

# **UK perspective on air quality policy and health- meeting the challenges**

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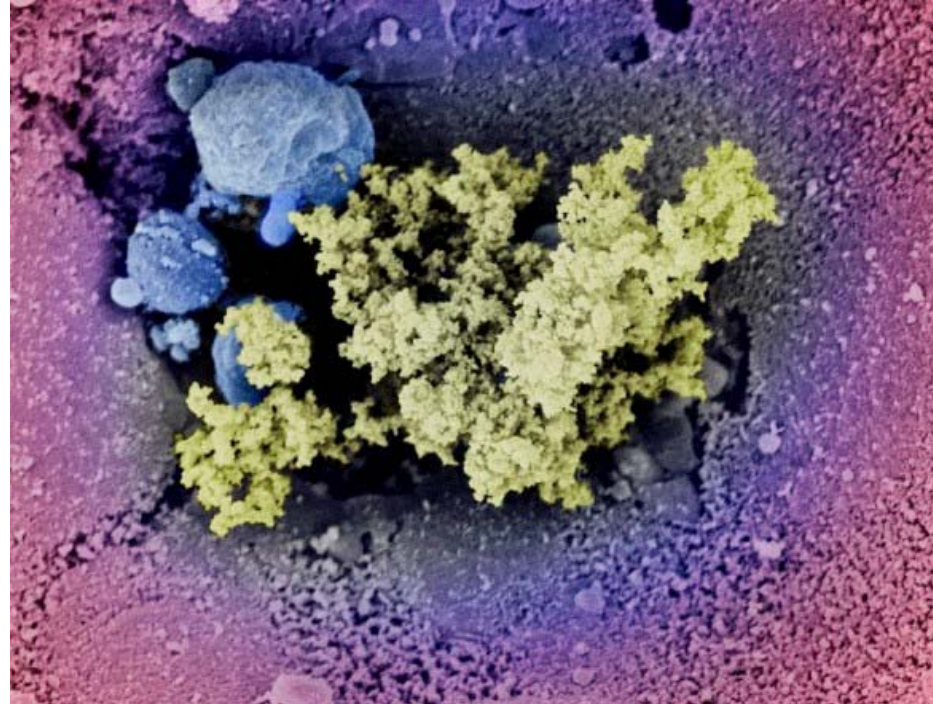
**Air Quality and Industrial Pollution**

**Defra**

**Cair4Health Worskhop Brussels 19 June 2008**

# One health problem from air pollution

- In 2005, man-made particulate air pollution in UK was estimated to reduce average life expectancy by **7-8 months**;
- This health impact in the UK is valued at a cost of £9.1-£21.4 billions per annum;



- Measurements show that, at certain locations, long term reducing trends for  $\text{NO}_2$ ,  $\text{PM}_{10}$  are flattening out or even reversing.

Figure 2.4

Measured annual mean  $\text{NO}_2$  concentrations in the UK (mean of all sites and highest site and 2005 Strategy objective)

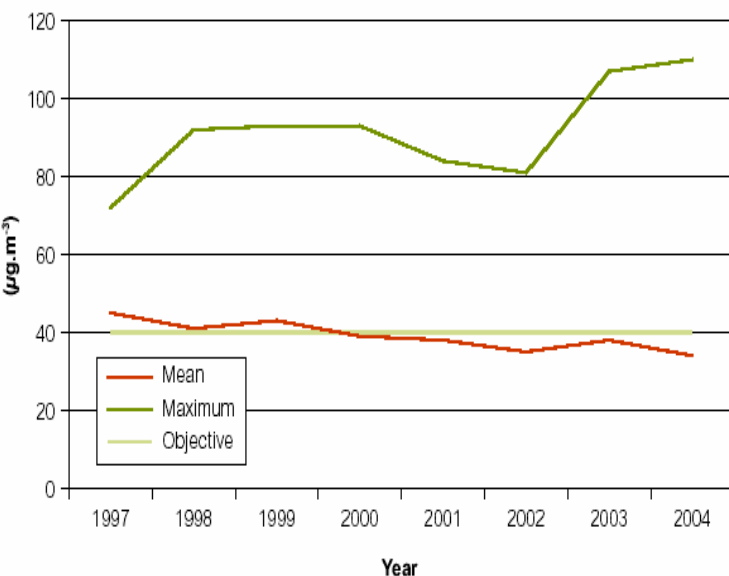
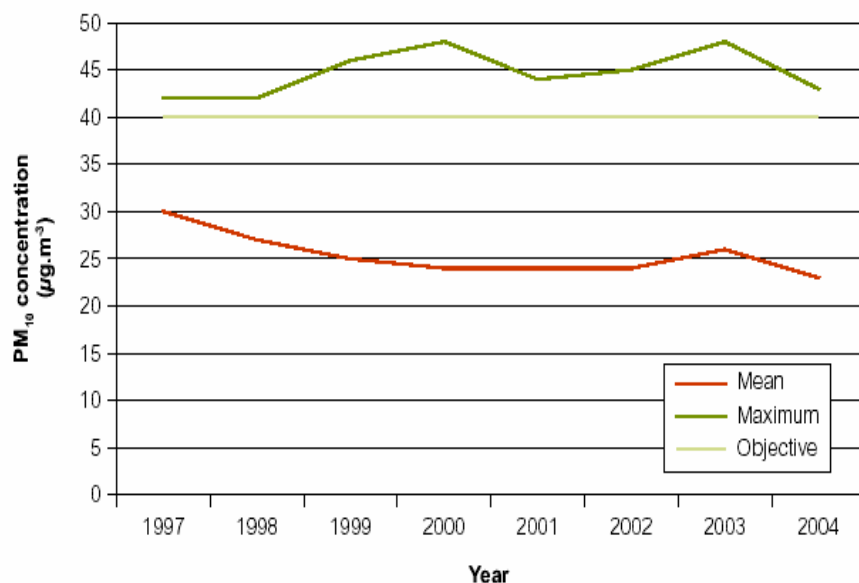


