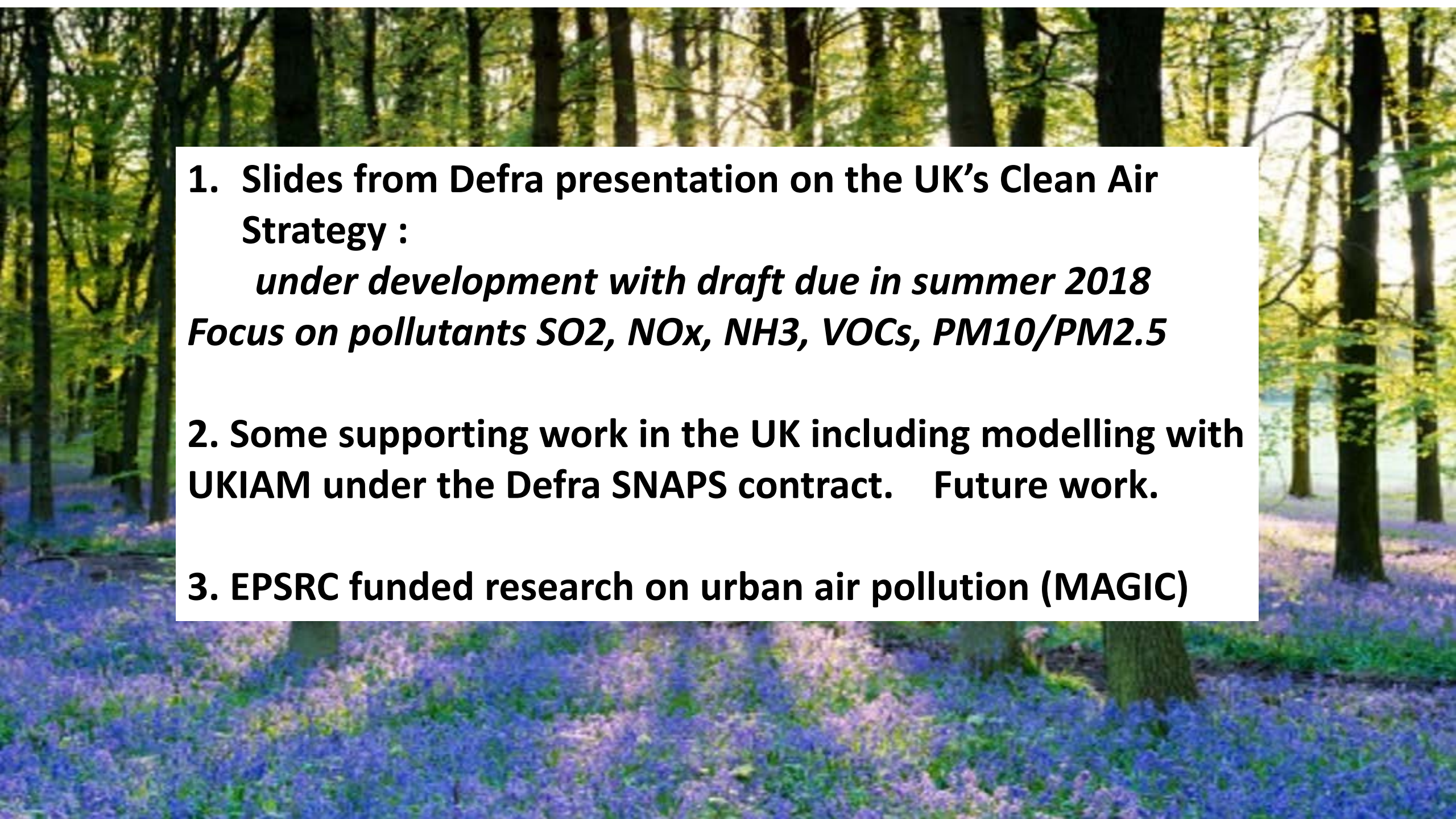
An update from the UK: the CLEAN AIR STRATEGY



1. **Slides from Defra presentation on the UK's Clean Air Strategy :**

   under development with draft due in summer 2018

Focus on pollutants SO2, NOx, NH3, VOCs, PM10/PM2.5

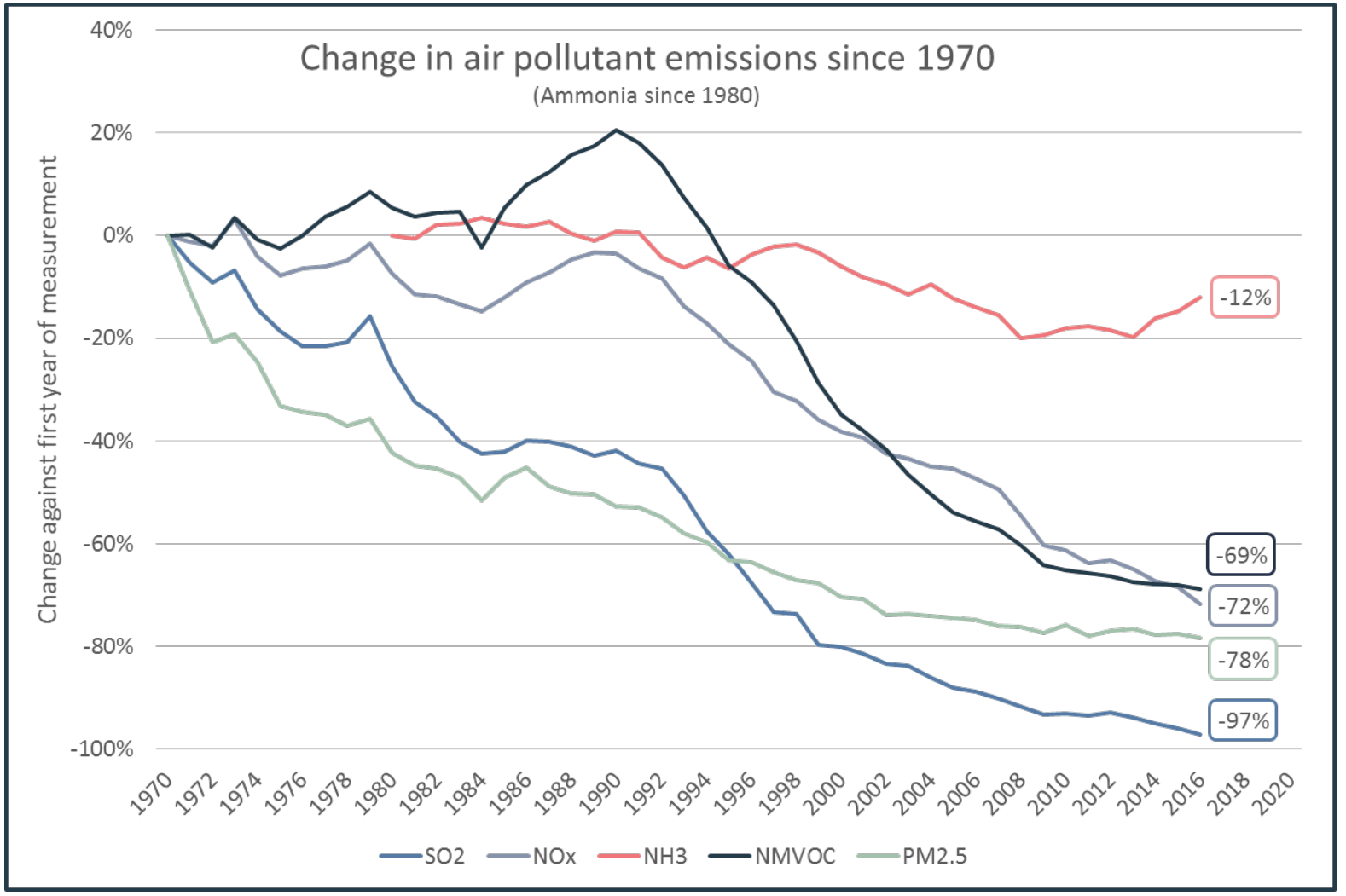
2. Some supporting work in the UK including modelling with UKIAM under the Defra SNAPS contract. Future work.

