Tackling Air Quality in London

The Environmental Research Group
King's College London

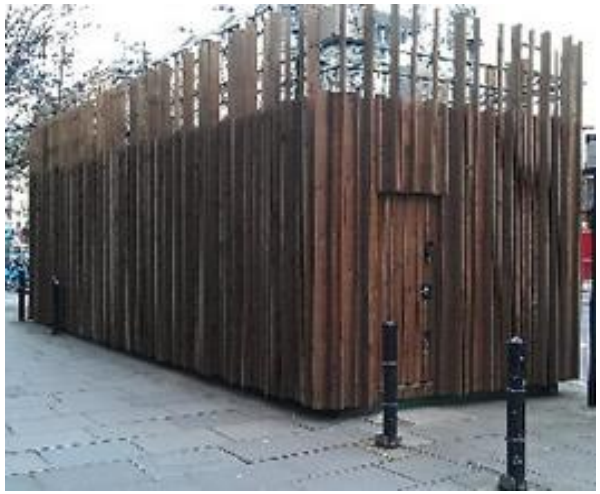
Dr David Dajnak
david.dajnak@kcl.ac.uk

MRC-HPA Centre for Environment and Health
Imperial College London

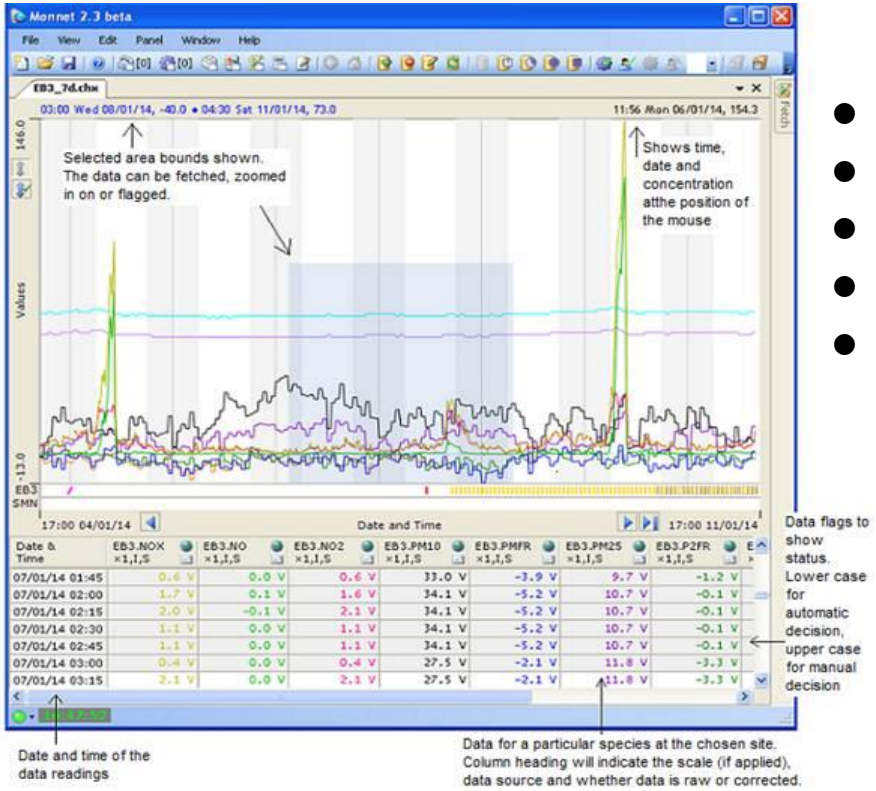
London Air Quality Network

http://www.londonair.org.uk/LondonAir/Default.aspx

- Compliance networks (>100 sites) - worlds biggest
- NO_X, NO_2, PMnumb, $PM_{2.5}$, PM_{10}, SO_2, O_3, CO, VOC's