Figure 2.8

Measured annual mean  $\text{PM}_{10}$  concentrations in the UK (mean of all sites and highest site and 2004 Strategy objective)



# The Air Quality Strategy for England, Scotland, Wales and Northern Ireland



A consultation document  
on options for further  
improvements in air quality

Volume 1  
April 2006



- **Published  
Summer 2007**



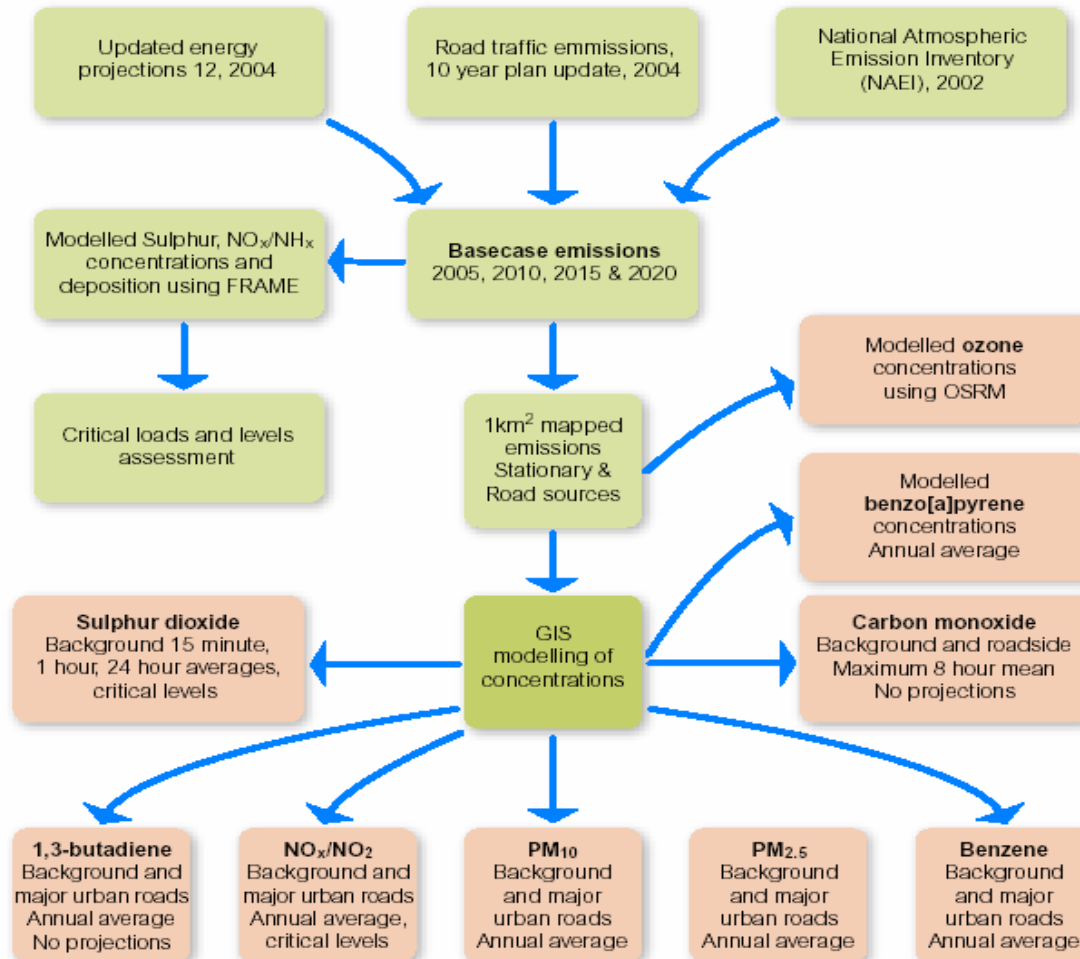
# How will we improve air quality?

1. Develop a baseline profile for air pollution across the UK from 2005 to 2020 if no new policy measures are agreed;
2. Develop a profile for air pollution across the UK in 2020 if a number of different new policy measures are agreed;
3. Compare all the impacts, costs & benefits of different measures in order to decide:
  - a) which ones, if any, to implement
  - b) which new objective(s) to set

# How?

Figure 2.1

Summary of inputs, processes and outputs for the national air quality modelling



# How?

- Impacts of new policy measures assessed against 4 main criteria:
  1. Monetary Costs & Benefits Analysis;
  2. Exceedences assessment;
  3. Ecosystems assessment;
  4. Qualitative assessment.

# How?

- Cost Benefit Analysis used
- Long term exposure epi for PM(Pope et al)
- Short term time series epi for PM
- WTP economic study used to value life expectancy changes

# Damage Costs

- $PM_{10,2.5}$  - Chronic Mortality; Acute Mortality; Acute Morbidity (RHA)
- Ozone,  $SO_2$  – Acute Mortality and Morbidity (RHA)
- Ozone - Yield loss in various crops
- Materials damage – acid deposition, Ozone to polymers, soiling

# Exposure-response relationships

- **Chronic PM<sub>2.5</sub> – 6% per 10 µg/m<sup>3</sup> (also 1%, 3%)**
- **Acute effects: % per 10µg/m<sup>3</sup> daily mean (except ozone which is 8-hour mean)**

	Mortality	RHA	CVHA
PM <sub>10</sub>	0.75	0.8	0.8
SO <sub>2</sub>	0.6	0.5	
O <sub>3</sub>	0.6	0.7	
NO <sub>2</sub>	-	0.5*	