3. EPSRC funded research on urban air pollution (MAGIC)

Department
for Environment
Food & Rural Affairs

Slides provided from Defra on the Clean Air Strategy: reducing emissions of air pollution

Emissions of air pollution have decreased



POLLUTANTS THAT AFFECT **AIR QUALITY**

Primary Particulate Matter ($PM_{2.5}$)

*percentage of total $PM_{2.5}$ emissions (2016) source: NAEI 2018

SOURCES

Domestic wood & coal burning — 38%*

Industrial combustion — 16%*

Road transport — 12%*

Use of solvents & industrial processes — 13%*

IMPACTS

These tiny particles from smoke, soot and dust can get into the...

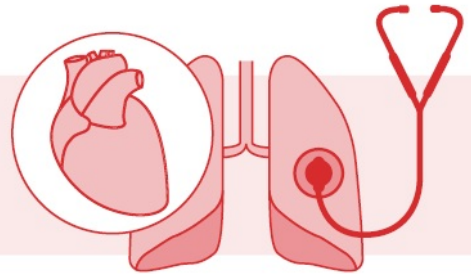
lungs and blood

PM can be transported around the body

and get embedded in organs

More likely to be affected are:

those already suffering from lung and heart conditions



the elderly

pregnant woman and their unborn babies

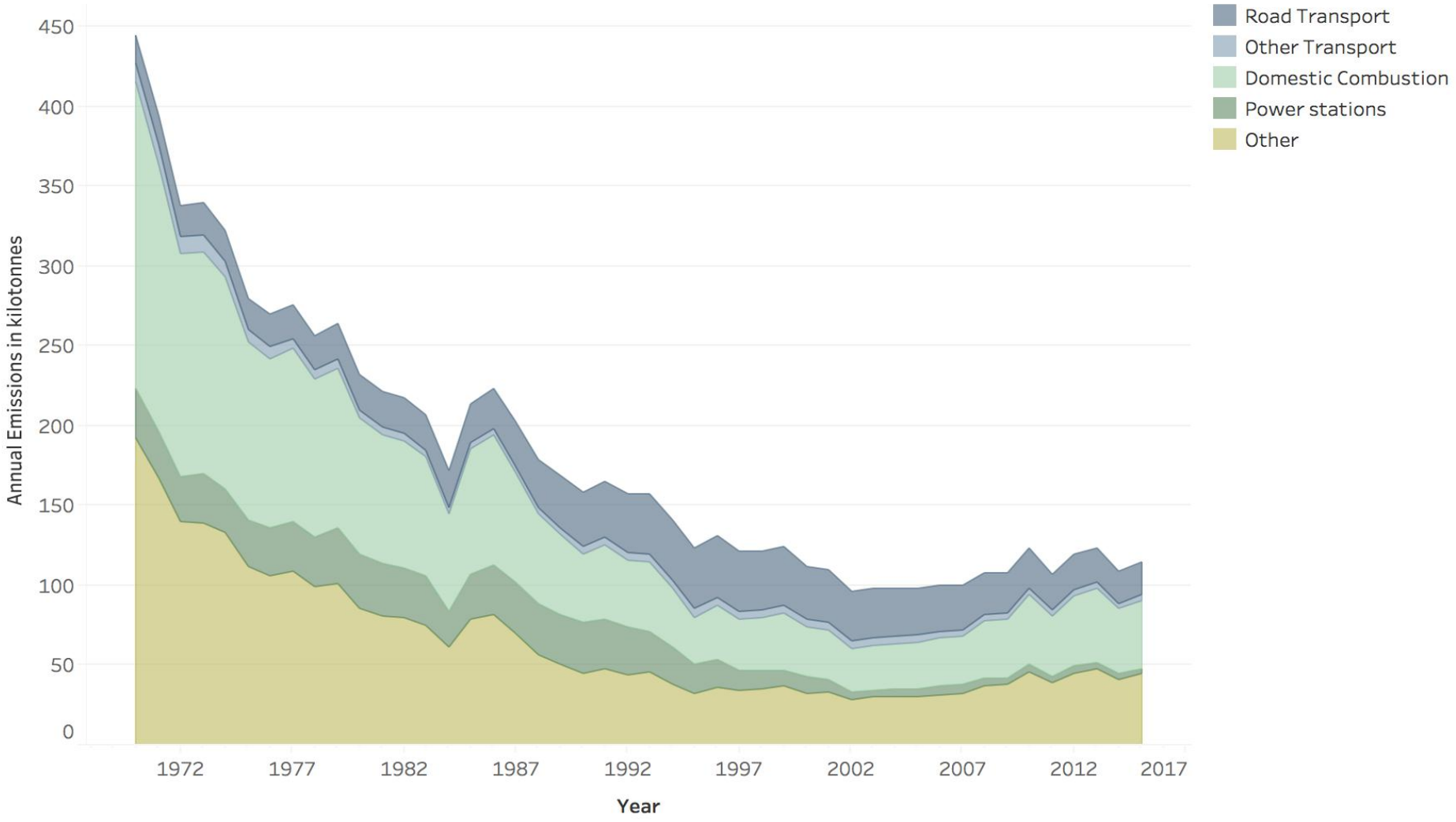
and the very young

LIFESPAN

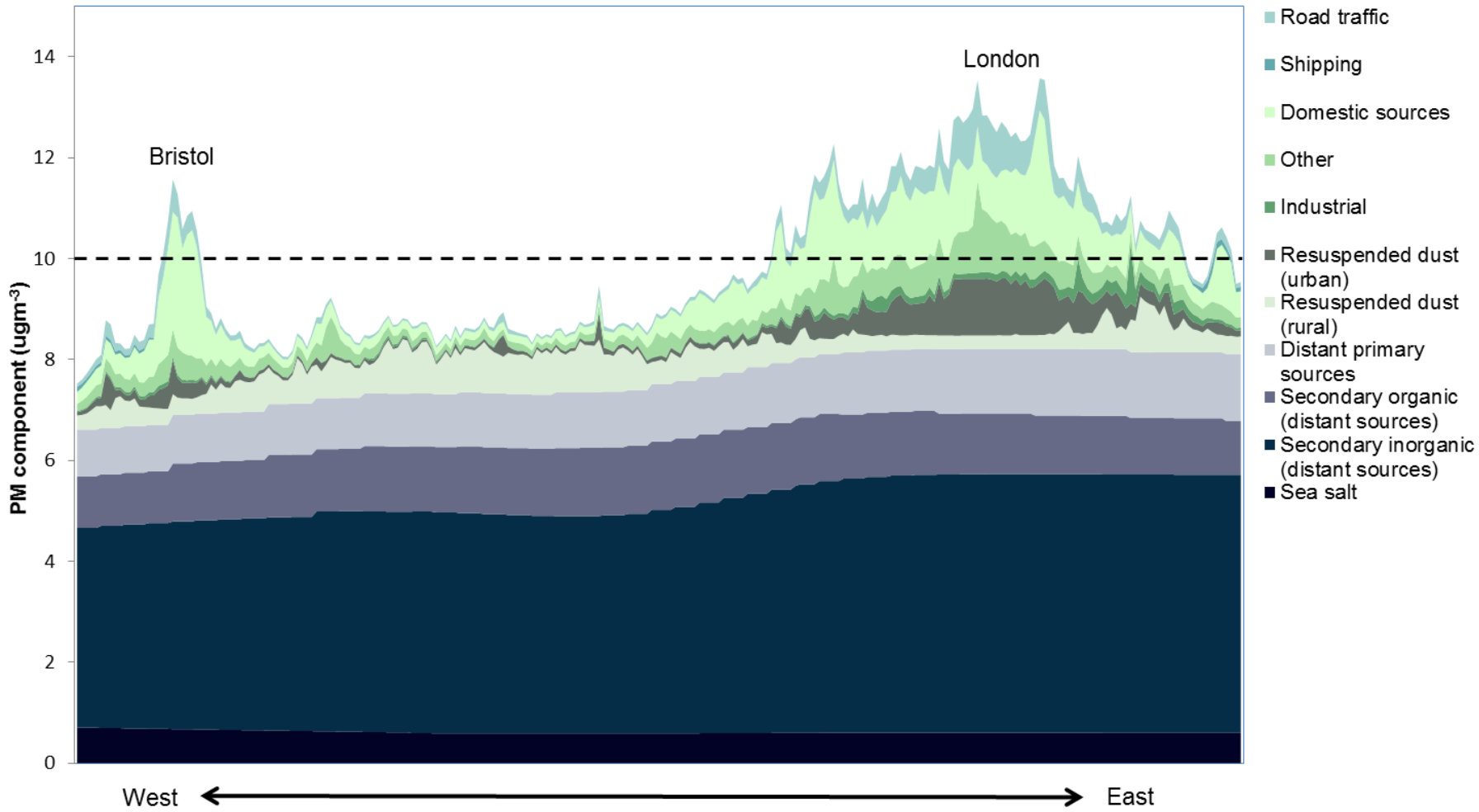
$PM_{2.5}$ can **shorten** lifespans

Original design by Defra Digital Comms

Total PM2.5 emissions by year



Annual mean $PM_{2.5}$ west to east transect across the UK for 2016 from PCM model



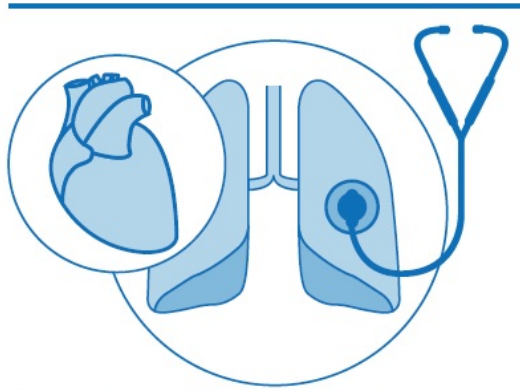
POLLUTANTS THAT AFFECT **AIR QUALITY**

Nitrogen oxides (NO_x) pollution

*percentage of total NO_x emissions (2016) source: NAEI 2018

SOURCES

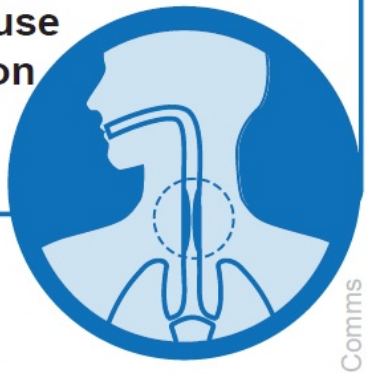
Road transport	34%*
Near roadsides	80%
Energy generation	22%*
Domestic & Industrial combustion	19%*
Other transport	17%*