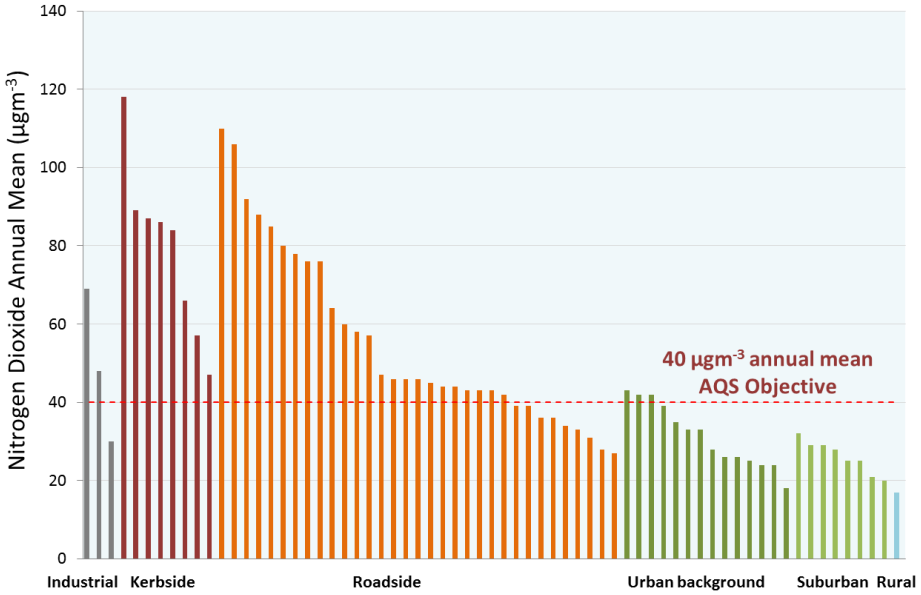
Marylebone Road super-site

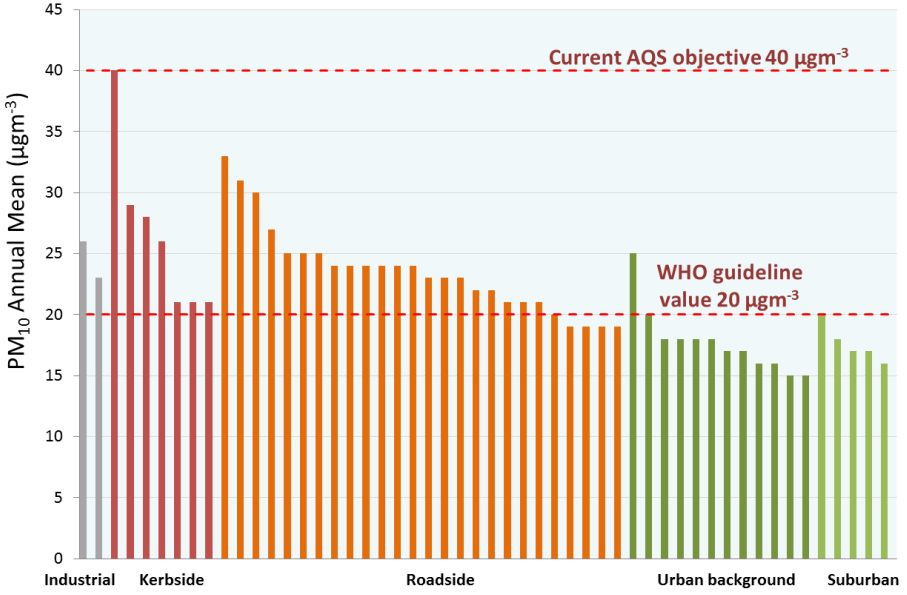


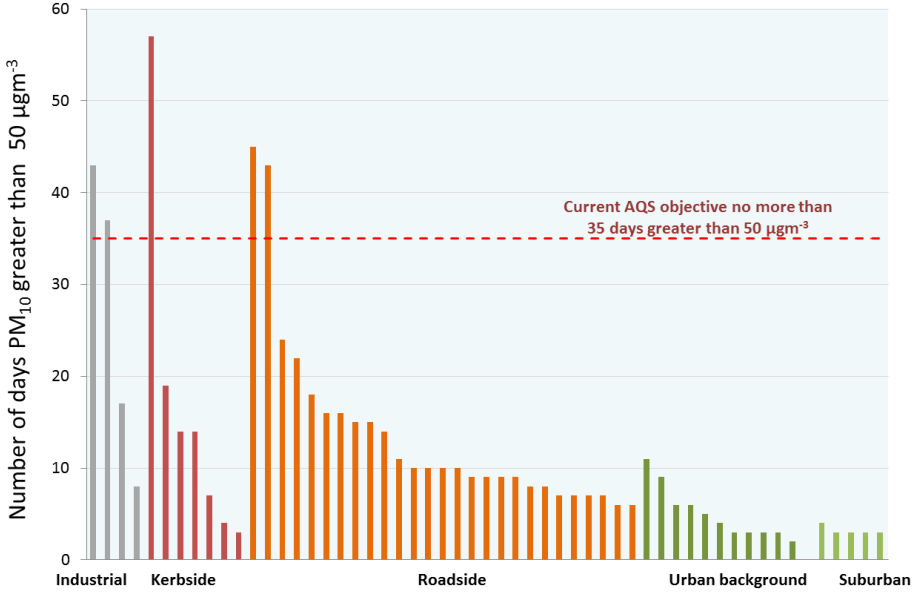
- reports
- nowcast
- forecasts
- data downloads
- site information

MONNET - Network management system

What is the AQ problem in 2016?





