

Nitrogen Dioxide Ambient Concentrations and Future Control Measures

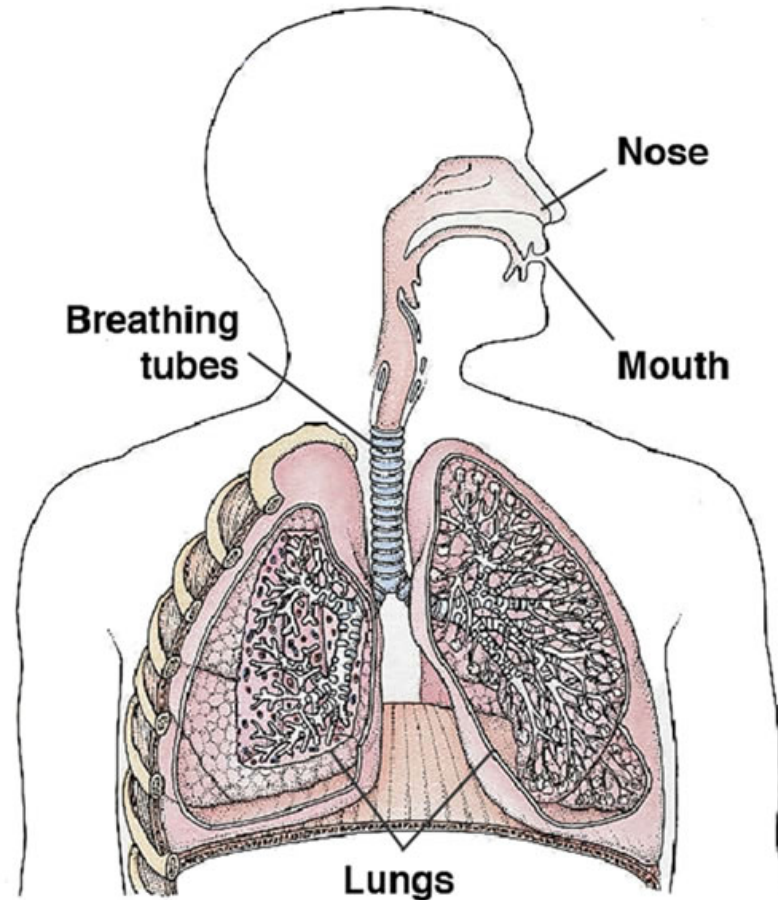


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Contents

- Introducing Inhalation Air in the context of Environmental Health
- Local and Regional Investigations
- Local Nitrogen Dioxide in Different Environments
- Mass Energy Equivalence and Local Air Quality Management
- Combustion Power and Emissions
- Challenges for Policy
- Future Measures
- Vehicle Disclaimer
- Conclusions

Inhalation



- When relaxing adults breath six times a minute
- A portion of the air sample we inhale passes into our blood via the alveoli
- haemoglobin in red blood cells passes oxygen to cell tissue
- White blood cells attempt to repel contamination

Air and Water – a Difference in Quality?

- Basic Sanitation - is a major break through for environmental health
- Waste water effluent is kept separate from drinking water; stopping typhoid and cholera
- Waste emissions from combustion not always sufficiently distinct from inhalation air
- Increased public awareness about life style health choices; diet-vegetables, exercise - less so for the air we breath

Environmental Protection for the most vulnerable

- The WHO and EU limit value for $\text{NO}_2 = 40\mu\text{g}/\text{m}^3$ is for the protection of the most vulnerable members of a population
- Likely to be newly born babies and the very elderly
- Rational - The Neo natal baby group is increasing across Europe as survival rates improve

Agglomeration Modelling



- Low Resolution
- Does not aim to determine local details where exceedence persists
- Predictions limited by emission factors
- Agreement with City Model on variable contribution of heavy vehicles on various road links
- Over optimistic on compliance dates