Exacerbates symptoms
of those already suffering from lung or heart conditions shortening lives and reducing quality of life

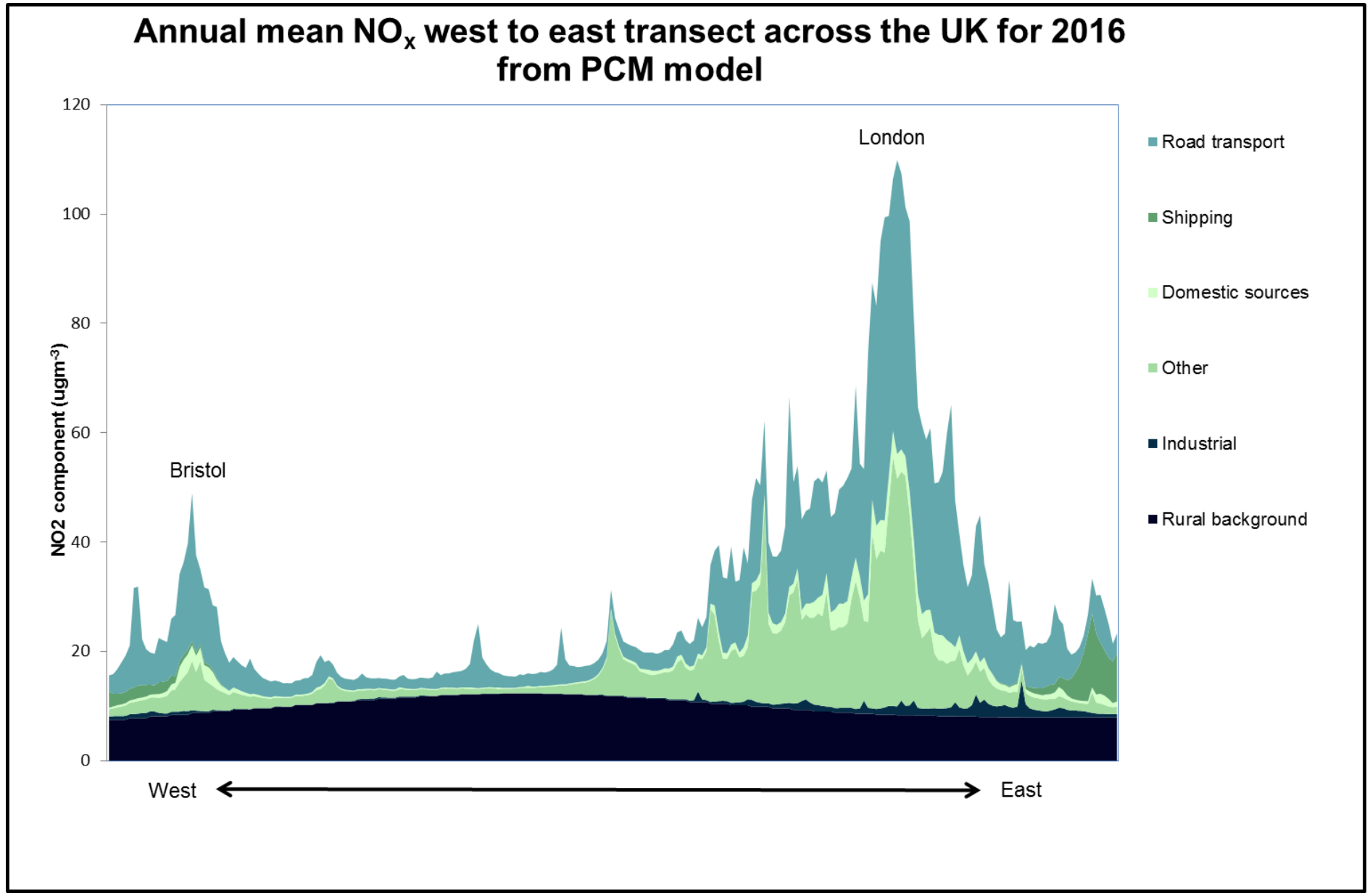
high levels of NOx can change soil chemistry and affects biodiversity in sensitive habitats

Short-term exposure to high concentrations of NO_2 can cause inflammation of the airways



INCREASES susceptibility:
- respiratory infections
- allergens

Original design by Defra Digital Comms


Annual mean NOx west to east transect across the UK for 2016 from PCM model
120
100
80
60
40
20
0
NO2 component (ugm-3)
London
Bristol
West
East
Road transport
Shipping
Domestic sources
Other
Industrial
Rural background

POLLUTANTS THAT AFFECT **AIR QUALITY**

Ammonia (NH_3)

SOURCES

Agriculture
(includes anaerobic digestion)

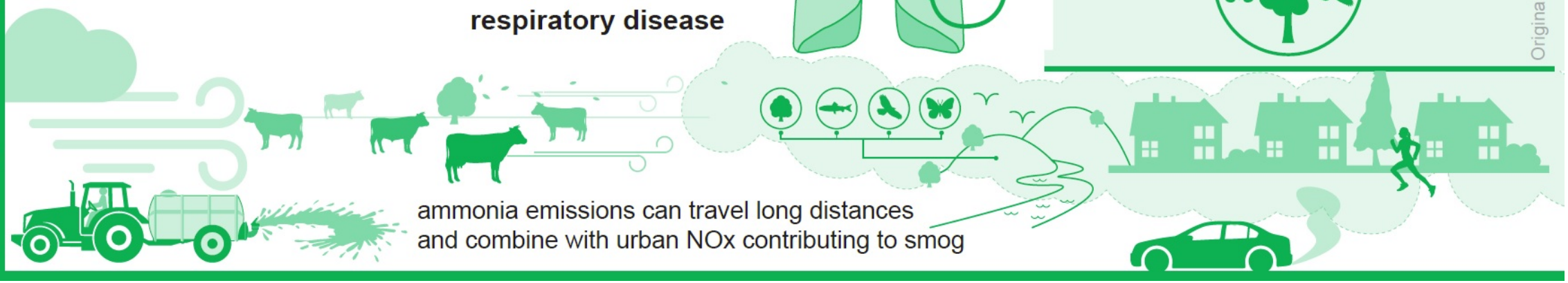
88%*

*percentage of total NH_3 emissions (2016) source: NAEI 2018

IMPACTS

Ammonia reacts in the atmosphere to produce particulate matter (PM) which has significant health impacts including:

cardiovascular and respiratory disease



ammonia emissions can travel long distances and combine with urban NOx contributing to smog