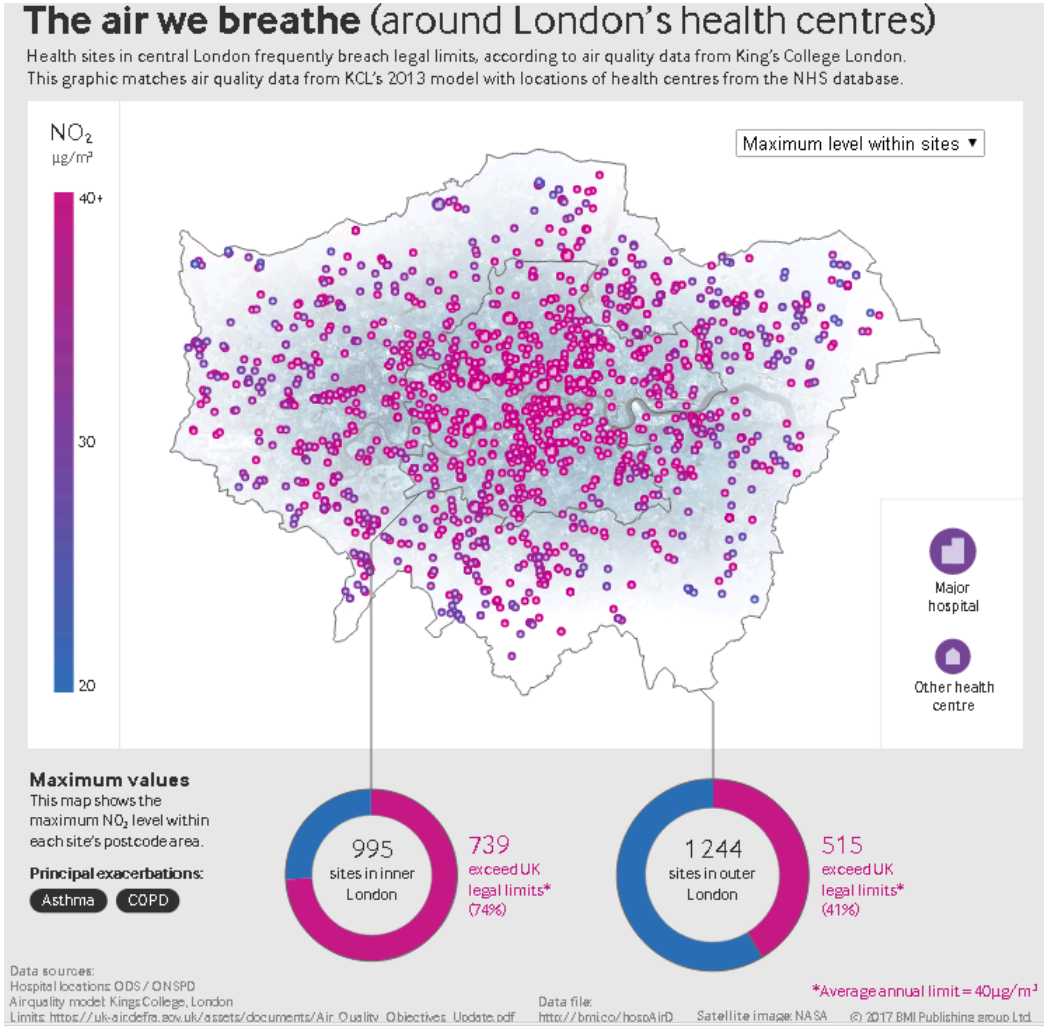


London's Air Quality Problems

- Policies and technology: **failed** to bring NO_2 below the legal limits
- Reduced lung function growth, increased symptoms of bronchitis in asthmatic children, low birth weight and reduced life expectancy associated with long-term exposure to NO_2
- Tackle air pollution: **legal obligation** and **protect public health**
- Over 9,000 Londoners died prematurely from long-term exposure to air pollution in 2010