Environment Act 1995

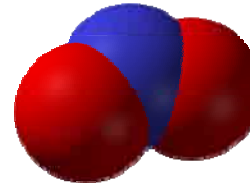
CHAPTER 25

LONDON: HMSO

£25.90 net

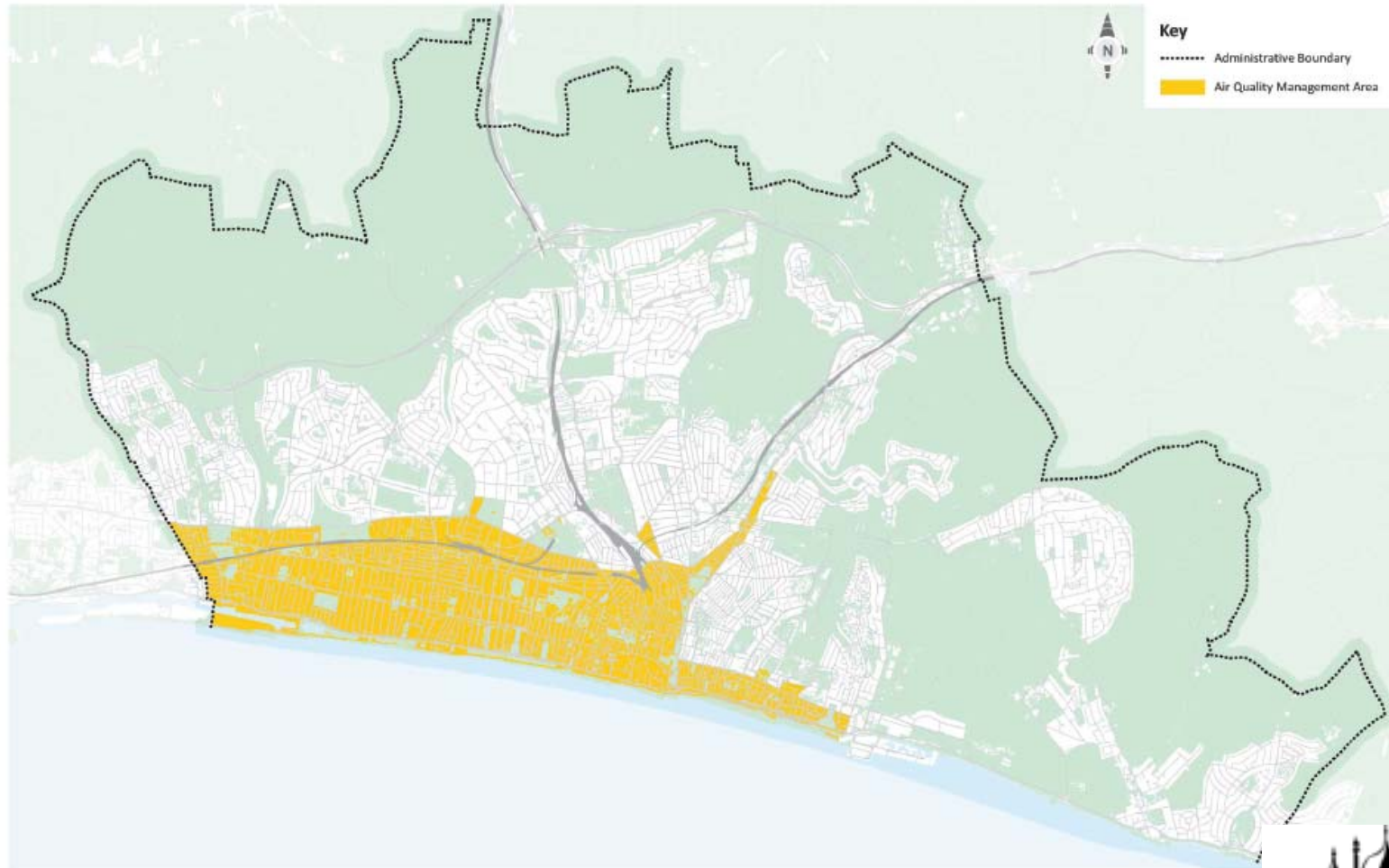
Part IV states

Local Authorities have a duty to investigate air quality in their areas. LAQM.