The effects of ammonium deposition

acidification of habitats

excessive nitrogen in habitats

reducing biodiversity

Original design by Defra Digital Comms

POLLUTANTS THAT AFFECT AIR QUALITY

Volatile organic compounds (VOCs)

SOURCES

Industrial processes	22%*
Household products	18%*
Agriculture	14%*
Residential burning	5%*
Transport	5%*

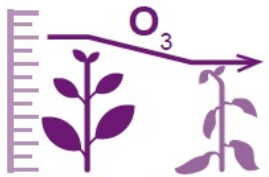
*percentage of total VOC emissions (2016) source: NAEI 2018

IMPACTS

VOCs can form airborne PM

VOCs REACT with other pollutants → O_3 ground level ozone

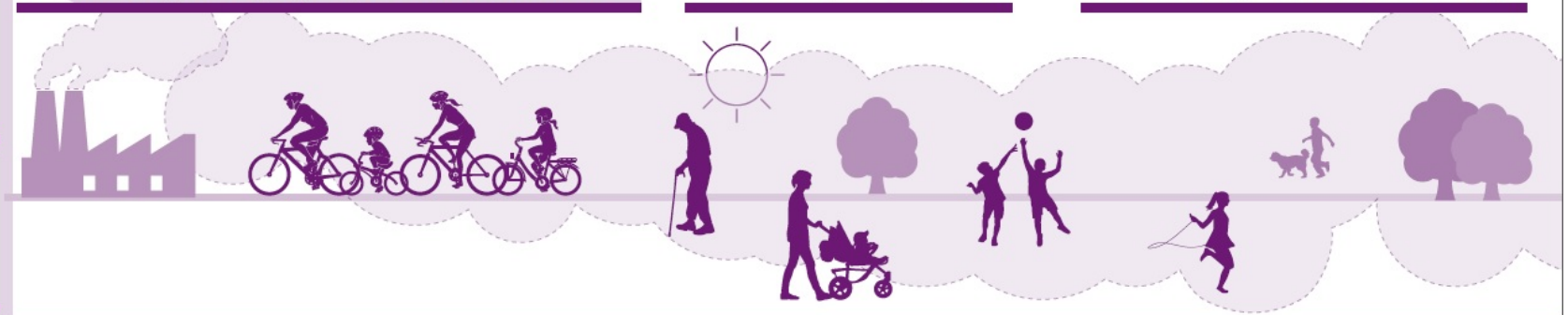
Ozone can cause inflammation of the respiratory tract, eyes, nose and throat



it affects plant growth

potential impacts on:

biodiversity & climate change



POLLUTANTS THAT AFFECT **AIR QUALITY**

Sulphur dioxide (SO_2)

SOURCES

Energy generation — 37%*

Industrial combustion — 22%*

Manufacture & use of domestic solid fuel — 22%*

*percentage of total SO_2 emissions (2016) source: NAEI 2018

IMPACTS

A respiratory irritant that can cause constriction of the airways

People with asthma are particularly sensitive

Health effects can occur very rapidly

Contributes to the formation of **ACID RAIN**

SO_2 pollution damages the environment

this affects biodiversity

Air quality in 25 Year Environment Plan

Launched by PM on 11 January

Sets out how we will improve the environment within a generation including measures to improve Air Quality:

- Legally binding targets to reduce emissions of five damaging air pollutants. This should halve the effects of air pollution on health by 2030.
- Ending the sale of new conventional petrol and diesel cars and vans by 2040.
- Maintaining the continuous improvement in industrial emissions by building on existing good practice and the successful regulatory framework.
- Exploring options to address pollution from coal and wet wood.
- Legislating to set limits on the levels of air pollutants that MCPs and generators can emit.
- Working with farmers to use fertilisers efficiently to reduce release of ammonia

Recent progress

- Legislation passed on Medium Combustion Plants and high-NOx generators – now being implemented
- HMT-Defra call for evidence on the use of red diesel in towns and cities was announced by Chancellor in Spring Statement
- Legislation passed on National Emissions Ceilings Directive targets
- Countryside Productivity grants offered for low emissions farm equipment (from Autumn 2017), Ammonia events for farmers run by Campaign for the Farmed Environment throughout Spring 2018
- Call for evidence on Domestic fuel burning ran from 30 January to 27 February 2018; 315 responses received from a range of sectors.
- Round Table with industry and experts on NMVOCs from domestic products looking at what action should be taken to address indoor air pollution held on 19th April
- Round table with health experts and organisations considering achievable health-based targets for particulate matter held on 26th April

What the Clean Air Strategy will do:

- Tell a wider story on air pollution than diesel vehicles, clearly and simply
- Set out how we propose to meet our emissions reduction targets by reducing emissions from significant sectors
  - Domestic
  - Farming
  - Industry
  - Transport
- Accelerate work on areas where evidence/solutions not yet clear enough e.g. tyres and brakes, non road mobile machinery / red diesel, VOCs
- Strengthen framework for future action

Defra contract Support for National Air Pollution Strategies, SNAPS -> modelling of UK scenarios up to 2030 with UKIAM combining:-

