Policy implications and solutions – what options do we have?

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Outline of talk

- Implications of REVIHAAP for policy
- PM – what ***can*** the UK control?
- PM – what ***should*** the UK control and for what outcomes?
- How can we make sure legislation evolves in line with the science and medicine for PM, NO_2 [and Ozone]?

PM - Policy

- A move away from ‘all PM components are equally harmful’
- The NECD revision should add a **ceiling for $PM_{2.5}$**
- In achieving NECD ceilings and the ambient LVs for $PM_{2.5}$, MSs should give **priority to reducing emissions from vehicles and from combustion of solid and liquid fuels** including NRMM and biomass
- WHO should consider developing an **AQG for road vehicle PM emissions**
- Note that there is **no regulatory pressure** on **vehicle** (or any other) primary combustion in the **ambient** air quality Directive
- EU should consider actions to reduce **non-tailpipe** emissions from vehicles

PM - Legislation

•There is a need to **revise** the existing **WHO AQGs** for $PM_{2.5}$ and PM_{10}

• There is a need to re-evaluate and lower the **Stage 2 indicative limit value for $PM_{2.5}$** (currently 20µg/m^3 annual mean)-cf WHO AQG (10µg/m^3) and US NAAQS (12 µg/m^3)

•Support for the **exposure-reduction** approach has strengthened

• The **National Exposure Reduction Target** in Directive 2008/50/EC would benefit from being made **mandatory** by 2020 to ensure improved public health

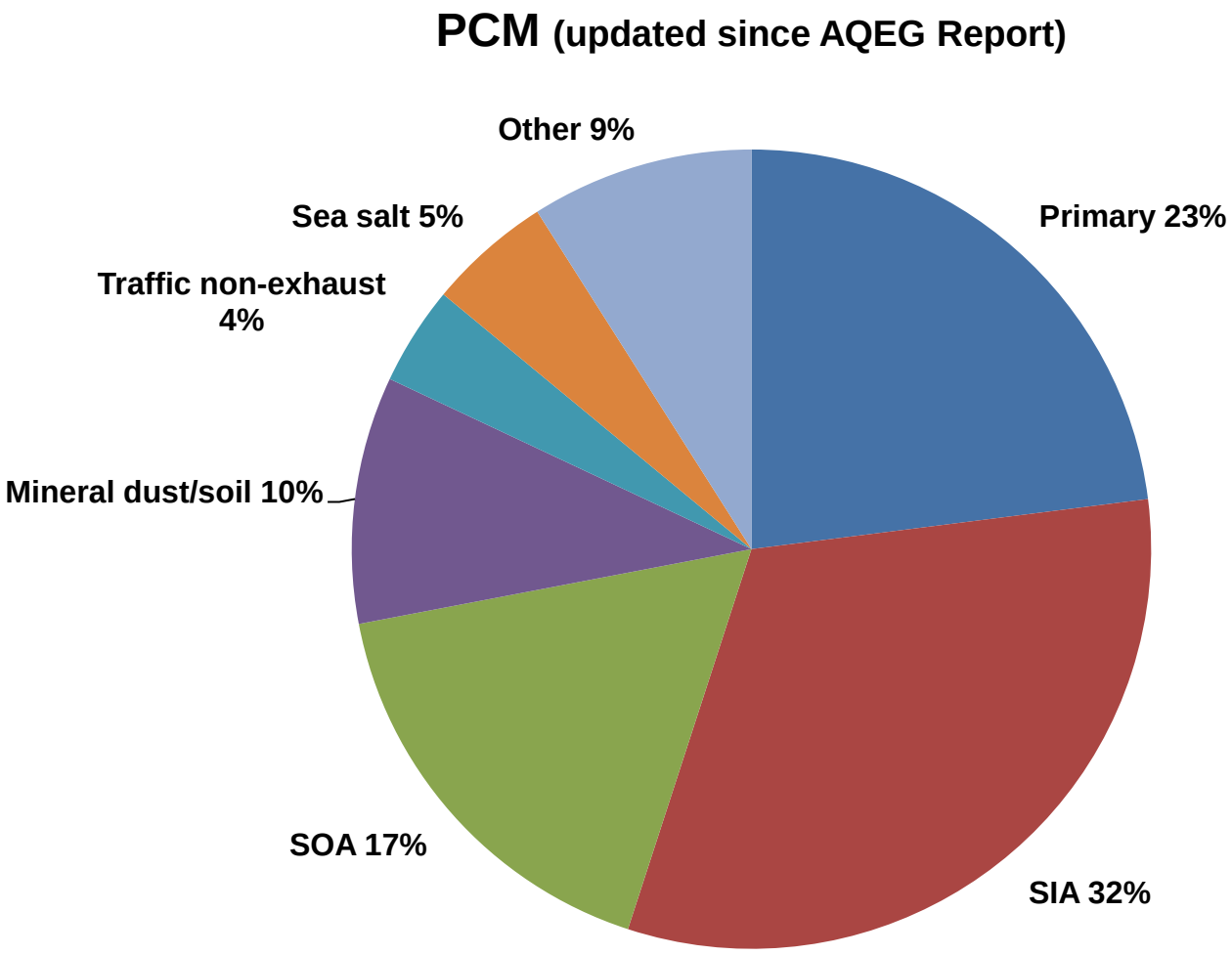
Nitrogen Dioxide

- Much **more epidemiology** reporting associations of effects with short- and long-term outdoor exposures
- Many associations **robust to inclusion of PM** in 2-pollutant models
- With the epi and toxicological findings especially on respiratory effects, these results are **suggestive of a causal relationship**
- Many studies in areas where NO_2 < annual LV, so case for **revising WHO AQGs** on basis of **outdoor** epidemiology: could result in **lower** AQGs
- There is **no *health-based* case** to relax or remove the existing annual EU LV