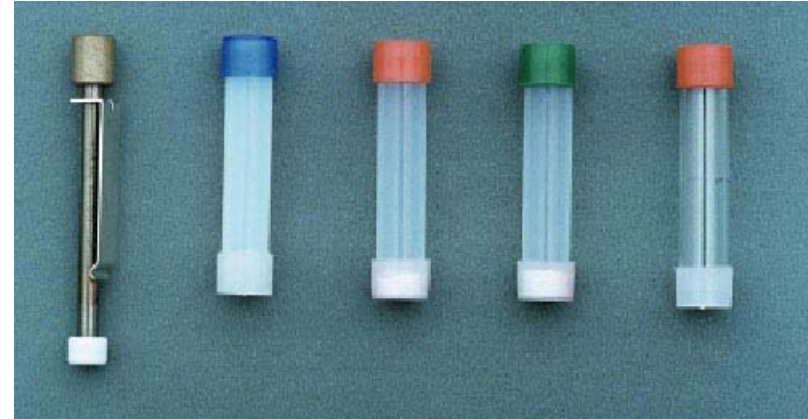


Nitrogen Dioxide can weaken disease resistance in the respiratory tract. Influence on lung tissue development in babies and those born early?

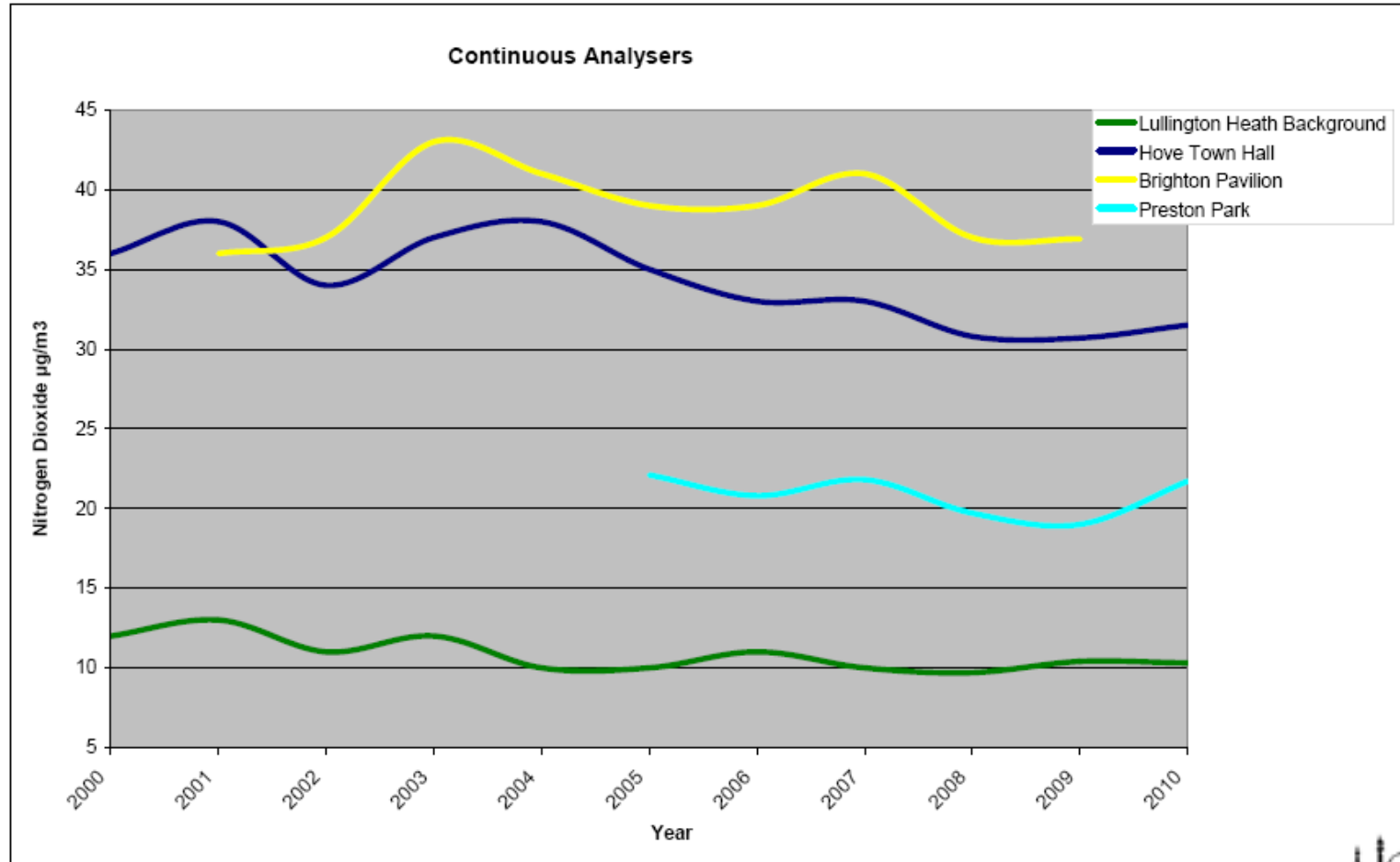