# Damage costs

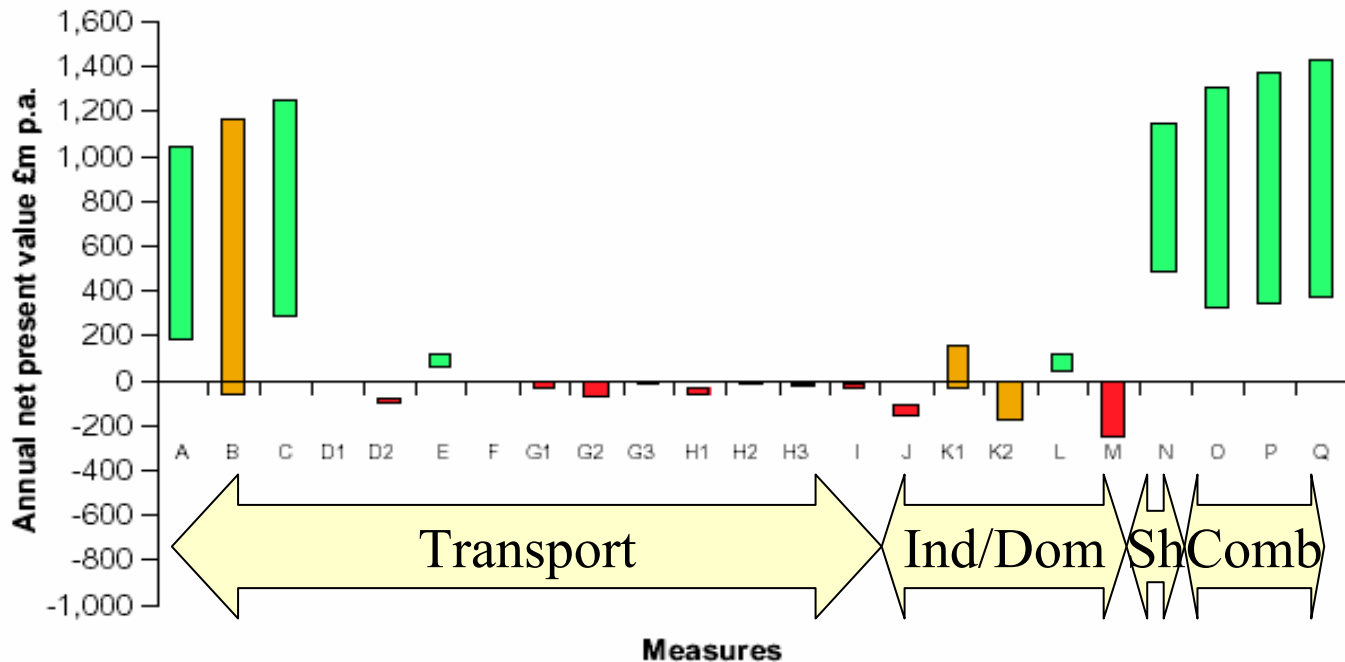
- Cost of Life Year:
- £29,000 in 'good health'
- £15,000 in 'poor health'
- Hospital admission cost - £1,900-£9,200
- Death brought forward - £15,000

# Measures: Costs & Benefits

Figure 3.5

Summary of monetary costs and benefits assessment<sup>19,20</sup>

Traffic light assessment for costs and benefits



# Measures: qualitative assessment

- **Noise:** small positive impacts for certain transport measures;
- **Deprived areas:** small positive benefits from certain measures;
- **Competition:** more assessment needed for certain measures;
- **Small businesses:** more assessment needed for certain measures.

# Measures: results

- Government and DAs are considering implementing or arguing for in relevant international fora the following measures:
  - New Euro standards for vehicles;
  - Incentives for early uptake of Euro standards;
  - Incentives for early update of Low Emission vehicles;
  - National road pricing scheme;
  - Reducing emissions from small combustion plants;
  - Reducing emissions from ships;