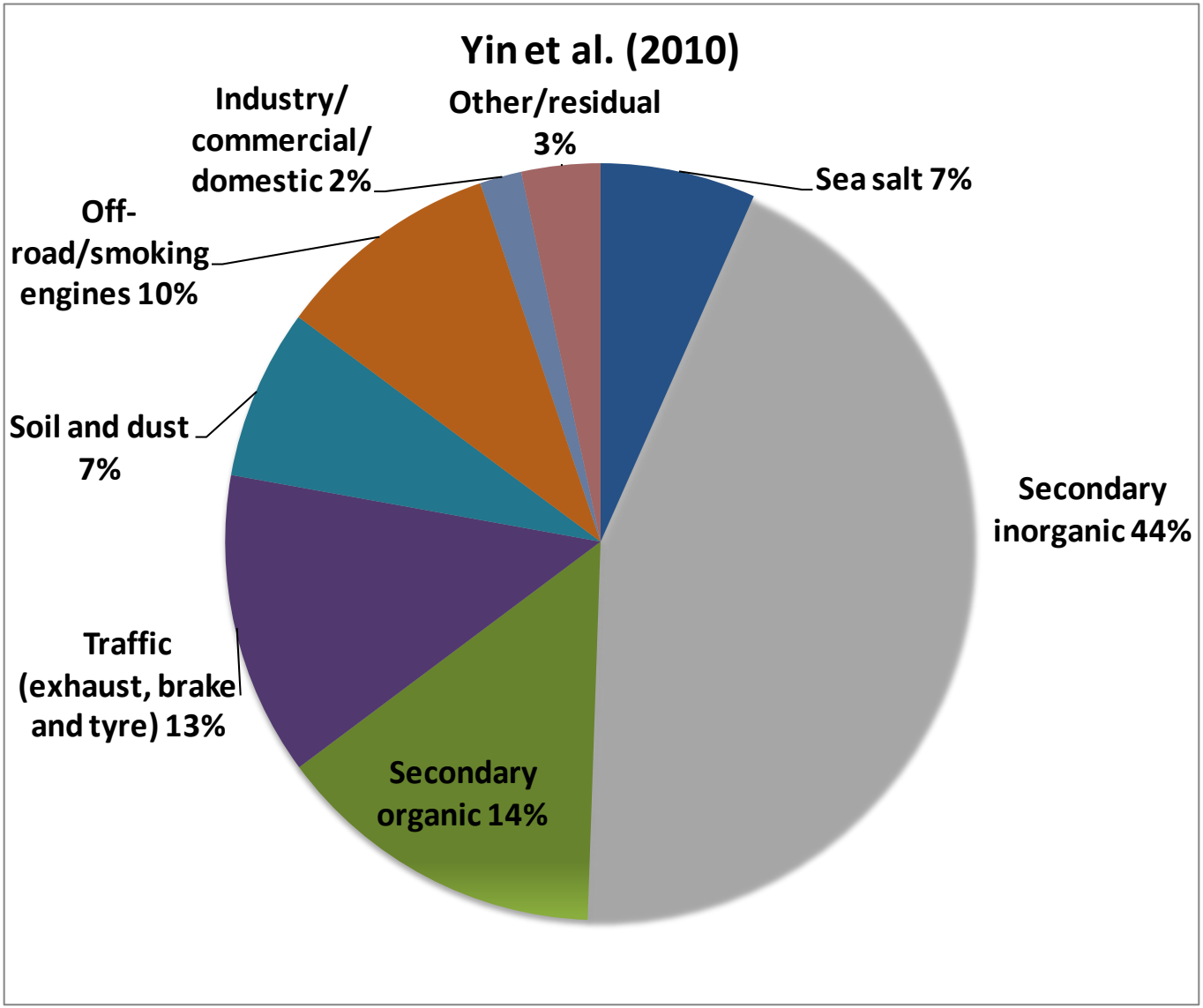
Some questions on reducing $PM_{2.5}$ concentrations

- Work in progress for AQEG
- How much of its $PM_{2.5}$ can the UK actually control?
- What is the role of ammonia?

Components of $PM_{2.5}$ (2008)



UK Total



Analysis for Birmingham

Percentage contributions to UK annual mean $PM_{2.5}$

	UK	Non-UK	Shipping	Natural	Other
Primary	19	4			
SIA	13-20	14-24	6		
SOA	12-14*	2-3*			
Mineral dust	0			7-10	
Non-exhaust	4				
Sea-salt	0			5-7	
Other	0				3-9
Total	50-55	21-30	6	12-17	3-9

* A large part of this SOA is likely to be biogenic, including cooking

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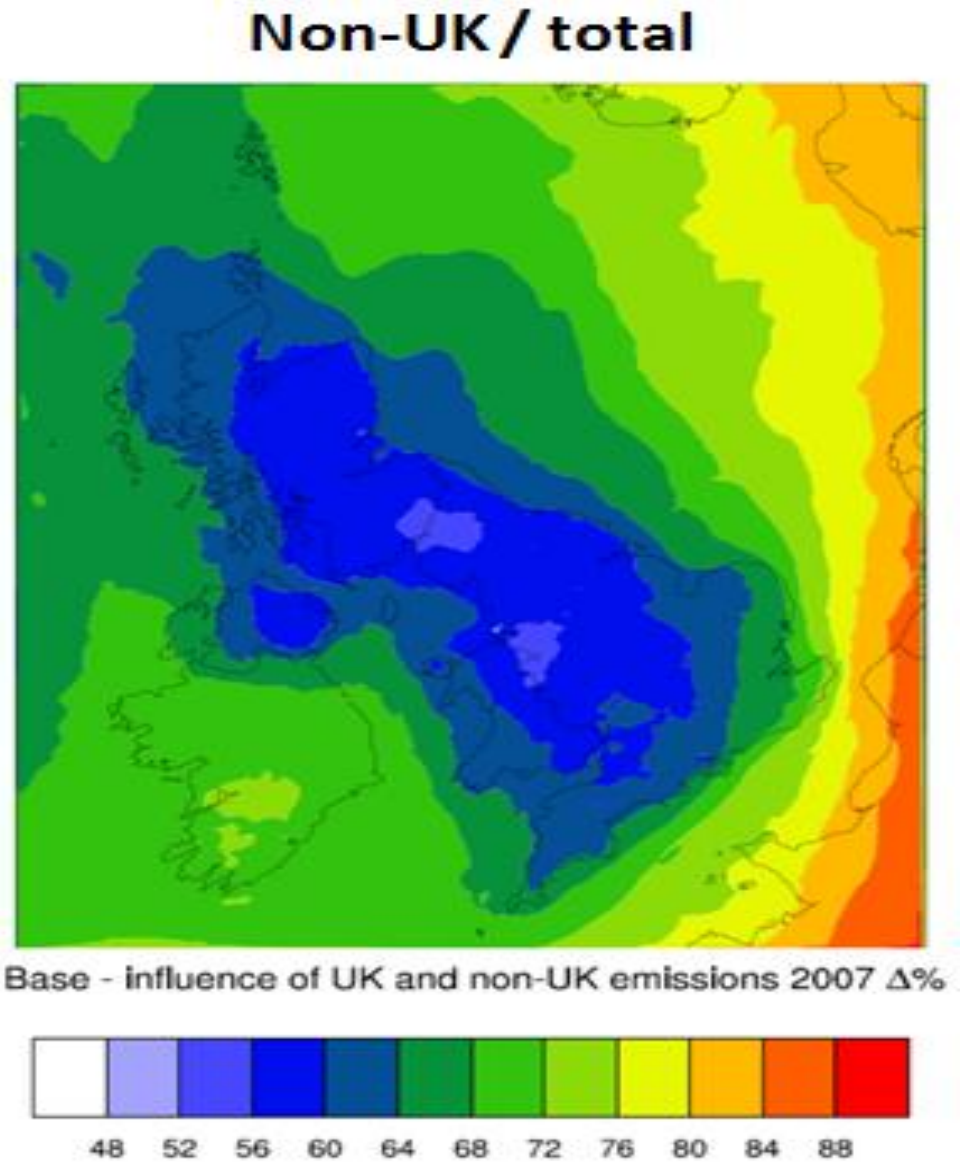
SIA from EMEP4UK Model (Nemitz et al 2013)