Air Quality Management Area



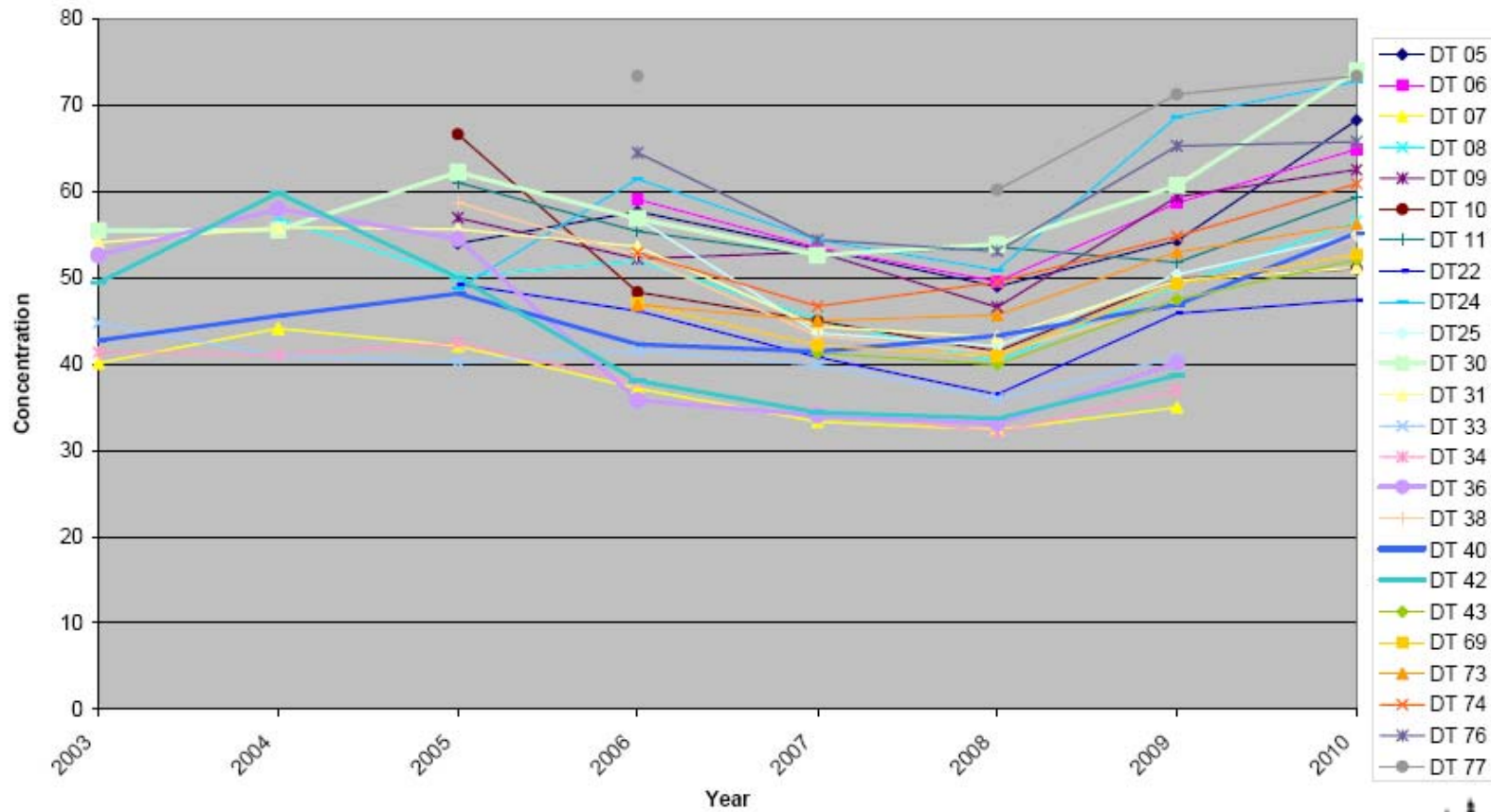
Air Monitoring



Continuous Analyser Trends



Diffusion Tube Trends



What is the Difference Between an Emission and an Ambient Level?