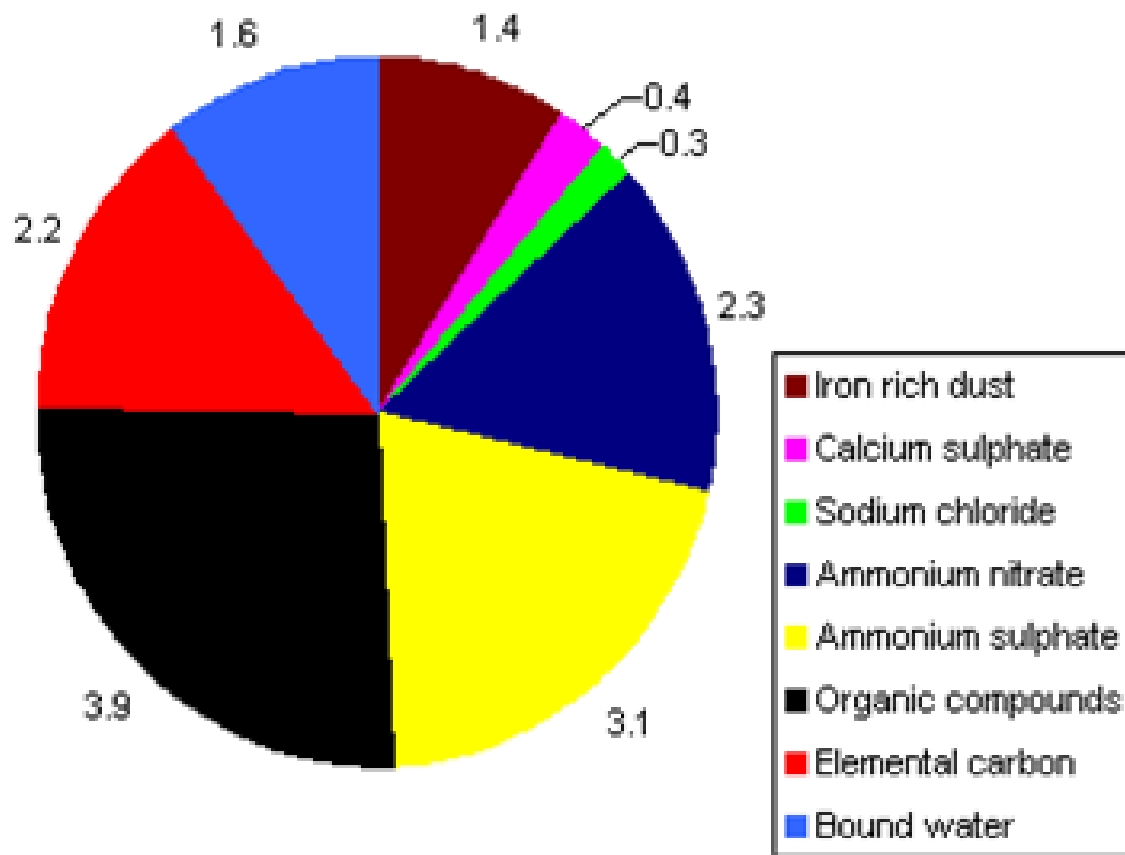
# Measures: results

- Local Transport measures (e.g. LEZ, CC);
- Smarter Choices;
- Stricter speed limits at local level;
- Sustainable Freight distribution.

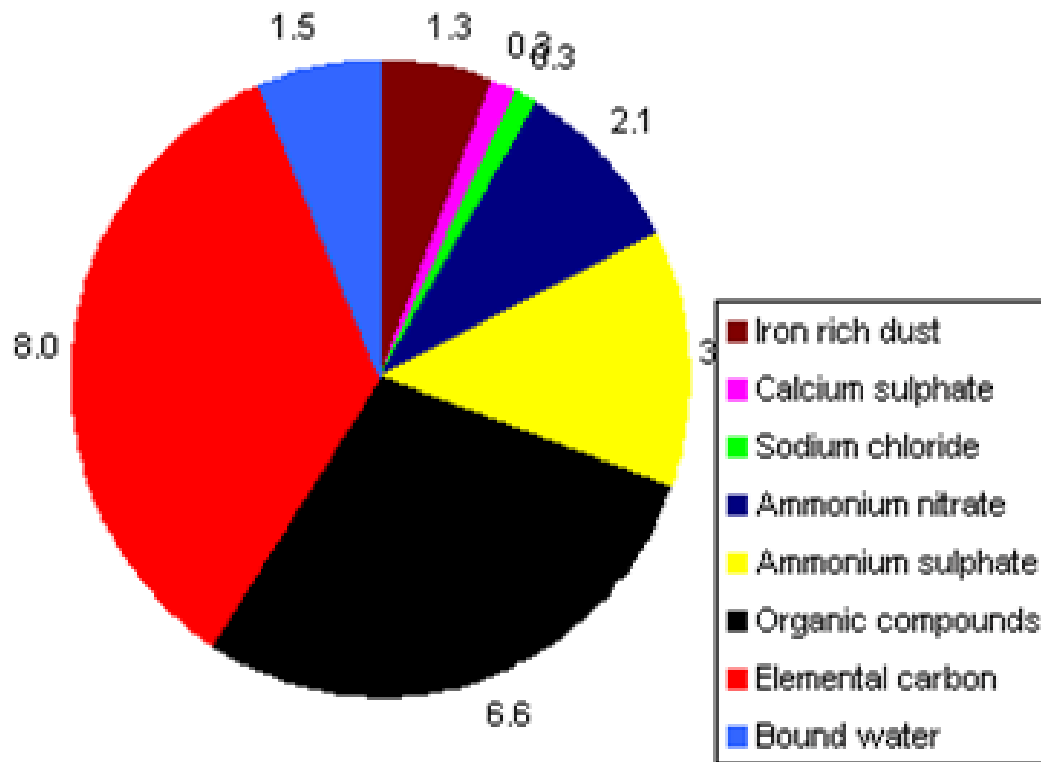
# Some continuing problems

- We still are uncertain about the toxic components of PM<sub>x</sub>
- How harmful are long exposures to 'low' levels of ozone?