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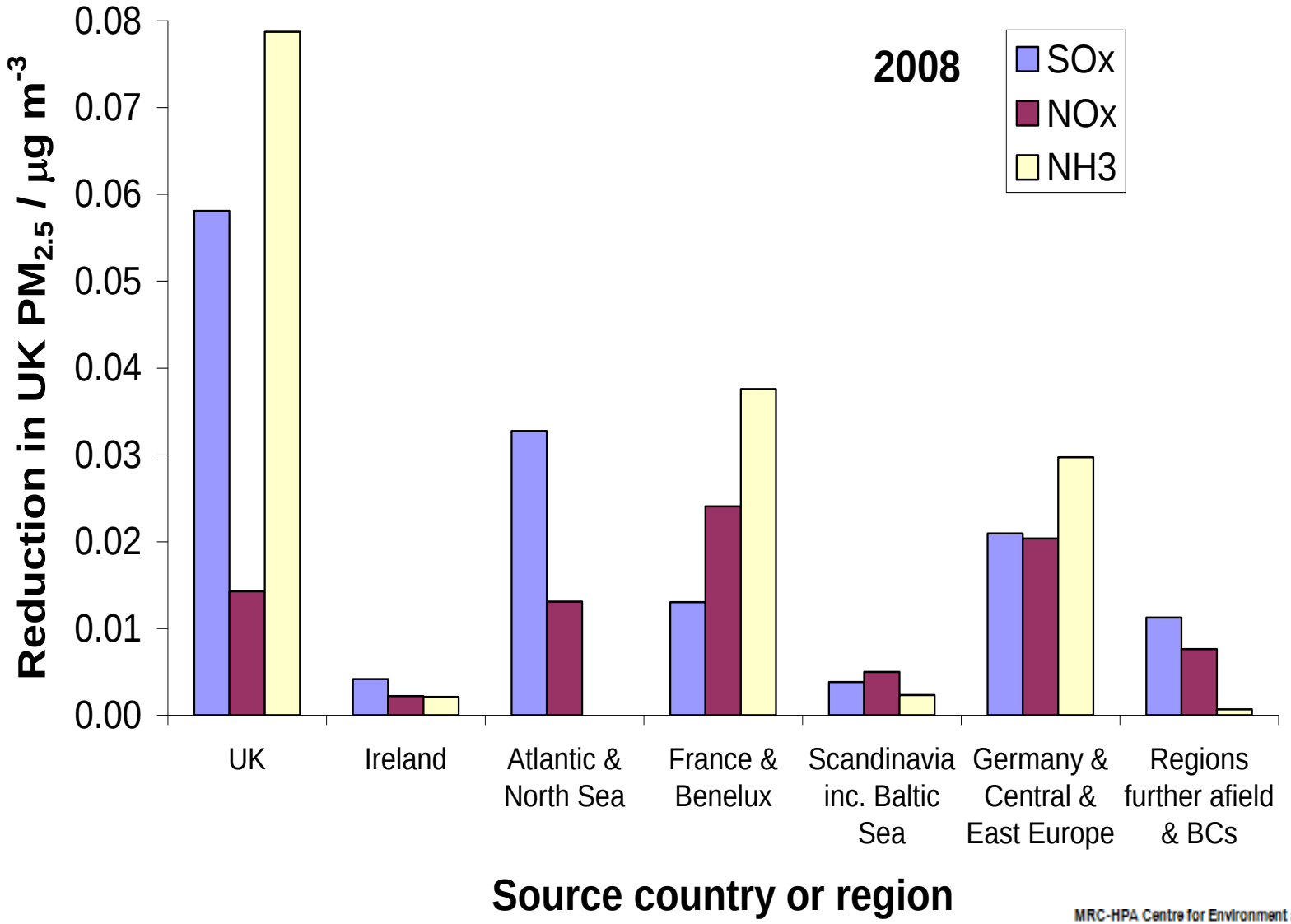
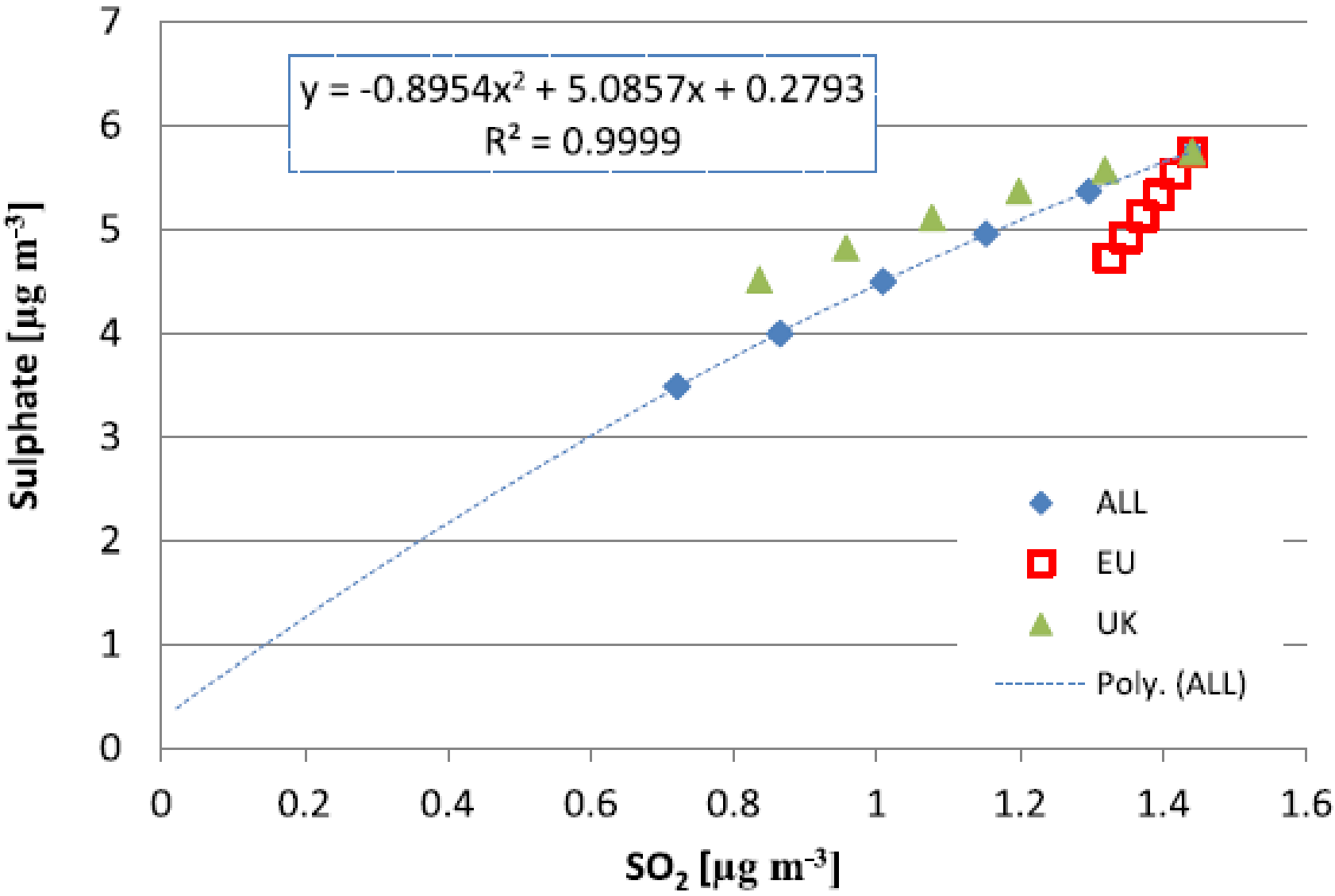


Source: EMEP MSC-W

So how do concentrations respond to emission reductions?