- An emission is discharged from a source usually an exhaust pipe or a chimney (mg/m^3)
- An emission disperses and dilutes in air before being inhaled
- A level is the concentration we breath ($\mu\text{g}/\text{m}^3$)
- Some emission sources are very close to where people live
- This gives less time and distance for effective dispersion and entrainment of fresher air

City Dispersion Model Predictions

Around 2% of the Brighton and Hove area (87.5 km²) continues to exceed the long-term objective for Nitrogen Dioxide

After the 2011 Census Results are released in July-12 we will have a better understanding of how many people live in this area



What a difference half a km makes!



Near Offshore Background $\text{NO}_2 = 11-13 \mu\text{g}/\text{m}^3$
Over five years



Roadside facade
 $\text{NO}_2 = 70 \text{ to } 80 \mu\text{g}/\text{m}^3$
Over five years

Streetscape an: influential variable on roadside NO₂



11m width Street Canyon with B-road

2,400 vehicles a day

Façade NO₂ 46 µg/m³

Average since 2003



Broad Main Coast Road

38,600 vehicles a day

Long Term City Roadside (not sea side)

NO₂ < 45 µg/m³ since 2003

Facades compliant with limit value

Village Enclosures



Surrounding the village Defra background $\text{NO}_2 = 13$ or $14 \mu\text{g}/\text{m}^3$ over 1km^2

Recorded Facade NO_2 in the High Street over three years between 46 to $54 \mu\text{g}/\text{m}^3$

$E = mc^2$ relevance to LAQM

- Mass–energy equivalence E is energy, m is rest-mass and c is speed
- Inertia equal to kinetic energy
- Gradients increase gravitational force on mass – more energy required to move heavy bodies
- Real world emissions relate to gear changes, acceleration rate, road gradient, fuel - RPM

Evolution of carrying vehicles



Heavier chassis compared to older vehicles

Current bus = 12,000 kg

Old Routemaster = 8,000 kg

9 litre engines

Large Low speed engines may = more NO_x

More BHP in sprinter vans and diesel cars

Is MPG in diesel vehicles compromised by increases in size, weight and power?

Combustion Process Thermal NO_x

- Hot temperature-window breaks binary O₂ releasing energy
- Free Oxygen atoms readily combine with reservoir of nitrogen in air to form NO
- NO is oxidized to NO₂ in the combustion chamber and in ambient air
- Efficient combustion reduces PM and CO, but NO and NO₂ still result; what is air-fuel ratio?
- Abatement has an optimum temperature
- Engine and CAT degrade with time

