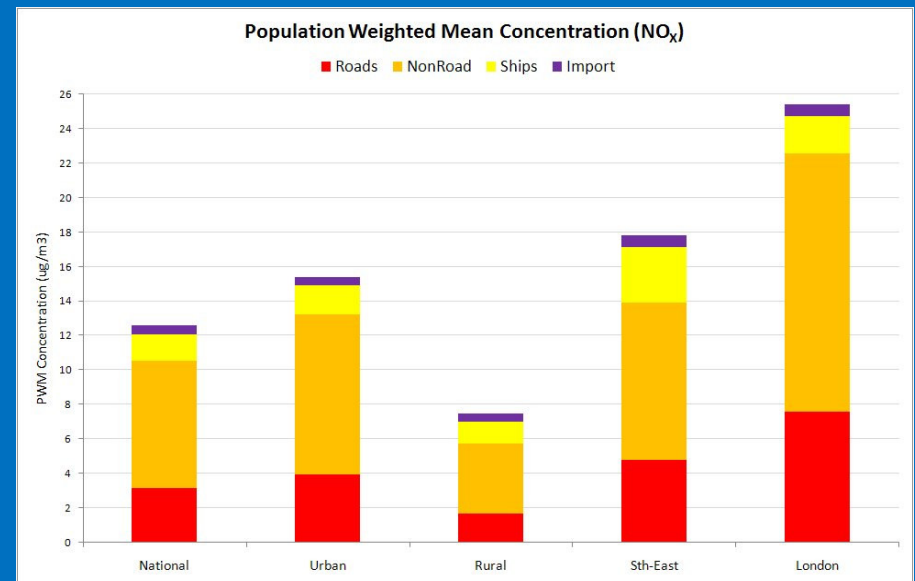
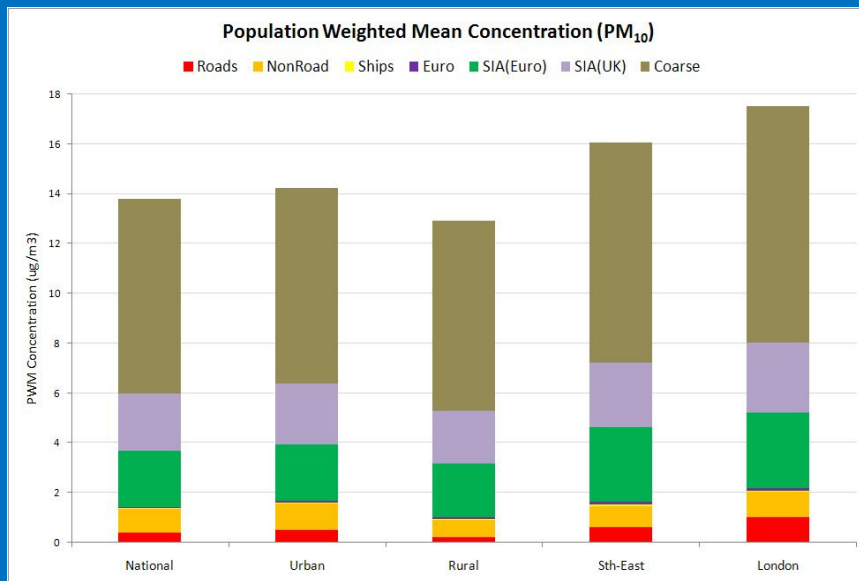
Source Apportionment Scenario UEP32



← PM₁₀ (2010)

PM₁₀ (2020)

NO₂ (2020)



Scenario analysis:

Different UK energy projections; power stations, CHP etc

Road transport scenarios: behavioural/new vehicles/technologies (inc Euro V/VI)

Agricultural scenarios: integrated NO₃ leaching & GHGs

Links to Multi-Pollutant Measures data base (MPMD) from ENTEC ; includes costs of measures.

WHIRLWIND TOUR IAM activities



WILL WE HAVE NEW EMISSION
CEILINGS by 2012?