- Reduction in ***primary combustion*** $PM_{2.5}$ emissions over urban scales results in a 1:1 reduction in primary $PM_{2.5}$ concentrations – ***a reduction of X% in emissions results in a ~X% reduction in concentrations***
- ***SIA (ammonium sulphate and nitrate)***concentrations are subject to complex and non-linear chemistry such that an X% reduction in precursor emissions results in a concentration reduction of ***very much less than X %.***

Reductions in SIA precursors lead to non-proportional reductions in SIA coponents (Harrison et al, 2013)



Apportionment of UK Population weighted mean $PM_{2.5}$ = 13 µg/m^3

Component	PCM apportionment	Yin et al apportionment
Primary	2.99	3.25
SIA	4.16	5.72
SOA	2.21	1.82
Mineral dust, soil	1.30	0.91
Traffic non-exhaust	0.52	-
Sea-salt	0.65	0.91
Other	1.17	0.39
Total	13	13

Reductions in current $PM_{2.5}$ mass* $\mu g/m^3$) for a 15% reduction in components/precursors

- **Primary** **0.45-0.49**
- **NH_3** **0.08-0.11** **(Nemitz et al)**
- **SO_2** **0.07-0.10** **(")**

- **NH_3 EMEP** **0.07-0.23**
- **SO_2 EMEP** **0.12-0.26**

*pop.wtd.mean

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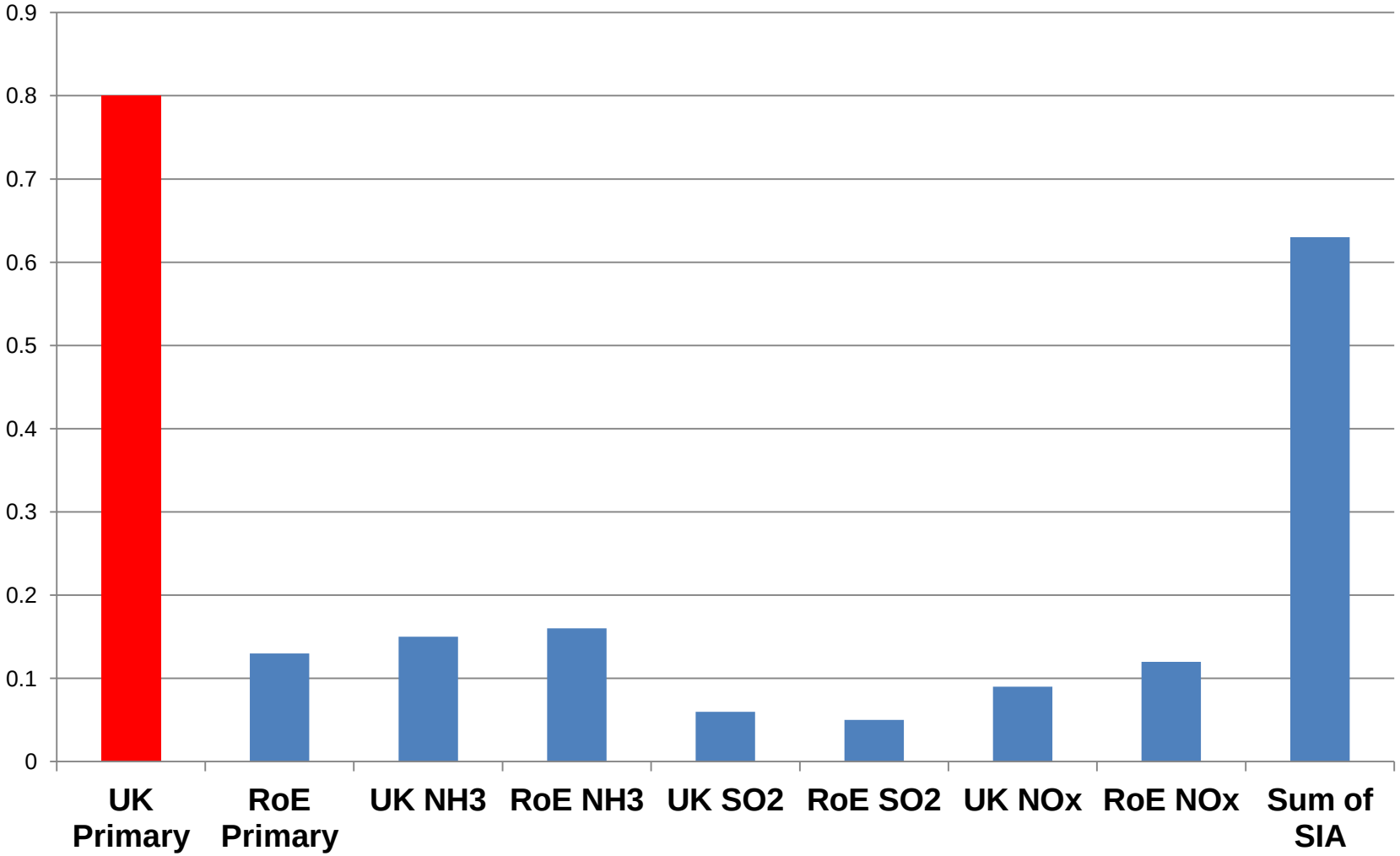
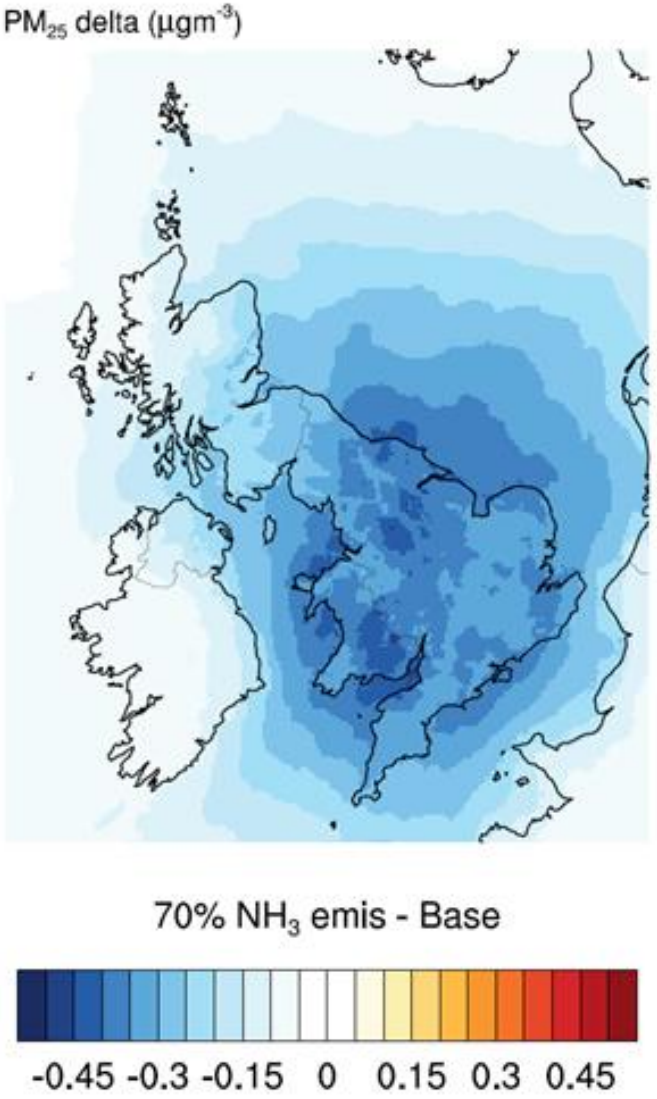
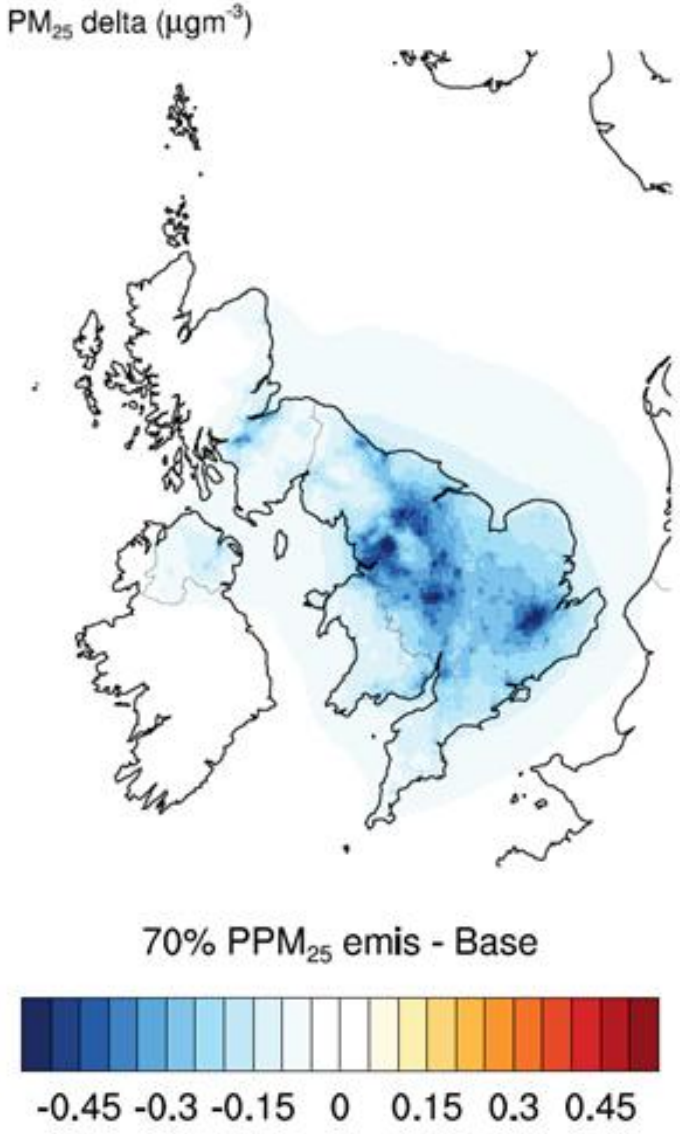
Reductions in PM2.5 AEI for 30% reduction in emissions of primary PM and SIA precursors (J. Stedman, S. Cooke, 2013)