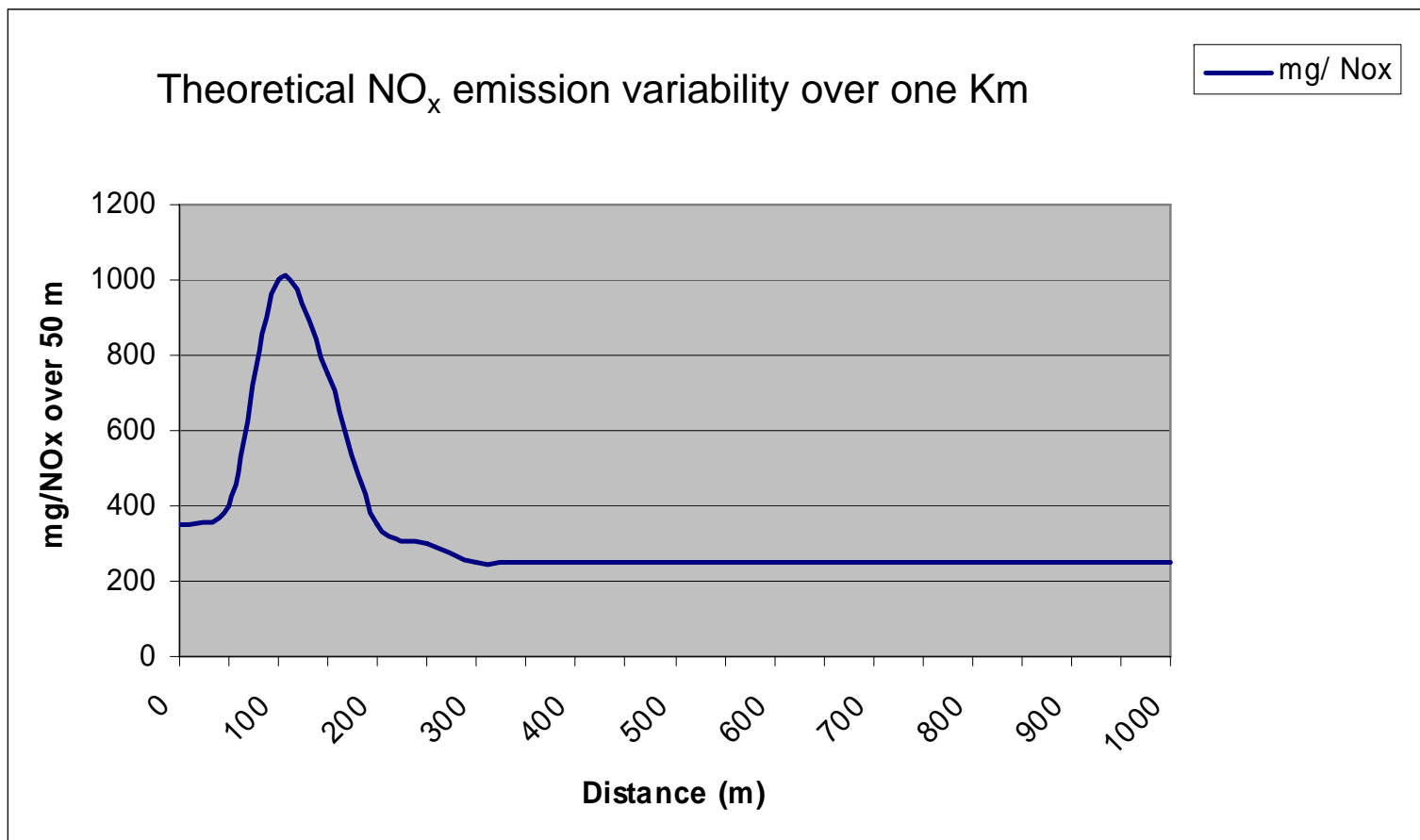
Power stations vs road traffic

- Large plant easier to control and manage
- Best Available techniques in combustion, abatement and dispersion easier to implement for large plants
- Tall chimney more effective for dispersion
- Industrial emissions often remote from residential areas, roads often adjacent
- Regulation disproportional to real impact