- Dieselisation of the UK fleet over the last 15 years has been prioritised by successive British Governments, with road transport responsible for half of London's total NO_X emissions in 2010
- ' **Dieselisation**' not been good for air quality!
- Diesel cars and vans predicted to make up 70% of London's total road transport NO_X emissions by 2025
- Need for more ambitious **Air Quality Strategy**

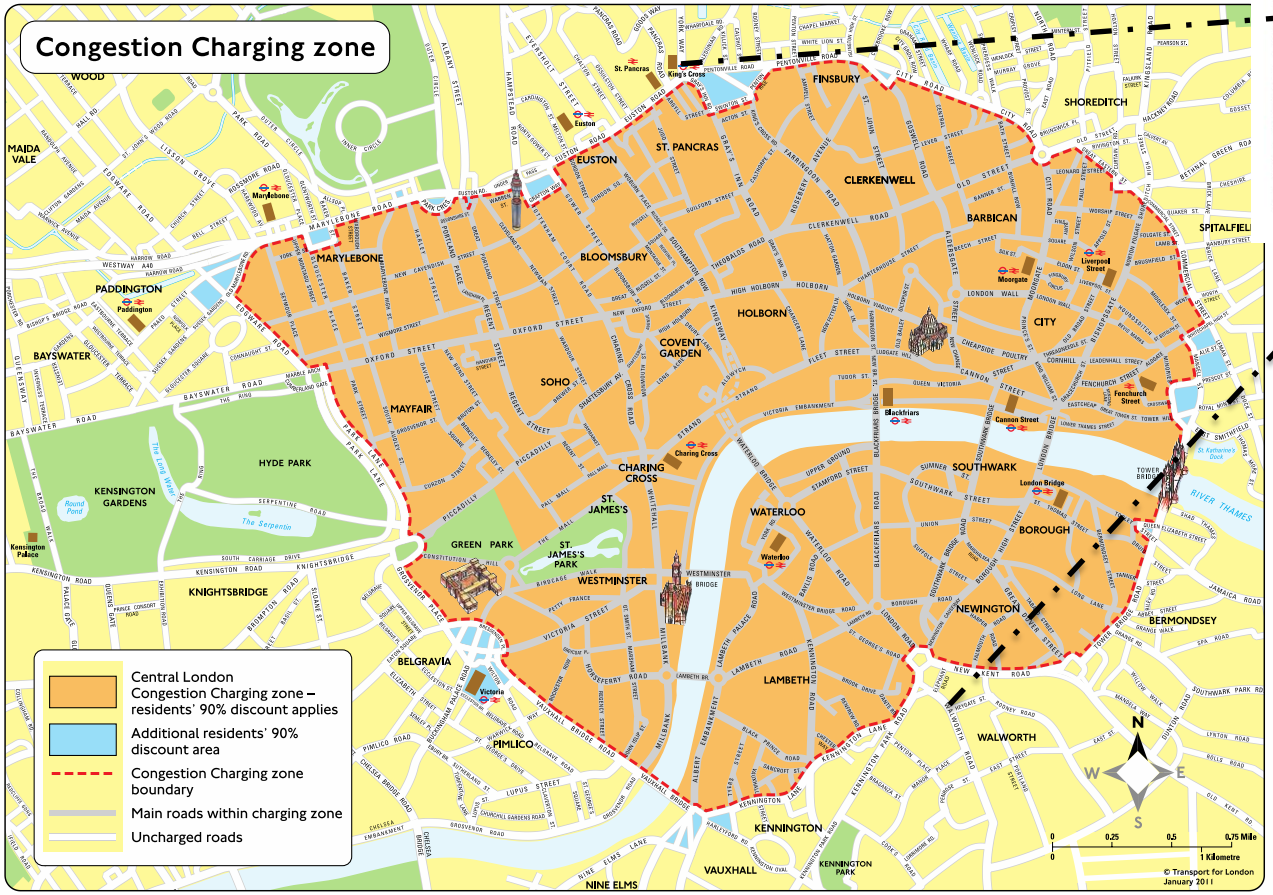
MRC-PHE
Centre for Environment & Health
Public Health England MRC Medical Research Council Imperial College London KINGS COLLEGE LONDON