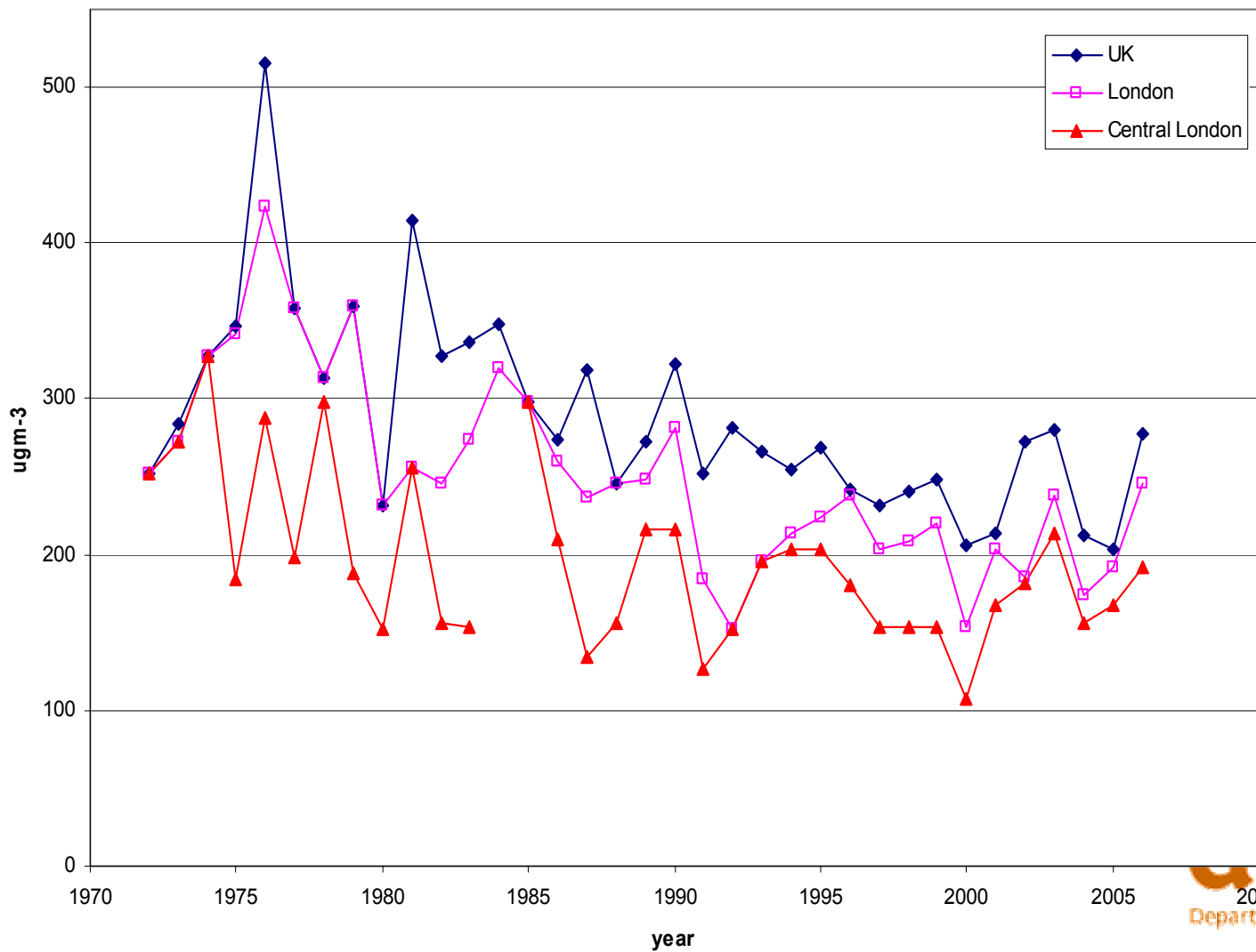
# Chemical Components Background Fine Fraction