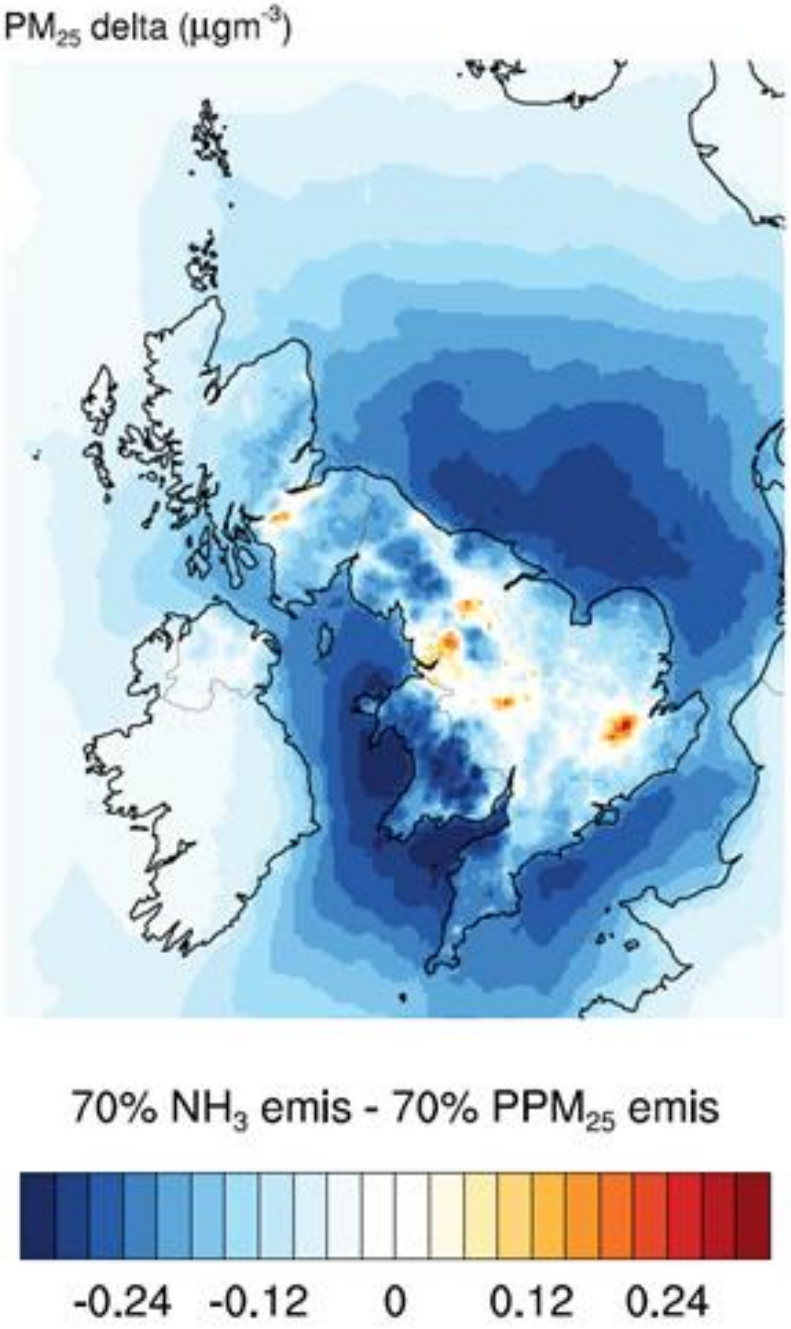


Effect of 30% reduction in NH_3(L) and Primary PM(R) on $PM_{2.5}$ mass (from Vieno, Heal and Reis, 2013)





Difference in $PM_{2.5}$ fields from NH_3 and Primary PM reductions of 30%



So how should we best manage PM?