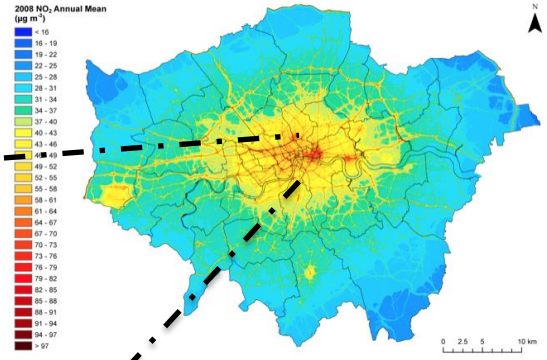
Most London hospitals exceed air pollution limits



London's poor NO_2 air quality is disproportionately affecting the most vulnerable people around schools, nurseries and hospitals

Congestion Charging





Vehicle Emissions in the CCS between 2002 and 2003 fell by 12% for NO_X and PM_{10}.

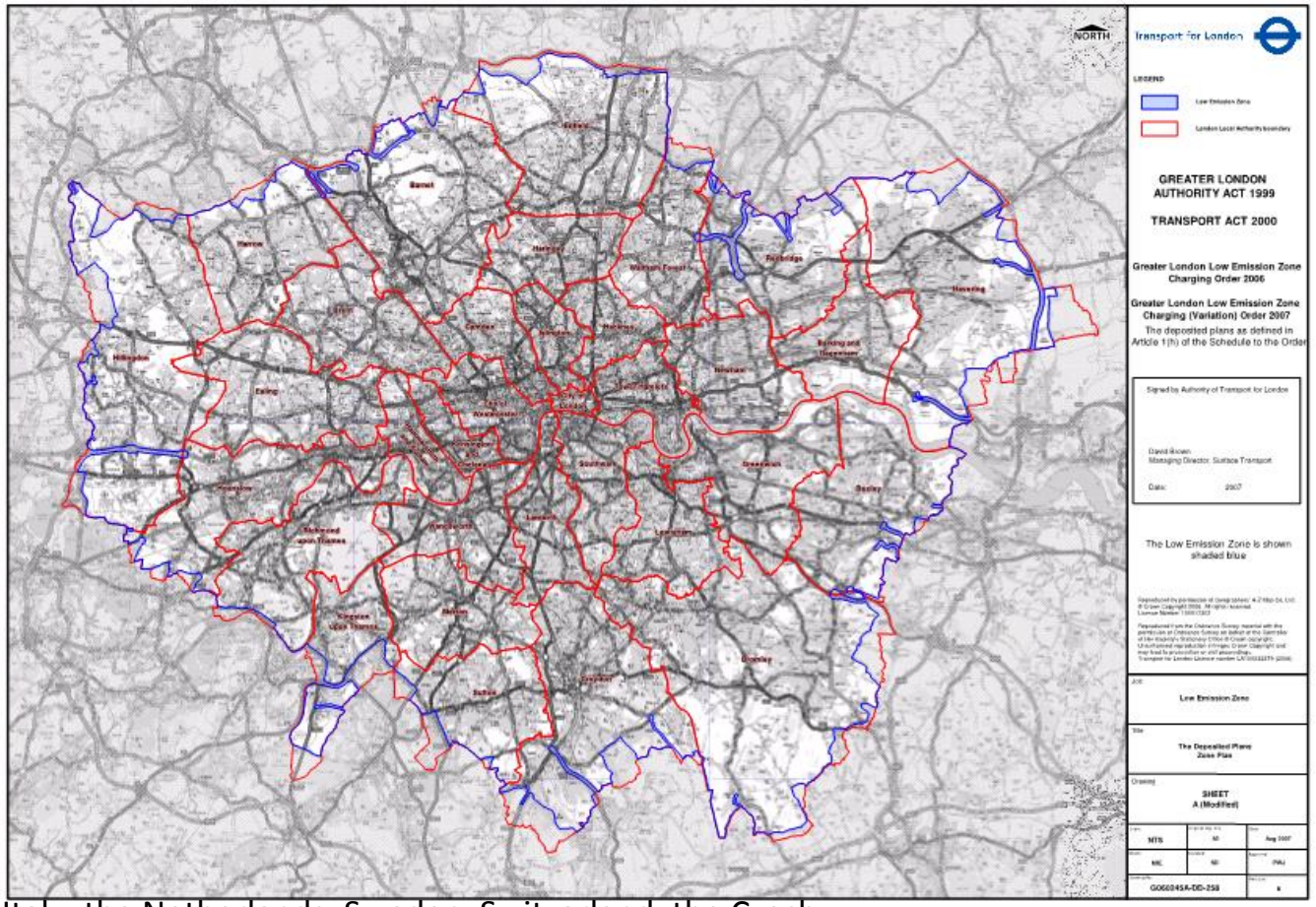
Air quality changed by -3.3 µg m^{-3} (NO_X), -0.8 µg m^{-3} (PM_{10}) and + 0.6 µg m^{-3} (NO_2)

- 1975 – Singapore, Stockholm, Milan, Oslo and Bergen….others
- Almost – New York
- London CCS 2002 – Cleaning London's Air – good option – effective at removing traffic – publically acceptable so long as proceeds used for Public Transport
- Began in Feb 2003, £5 veh/day, 7am-6.30pm Mon-Friday. 90% discount for residents
- No charge for disabled, M/C, emergency vehicle, Buses>17 seats, taxis and environmentally friendly vehicles

MRC-PHE
Centre for Environment & Health

Public Health England | MRC Medical Research Council | Imperial College London | King's College London

Low Emissions Zone



- Germany, Italy, the Netherlands, Sweden, Switzerland, the Czech Republic, Denmark, Austria and France
- London LEZ – operates 24 hrs/day, 365 days/year
- Phase 1, February 2008: HGV >12 tonnes, Phase 2, July 2008 HGV (3.5-12 tonnes), buses and coaches --- (EIII)
- London's Mayor delayed phase 3 (LGV - EIII) until January 2012 and alongside phase 4 (HGV, Bus and coaches (EIV), became the Mayors Air Quality Strategy.
- Phase 1 and 2 – very small impacts