National Atmospheric Emission Inventory, NAEI & projections

Abatement measures: Multi-Pollutant Measures Data base+ measures for NH3

Atmospheric modelling from UK to street scale +EMEP

Protection of UK ecosystems and crops

Health effects and costs : reflecting work of COMEAP

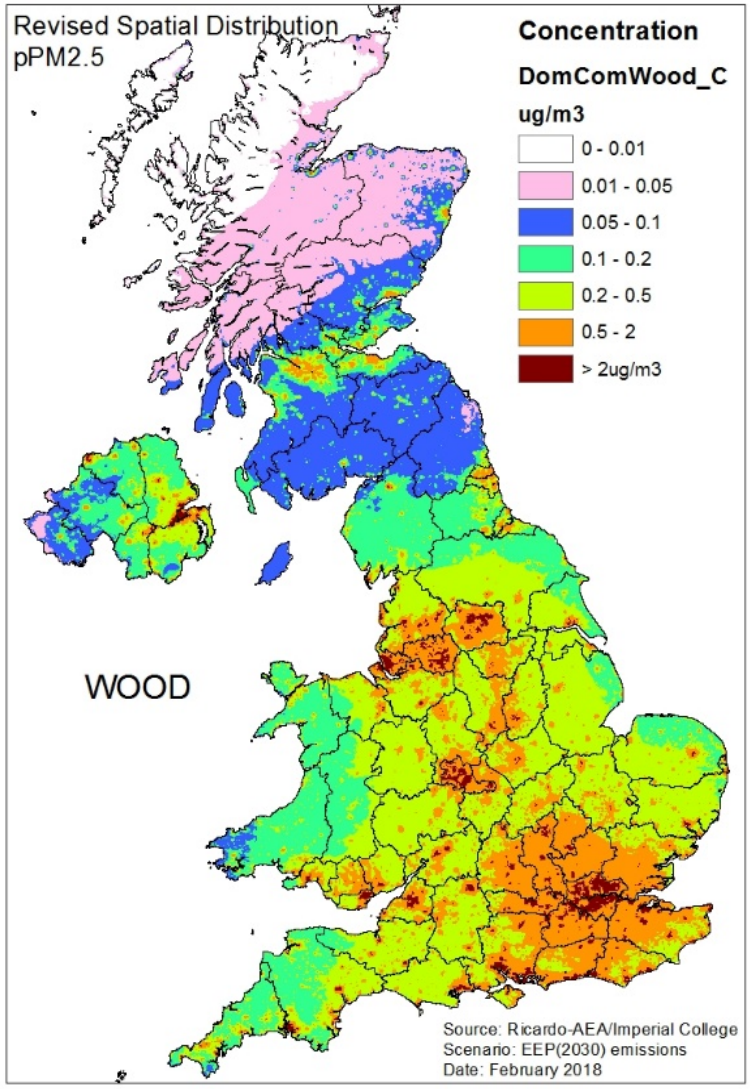
DOMESTIC WOOD-BURNING

Revised emissions of PM2.5 from domestic combustion-> much higher emissions from wood- burning, and in urban as well as rural areas.

Mapped concentrations much more consistent with observations by Kings College of 1 -2 ug/m3 in London in winter.

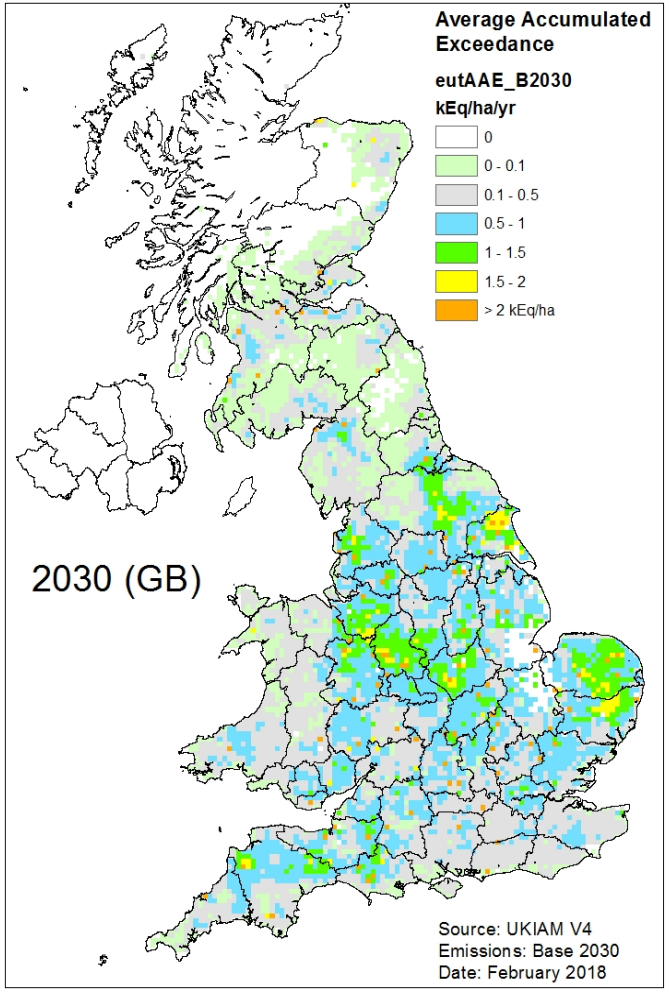
Big uncertainties both in wood consumed, type of stove/fire & fuel quality /storage - wet/dry wood combusted

Concentrations of PM2.5 from wood-burning in 2015 ug/m3 (UKIAM)