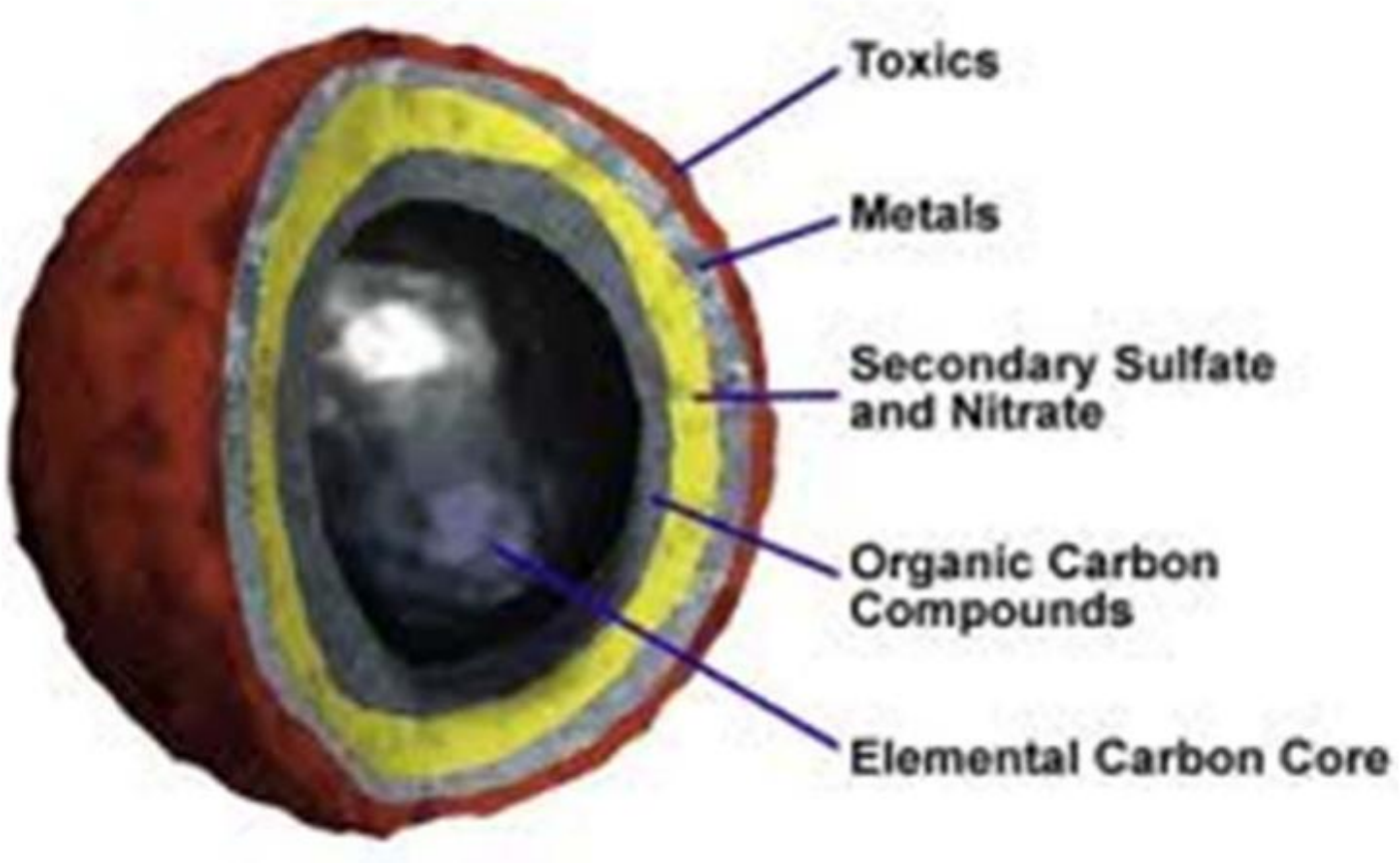
- $PM_{2.5}$ mass may be a good ‘metric’ for use in epi and even in HIA
- But if we have legislative targets for $PM_{2.5}$ ***mass***, what matters for public health is ***how*** one achieves them
- Are we reducing the right things?
- Distinguish between ‘indicators’ and ‘carriers’

- An ***'indicator'*** would be a benign entity that happens to correlate with a toxic component, but reductions in which may not necessarily lead to reductions in the toxic component
- A ***'carrier'*** would be a component of PM which is more closely associated with the toxic component and reductions in which would lead to reductions in the toxic component
- Uncertainty/ expert judgement
  - Can we say anything that is helpful in the absence of numerical standards?
  - Source-oriented approach?

What do *individual* particles really look like?

Do we know how/if particles act as *'carriers'/'indicators'*

Which are the real toxic agents?



WHO REVIHAAP

- Question D1 on policy implications
- In achieving NECD ceilings and the ambient LVs for $PM_{2.5}$, MSs should give **priority to reducing emissions from vehicles and from combustion of solid and liquid fuels** including NRMM and biomass
- Consistent with NPACT project in the USA
- Is there a public health case for reducing ammonia emissions? How toxic is NH_4NO_3?

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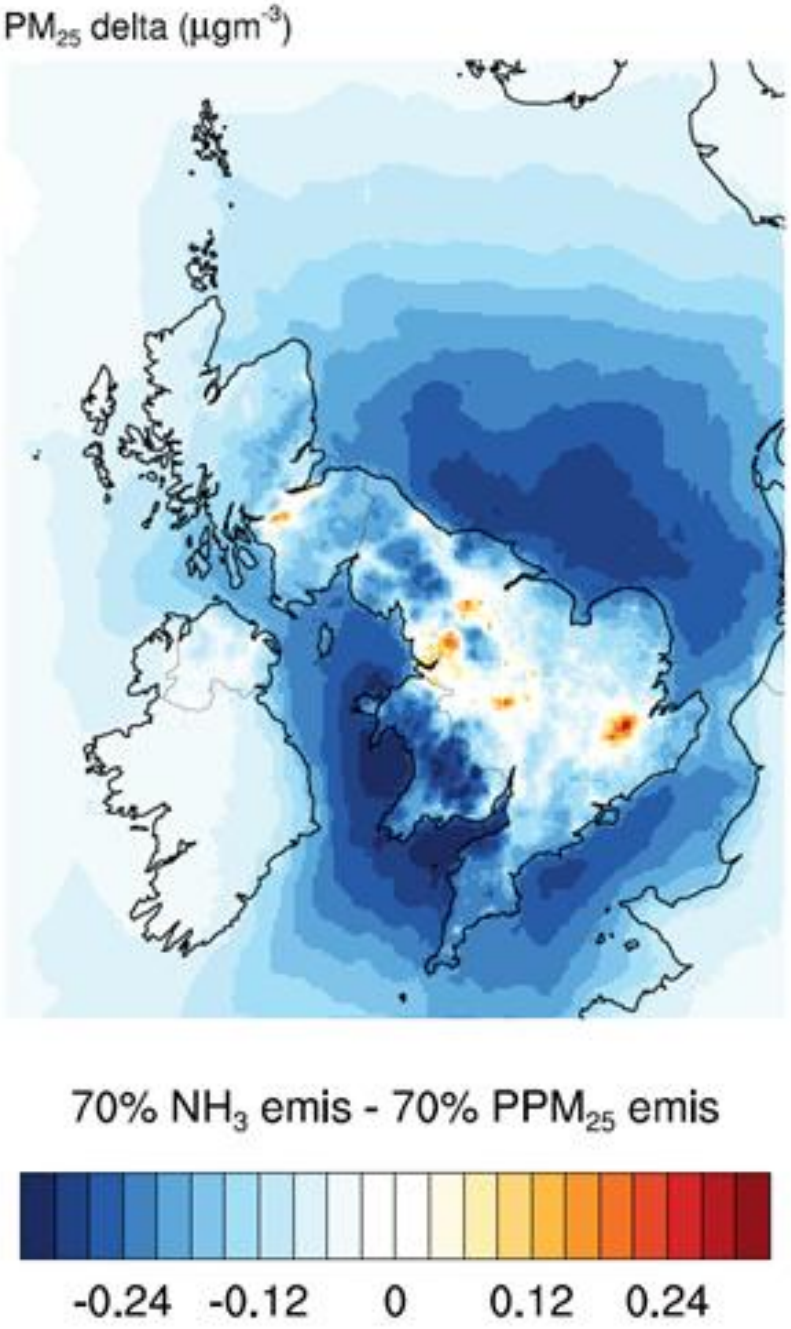
Difference in $PM_{2.5}$ fields from NH_3 and Primary PM reductions of 30%