# Chemical Components Roadside Fine Fraction



# Maximum 1-hour mean Ozone in UK



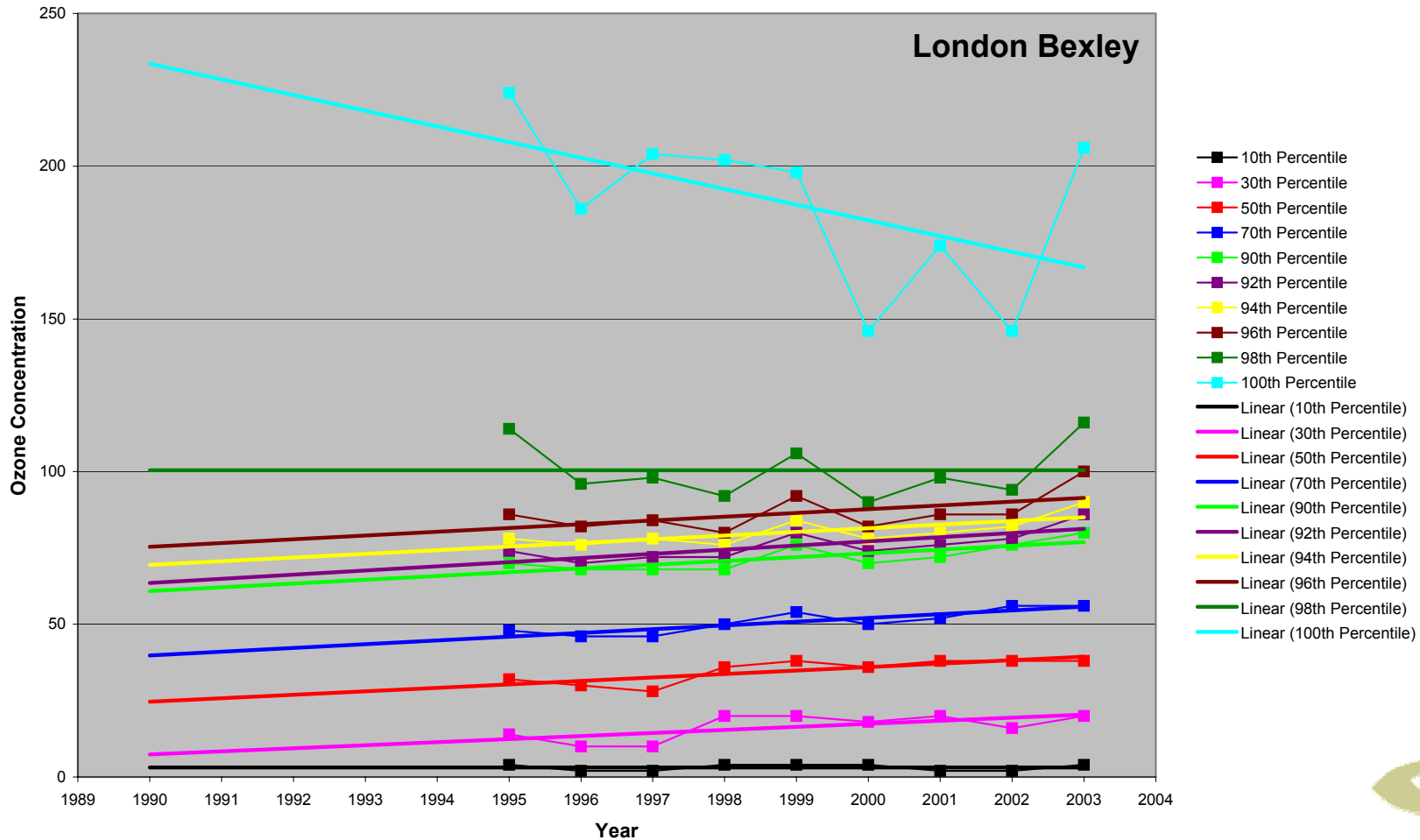
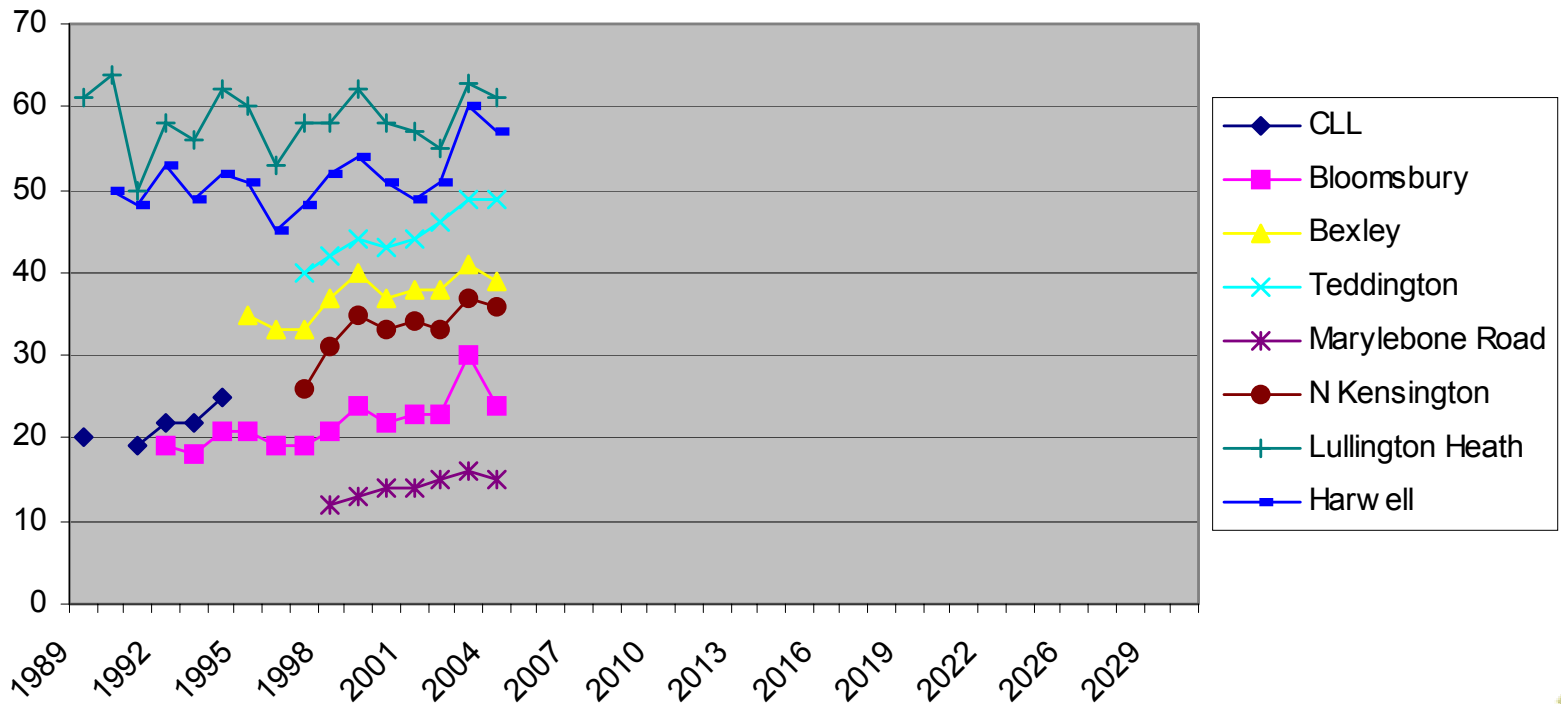


Figure 2: Annual Mean Ozone ( $\mu\text{g}/\text{m}^3$ ) at sites in London and the rural south eastern UK