NH3 abatement scenarios agriculture & anaerobic digestion

as modelled in UKIAM



Acidification much improved

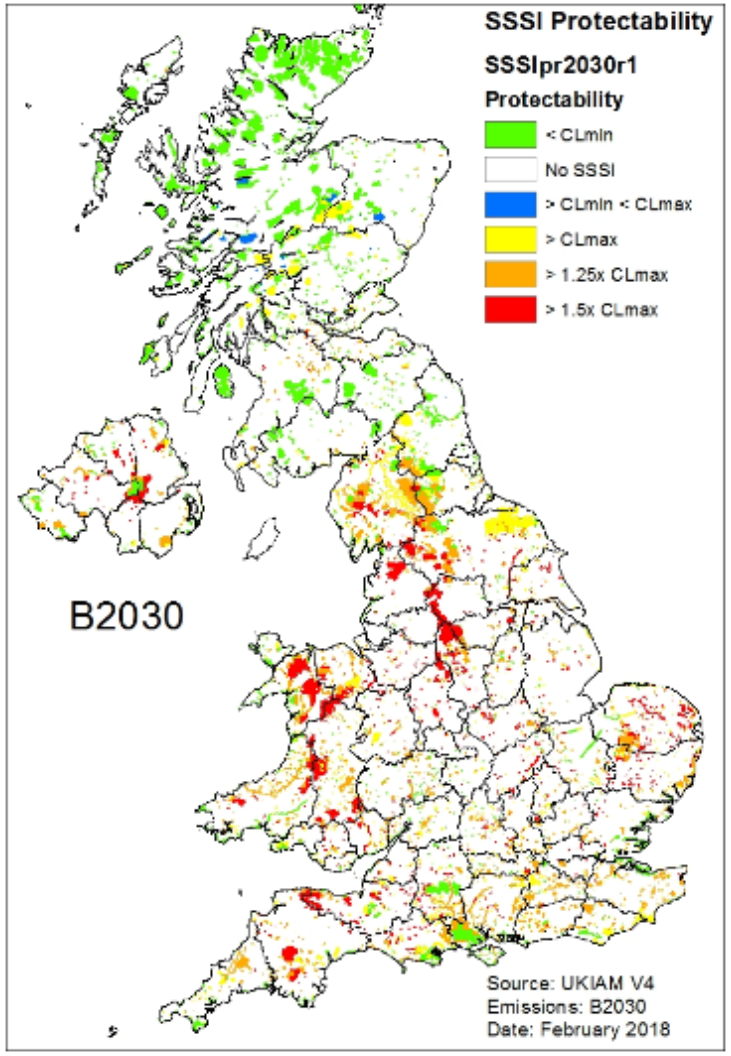
Eutrophication bigger problem

<- critical load exceedance all ecosystems

But particular emphasis on Natura 2000 sites and Habitats Directive+nationally important nature conservation sites

-> risk based approach

SSSIs and specific habitats within them



More general scenario analysis:

2015 as current situation & for validation

2030 BAU scenario + high, medium, and low ambition scenarios for attaining ceilings (based on MPMD and NH3 measures)

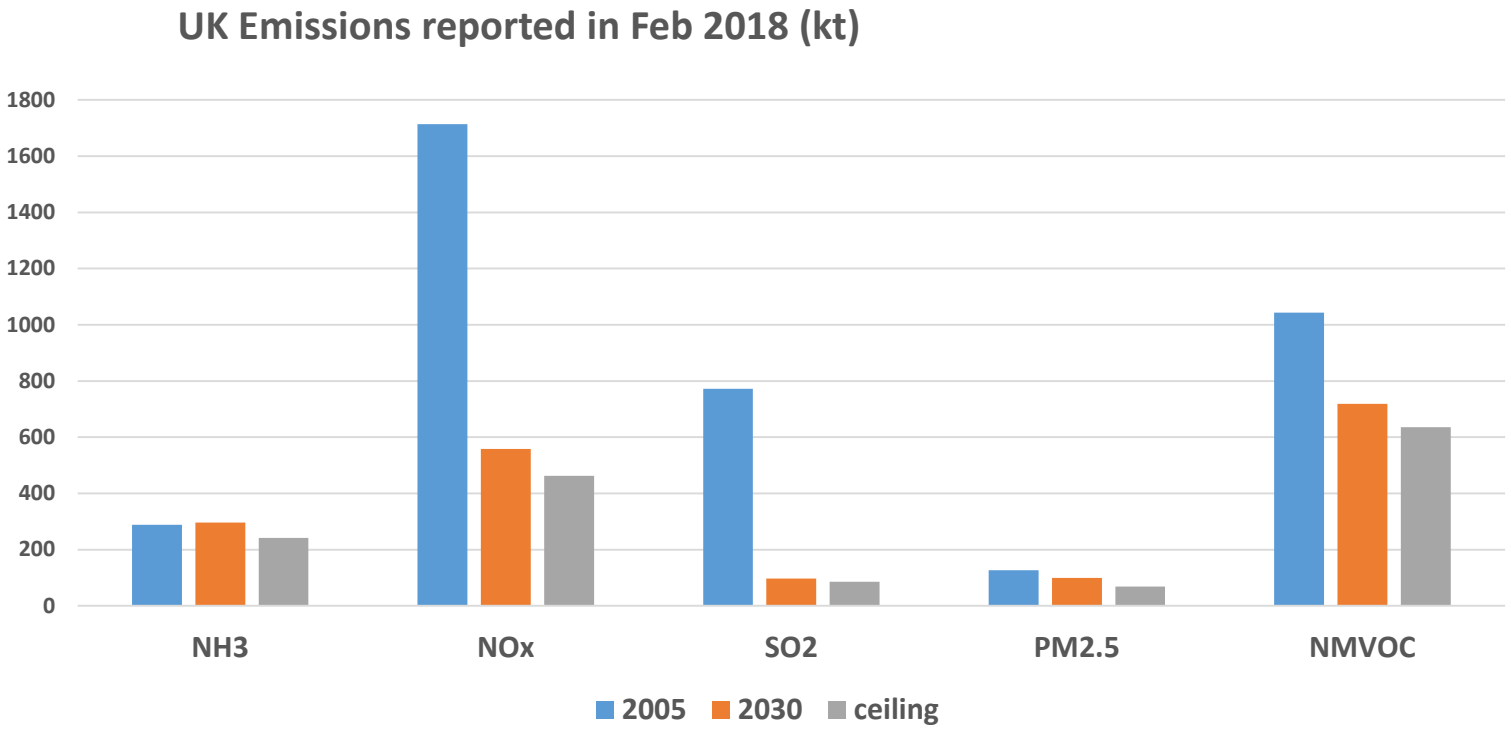
Cost benefit analysis consistent with IGCB assumptions and COMEAP recommendations re exposure to PM2.5 and to NO2:

Unadjusted NO2 coefficient 1.023 (95% CI 1.008,1.037) per 10 ug/m3 ann ave NO2 within a mix of co-existing pollutants

Effect of NO2 itself on mortality 40% (25 -55%)

Ref:"UK plan for tackling road-side concentrations" in July 2017. Appendix A of the technical report

Future work based on latest emission projections



Ref: UK Informative Inventory Report (1990-2016)
https://uk-air.defra.gov.uk/library/reports?report_id=956