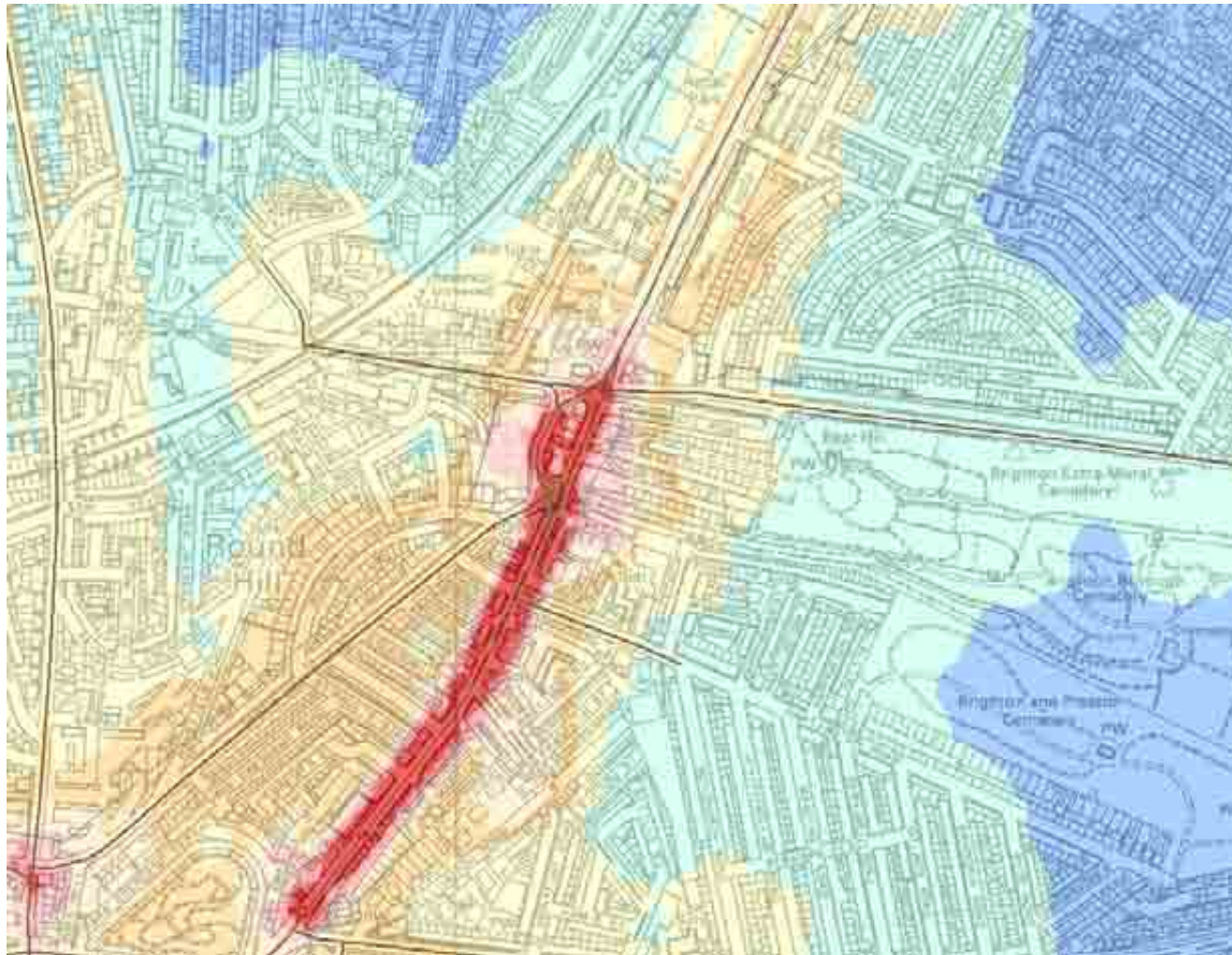
Tail pipe emissions

- Euro five diesel emission rates for NO_x likely to cause breach of air quality values
- Increase in diesel will compromise urban air quality – especially outside of London
- Euro Four diesel cars 250 mg/ NO_x km
- Euro Five diesel cars 180 mg/ NO_x km
- Euro Five petrol cars 70 mg/ NO_x km
- California all-fuel cars 40 mg/ NO_x /km

Euro Four diesel cars 250 mg/NO_x km



Pollution maps: 30 to 60 $\mu\text{g}/\text{m}^3$ NO_2 within 150m



Challenges for Policy

- Construction Environment Management plans and routing proposals?
- Influence of 20 mph zones on air quality?
- Definition of Transport Choice and Modal Shift?
- Contribution from private cars vs other sources not estimated well by DfT emission factors
- Low Emission Strategy needs to be more than switching from Euro II to Euro IV i.e. the do nothing scenario
- Various housing quality resides in poorer air
- Will micro-generation bring new emissions sources to high-density residential areas?
- Petrol emission improvements in CO, lead, benzene and NO_x
- Diesel has not delivered NO_x improvement since Pre-Euro – 10p difference between diesel and petrol price

Fines for Councils?

- In its original form the Localism Bill gave ministers sole power to force councils to pay fines levied by the EU against the UK Government for missing national targets
- Ministers will be prevented from arbitrarily passing EU fines onto councils under key concessions to the Localism Bill which have been secured by the Local Government Association (LGA).

What we can do?