# UK Strategy review: new proposals

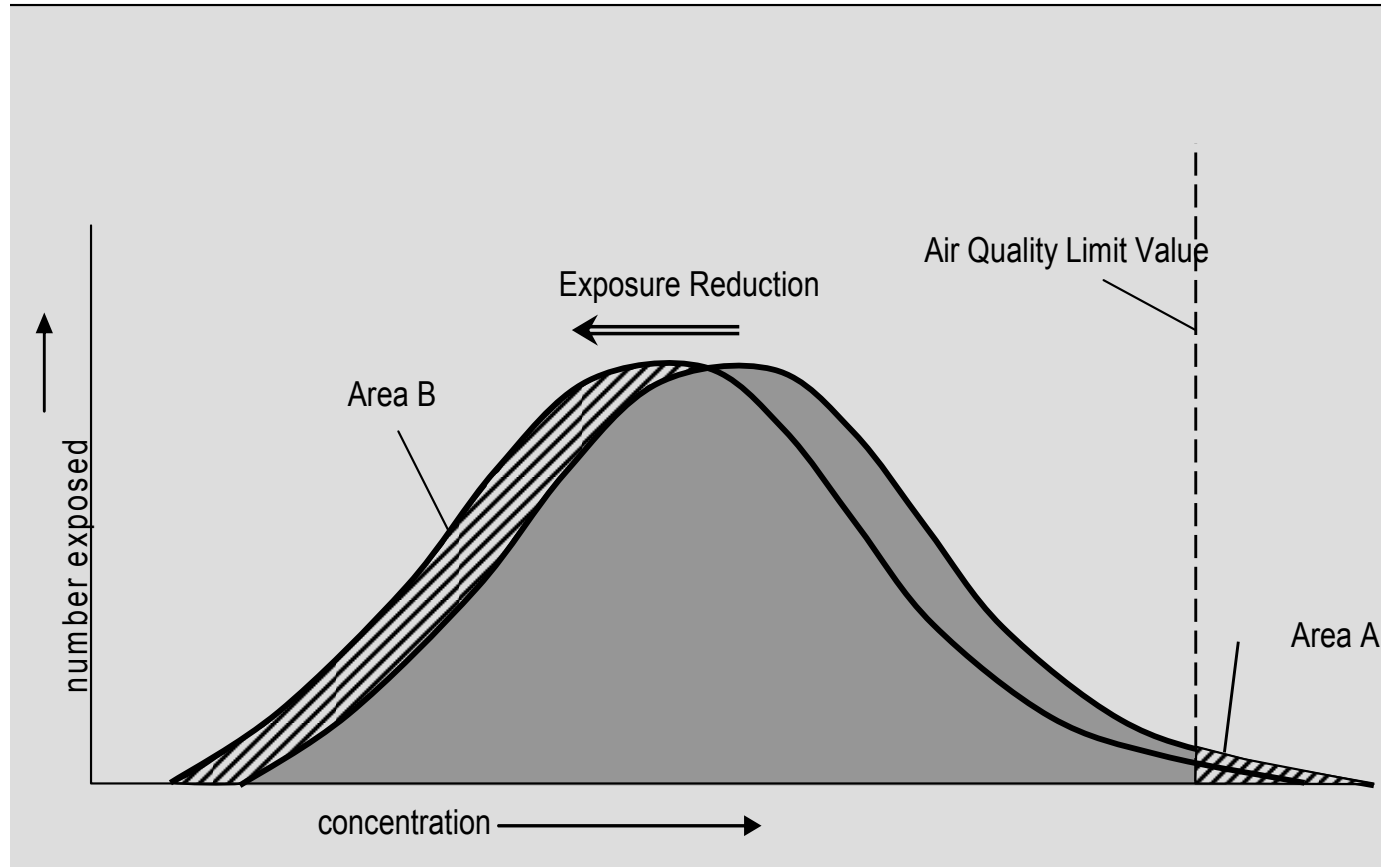
Human health:

- ***New  $PM_{2.5}$  Exposure-Reduction Approach to replace  $PM_{10}$  2010 objectives for 2010;***

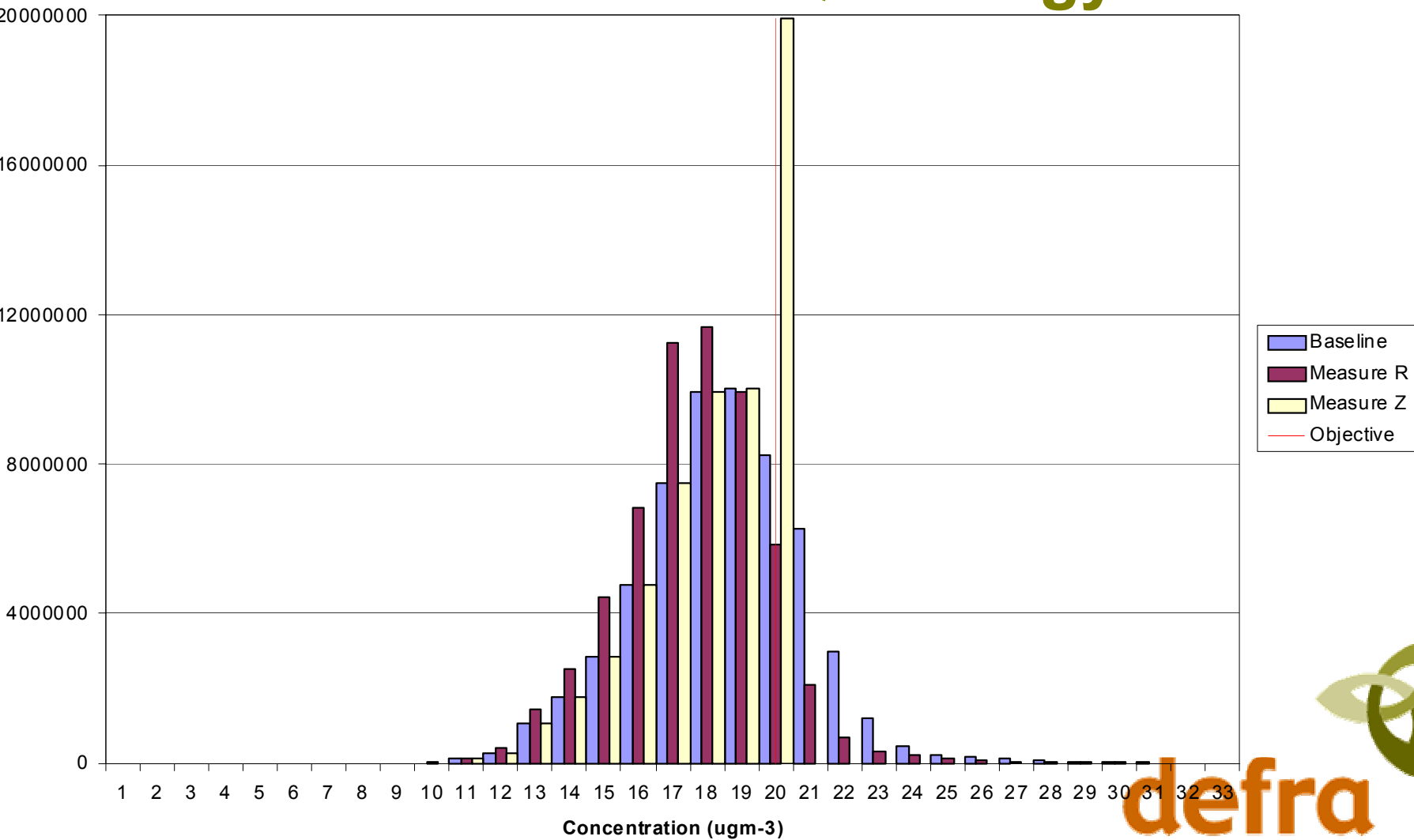
Ecosystems:

- For SSSIs + other protected sites,  $NO_x$  (99%) and  $SO_2$  (100% at  $10\mu g.m^{-3}$ );
- New  $O_3$  objectives (from DD3).

# Exposure-reduction concept



# Actual E-R Calculations from measures in AQ Strategy



# Exposure-Reduction Approach: what is it?

- Only for pollutants for which there is no safe level (i.e. particles);
- Formed by two inseparable components:
  1. “Backstop” or “concentration cap” objective (environmental justice)
  2. % reduction objectives over period of time in urban background areas (main driver for public health improvements)
- For PM<sub>2.5</sub> rather than PM<sub>10</sub> in order to follow latest WHO and COMEAP health expert advice.

# Exposure-Reduction Approach: the evidence

**Table 4.1:** Comparing exposure reduction approach and current objective/limit value approach

	Percentage of UK population above $20\mu\text{g}\cdot\text{m}^{-3}$ (background areas only) in 2020	Public health improvements, expressed as additional million life years saved compare to baseline in 2020 <sup>31</sup>	Percentage <sup>32</sup> exposure reduction in urban areas between 2010-2020, $\text{PM}_{10}$	Percentage exposure reduction in urban areas between 2010-2020, $\text{PM}_{2.5}$
Baseline	26.7%	0	6.7%	11.5%
Combined measure Q	11.9%	3.25	11.7%	17%
Scenario Z	0	1.57	10.1%	13.4%

# Exposure-Reduction Approach: the evidence

**Table 4.2:** Estimated annual cost and benefits of exposure reduction approach and current objective/limit values approach

	Estimated annual present value of additional benefits <sup>33,34</sup>	Estimated annual present value of additional costs
Baseline	0	0
Combined measure Q	£864m to £1,918m	£481m to £488m
Scenario Z	£349m-£820m	Difficult to estimate in detail but likely to be very high (i.e. much higher than £488m) both in economic and social terms

# UK Air Quality in 2050

- With optimal measures on climate change and air quality, it is possible to achieve improvements in air quality significantly greater than incremental measures on each
- Williams(2006) estimated future UK air quality in 2050 resulting from an aggressive pursuit of the UK long-term goal of a 60% reduction in CO<sub>2</sub> emissions
- Made assumptions of significant penetration of zero-carbon energy generation and in the transport sector
- Concluded that with optimal win-win policies for climate change and air quality, PM<sub>2.5</sub> and NO<sub>2</sub> urban background levels in London could decrease by ~55% compared to current levels

# UK Air Quality in 2050 and links with Climate Change

- High **hourly/8 hourly** ozone levels *may* become more frequent, with potential adverse effects on health
- The role of Biogenic emissions is likely to be crucial
- Urban **annual mean** levels will *certainly* increase towards the tropospheric background
- The tropospheric background may also increase
- How significant is this for human health? A key issue for the health effects community is the question of a 'no-effects' threshold for ozone



# Strategic link between Air Quality and Climate Change-challenge for policy

- If there is agreement to reduce GHGs by large amounts (60% and beyond) with a temperature rise of less than about 2C in mind then this could be done with major reductions in air pollutant emissions too
- So maybe we could set a long term goal for air pollutant emissions for say 2050 which embodies the energy and transport changes implicit in the GHG goal.

# WIN/WIN POLICIES

- Measures which reduce fuel use – energy efficiency, less transport activity
- Lower carbon intensity energy generation – ‘pure’ renewables (ie not biomass/biofuels), nuclear
- Low emission vehicles (hybrids...)
- Hydrogen economy IF generation of hydrogen is low carbon
- Carbon Capture and Storage
- Reducing aviation NOx ?
- Reducing global ozone

# TRADE-OFFS?

- Most aftertreatment techniques – FGD, particulate filters, (but note SCR can give the opportunity to optimise fuel consumption)
- Production of low sulphur fuels
- Diesel vs Petrol (Black carbon and CO<sub>2</sub> issues)
- Combined Heat and Power
- Biofuels and biomass burning
- Shipping emissions reduction?

# TRADE OFFS AND CONFLICTS- DIESELS

- Diesel vehicles – lower CO<sub>2</sub> vs higher Particulate and higher NO
- Two areas of concern:
  - dieselisation of the fleet and
  - trade offs of increased fuel consumption vs pollution abatement
- Mazzi and Dowlatabadi(2007) showed that from 2001 to 2020 the additional mortality due to increased diesel use in the UK would be 1850 deaths (910 due to Euro 3 and 940 due to Euro 4)

- But there are climate benefits from reducing Black Carbon-quantifying this is at the forefront of science at present
- Estimates suggest GWP(100yrs) is ~680
- But BC is short lived so GTP may be a better metric, then the effect is smaller over the longer term, but still a warming, so good climate reasons to remove particles from diesel exhausts
- Boucher et al at the Hadley Centre UK, estimate a 100yrs GTP for BC ~10 times smaller than the 100yr GWP
- So 'civilising' the diesel with control technologies for PM and NOx will reduce the conflicts between air quality and climate change goals