Indicative scenarios

Specific sources e.g wood-burning etc

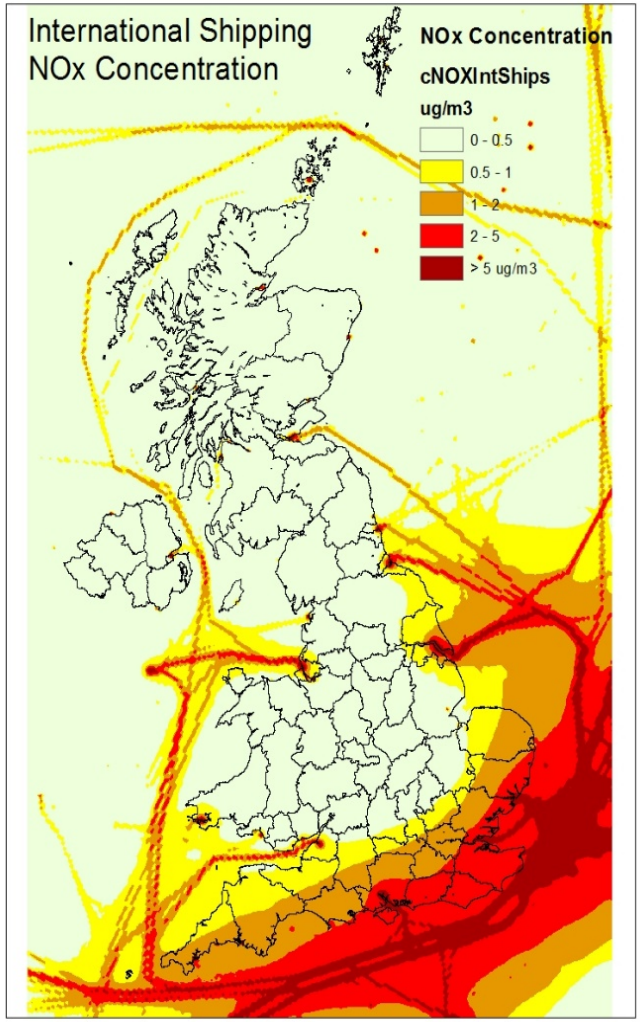
Agriculture NH3 & ecosystem protection

Road transport- evolving fleets (CO2 and AQ)

Shipping –(new inventory UK shipping emissions)

NB international contribution from shipping in Channel

? Effect of NECA



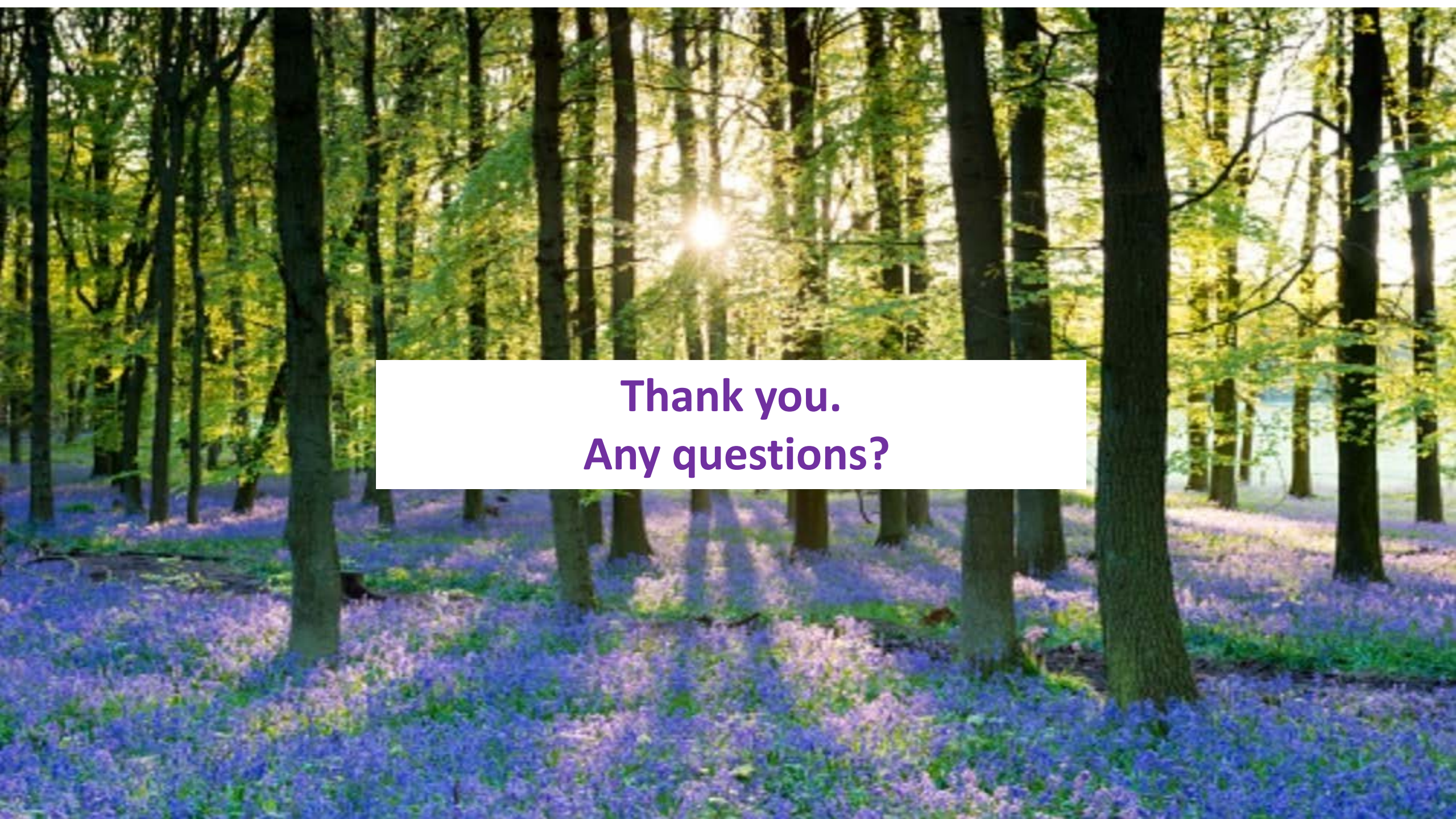
non-Defra funded research related to urban air pollution

Transport and hot-spots: other independent research

Modelling instantaneous exhaust emissions (with Cambridge & Imperial): uses PEMS data building on previous work on real-world exhaust emissions Linked to traffic modelling (VISSIM)

MAGIC project with Cambridge, Imperial & Surrey (funded by EPSRC): advanced CFD "Fluidity" code to model dispersion + field campaign central London area with tall buildings-> 3D concentration fields outdoors<-> indoor air pollution/ naturally ventilated buildings : www.magic-air.uk

-> modelling of turbulent flows and dispersion within and above urban canopy including street geometries and roof shapes etc, junctions. Investigates effects of moving vehicles on turbulence and dispersion e.g. buses in narrow canyons dragging pollutants upwind. Marked effects of tall buildings on flows and dispersion in wind tunnel and Fluidity. Comparisons with ADMS regulatory modelling


Thank you.
Any questions?