MRC-PHE
Centre for Environment & Health

Public Health England | MRC Medical Research Council | Imperial College London | King's College London

NO_x trends from 2000 to present

MRC-PHE
Centre for Environment & Health

Public Health England | MRC Medical Research Council | Imperial College London | King's College London

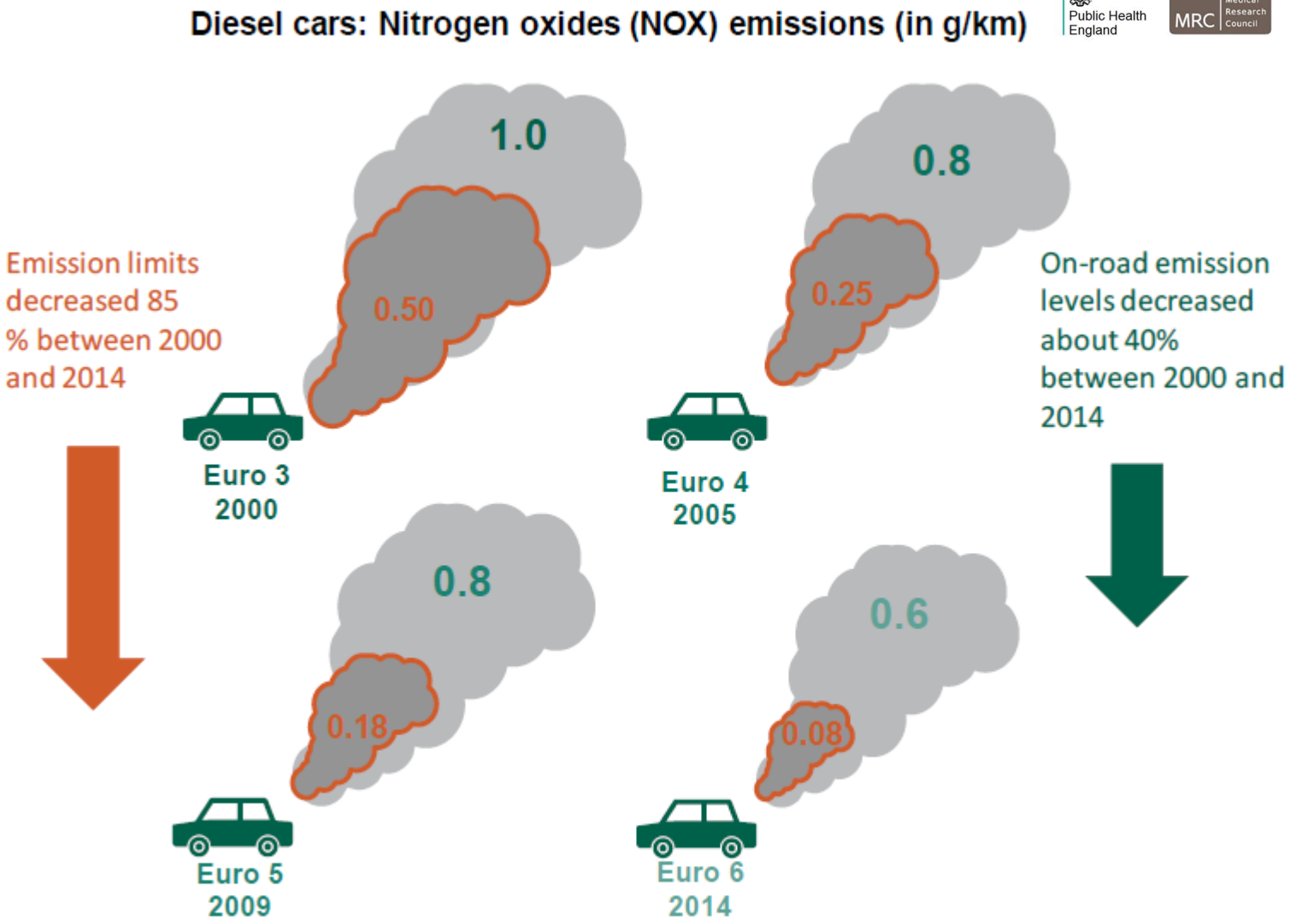
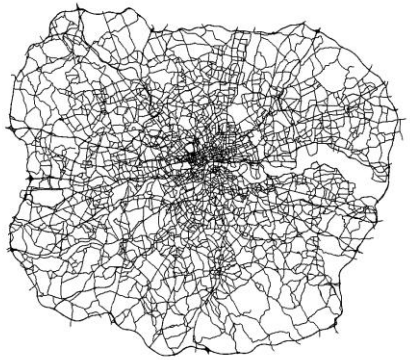