- Educate
- Walking, Cycling and travelling less in the urban realm
- Local Transport Planning
- Intelligent Procurement of Vehicles
- Infrastructure Planning for Alternative Fuels
- Policy Decisions
- Vehicle Manufacturers
- Ethical Investments & Pensions
- Developer Responsibility
- Informed Consumers



Information for Consumers



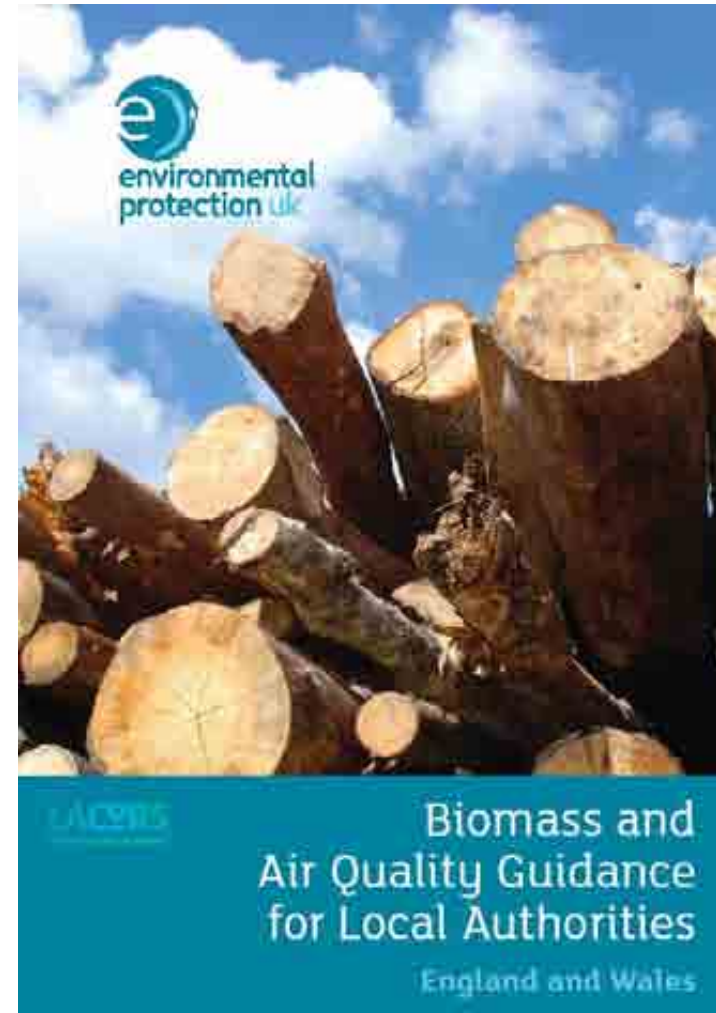
Fuel Consumption MPG: urban and extra urban
CO₂ Emission g/km

NO_x Emission mg/km and peak over < 200m

Role for the MOT tail pipe test?

Cost to buy vs cost to run

Development Control and Air Quality Guidance



Travel plans and education



Future Measures

- Behavioural Change in transport choices
- Decarbonisation – weaning off fossil fuel
- Emissions Reduction through graduated fuel change
- Infrastructure for AD-BG / CNG & Electrical Vehicles
- Smart Travel & IT, sophisticated software & ticketing
- Reduce and Consolidate freight – software applications
- Development Control ventilation & mitigation
- Exposure Avoidance – plan permission for care homes
- PCT outreach for neonatal care
- Centrally powered public transport system such as electrical tram or trolley bus for vehicle emission avoidance
- A balance between grid centralisation and micro-generation; a portfolio of supply - offshore wind power

Land Rover's Disclaimer

- *“The results given here do not express or imply any guarantee of the fuel consumption of any particular vehicle with which this information may be supplied. Vehicles are not individually tested and there are inevitable differences between individual vehicles of the same model. The vehicle may also incorporate particular modifications. Furthermore, the driver's style and road traffic conditions, as well as the extent to which the vehicle has been driven and the standard of maintenance, will affect its fuel consumption”.*
- **The same can be said for emissions of NO and NO₂ from internal combustion engines.**

Conclusions

- NO₂ continues to exceed EU-WHO and US limits at buildings adjacent to worse-case roadsides – not only in the largest cities
- No improvement on worse-street NO₂ in a decade
- Since 2008 on some road links we record a decrease in total traffic and an increase in roadside NO₂
- Total traffic number may not be the most influential variable for roadside air quality
- Our local model and AEA-defra agree the contribution from heavy vehicles varies between streets and diesel vehicles contribute the majority
- In our AQMA the contribution to roadside NO_x from private cars is predicted to be: 2-40%. DfT Emissions factors are likely to under estimate car contribution - where there are high proportions of diesels and old petrol cars