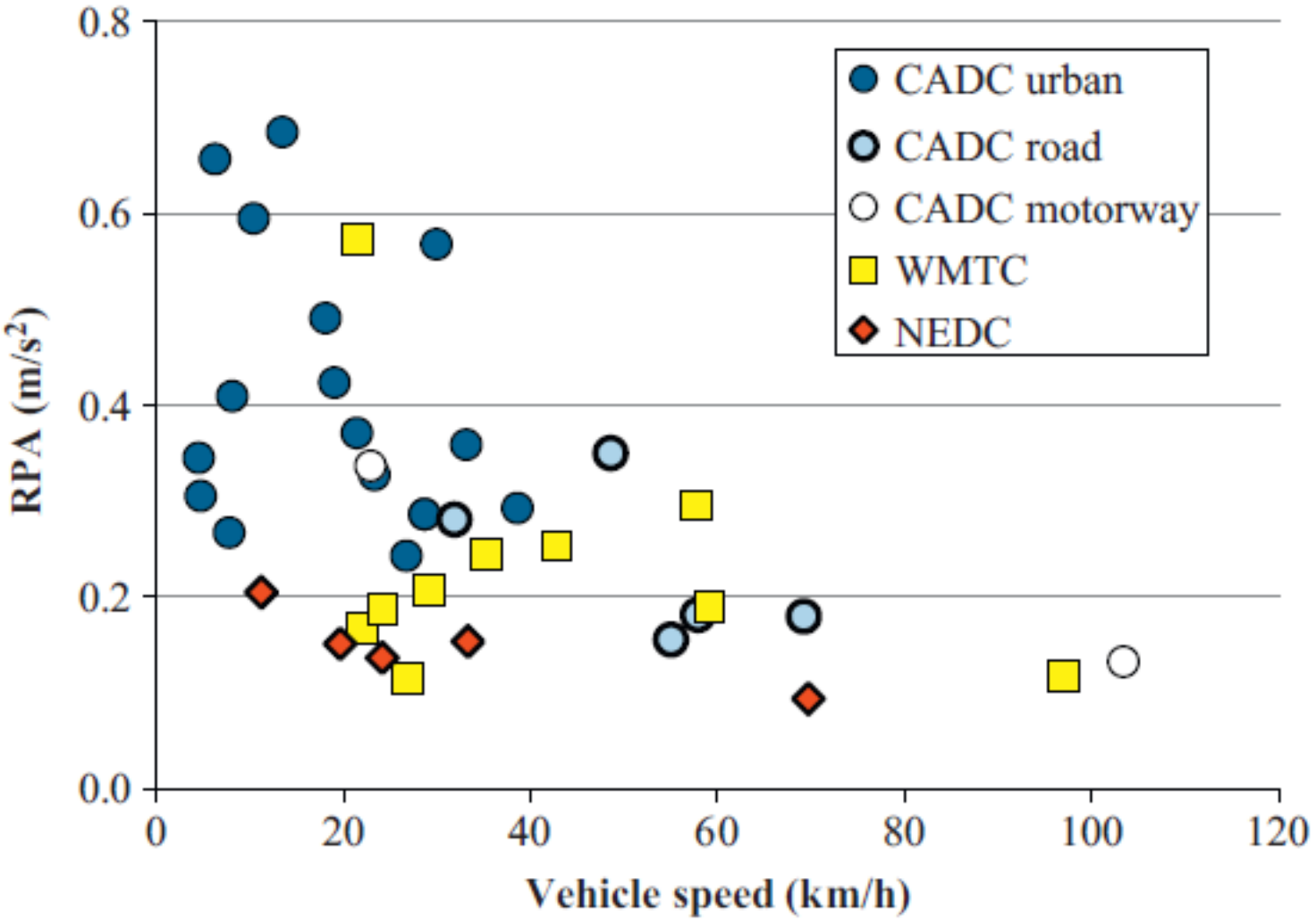


- An important point here is that if ***primary PM*** sources are seen to be the most effective way forward, the role of ***local air quality management*** becomes much more important
- There are strong arguments for reducing ammonia emissions because of impacts near high emitters (e.g. Near intensive livestock operations), and possibly for 'carrying' sulphate(?) and other possible toxic agents from combustion sources
- But we have policy on Sulphur already
- Is there an argument for reducing NH_4NO_3 ?

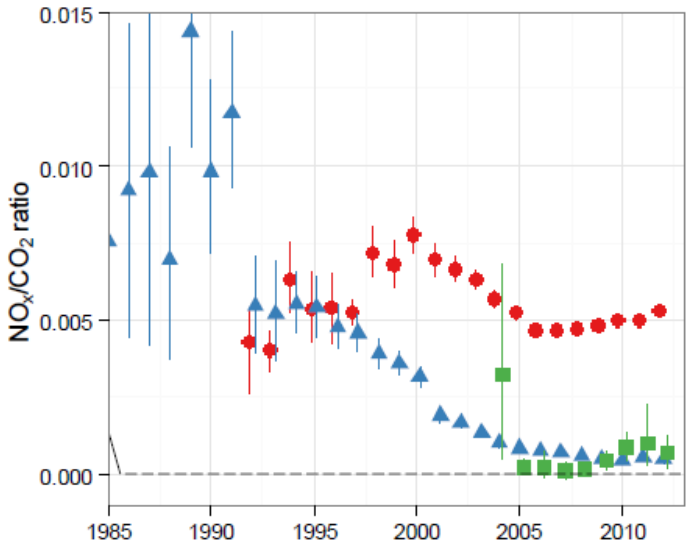
Nitrogen Dioxide
.....and vehicle emissions in general

- It's the real world driving stupid.....
- ***Euro 6/VI must be shown to work!***
- **Euro 7/VII** needs to be thought about now - draw on US experience?
- Policy pressure should shift towards ***implementation and effectiveness to check in-service performance***

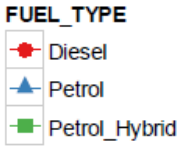
The regulatory test cycle does not capture real driving conditions

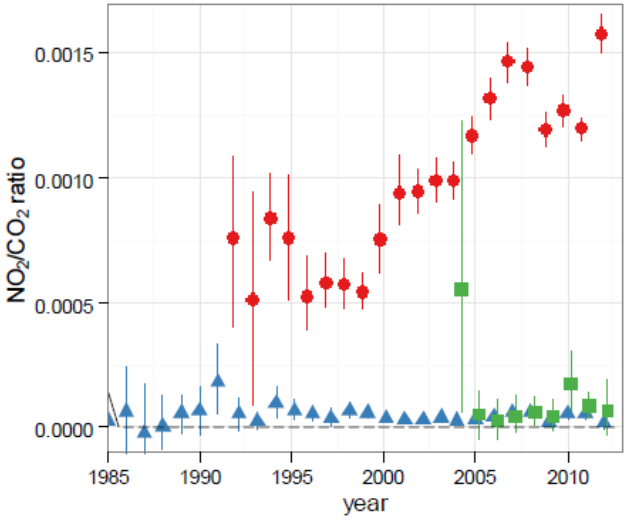


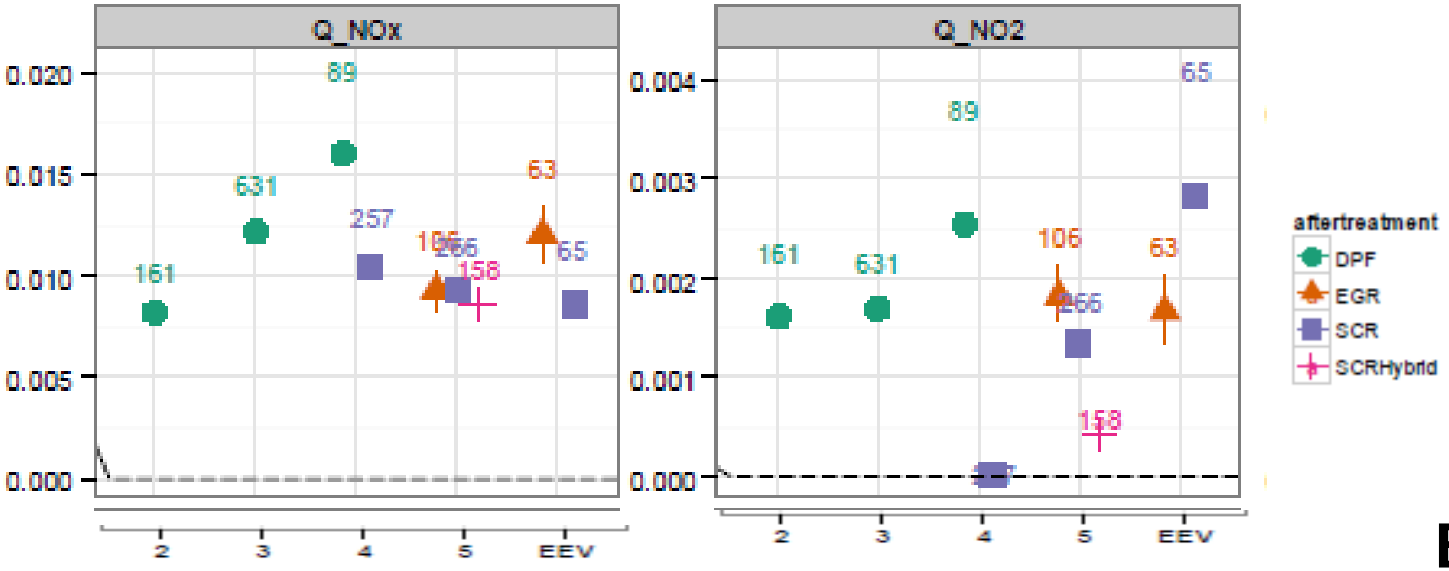
Some concerns...



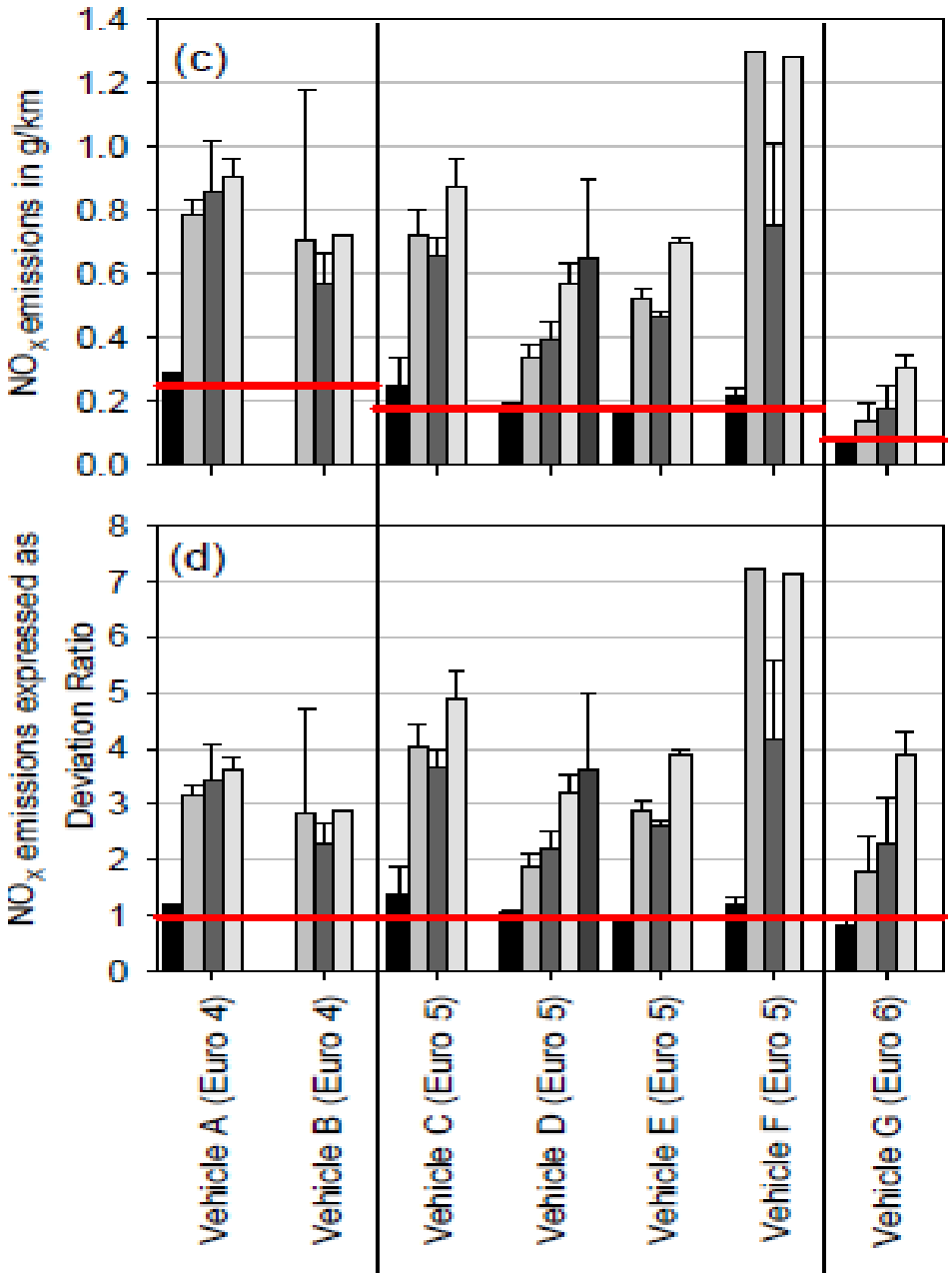
Cars





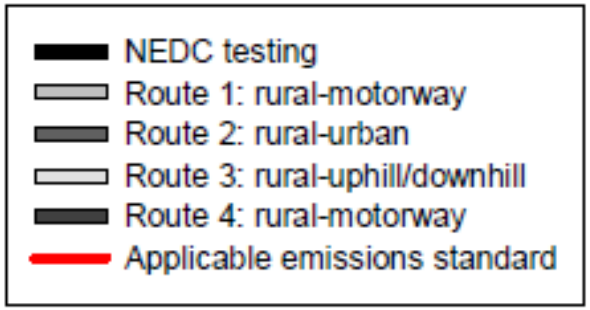


Buses



So will Euro 6 solve the problems for cars?

One Euro 6 diesel vehicle, *supplied and set up by the manufacturer*.
This one vehicle emits lower than Euro 5 but still does not emit at the Euro 6 emission limit. In fact it emits at ~ Euro 5 legal limit!



Evolution CHIPS

Diesel Particulate Filter Removal (DPF Delete)

Benefits of diesel particulate filter removal are::

- Better Performance
- Increased MPG
- Avoid Expensive Repair Costs

Thank You!