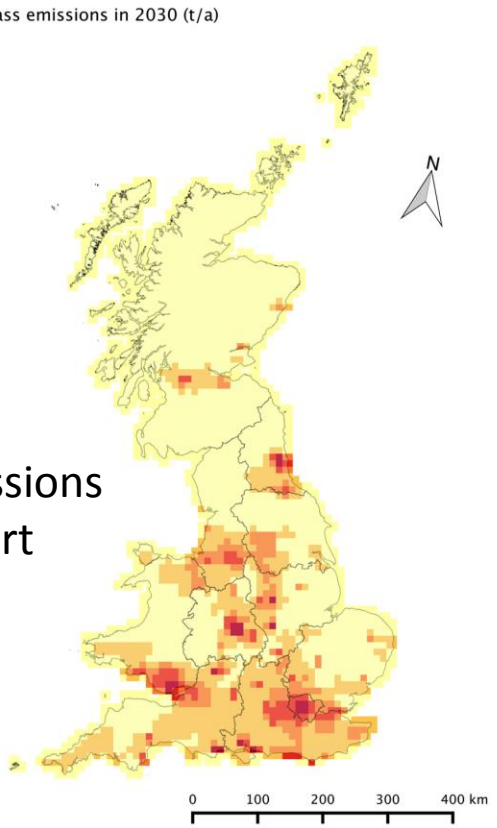
Figure 2-2 Difference between emissions limits and on-road measured values (sources: Carslaw 2011, ICCT, 2014)

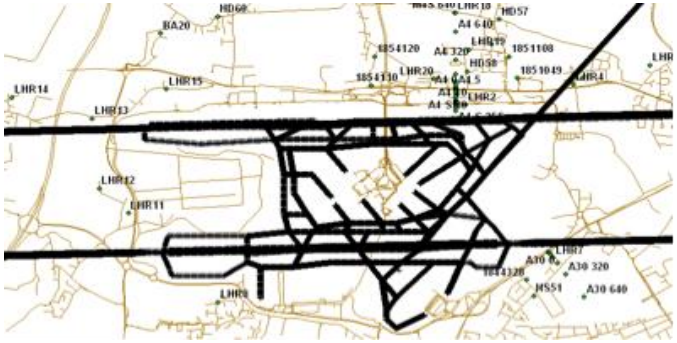
Atmospheric emissions inventories

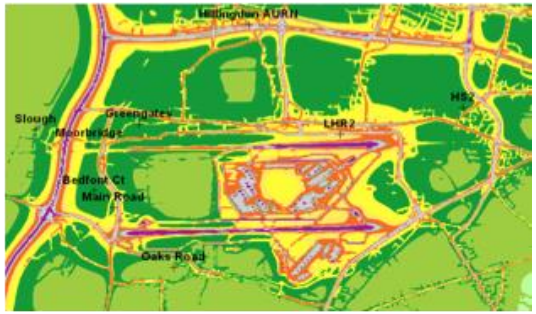


- Traffic counts/models
- Traffic speed (GPS)
- Traffic stock (ANPR)
- UK and European Methods

- Biomass emissions
- Road transport (IVOC)
- Cooking







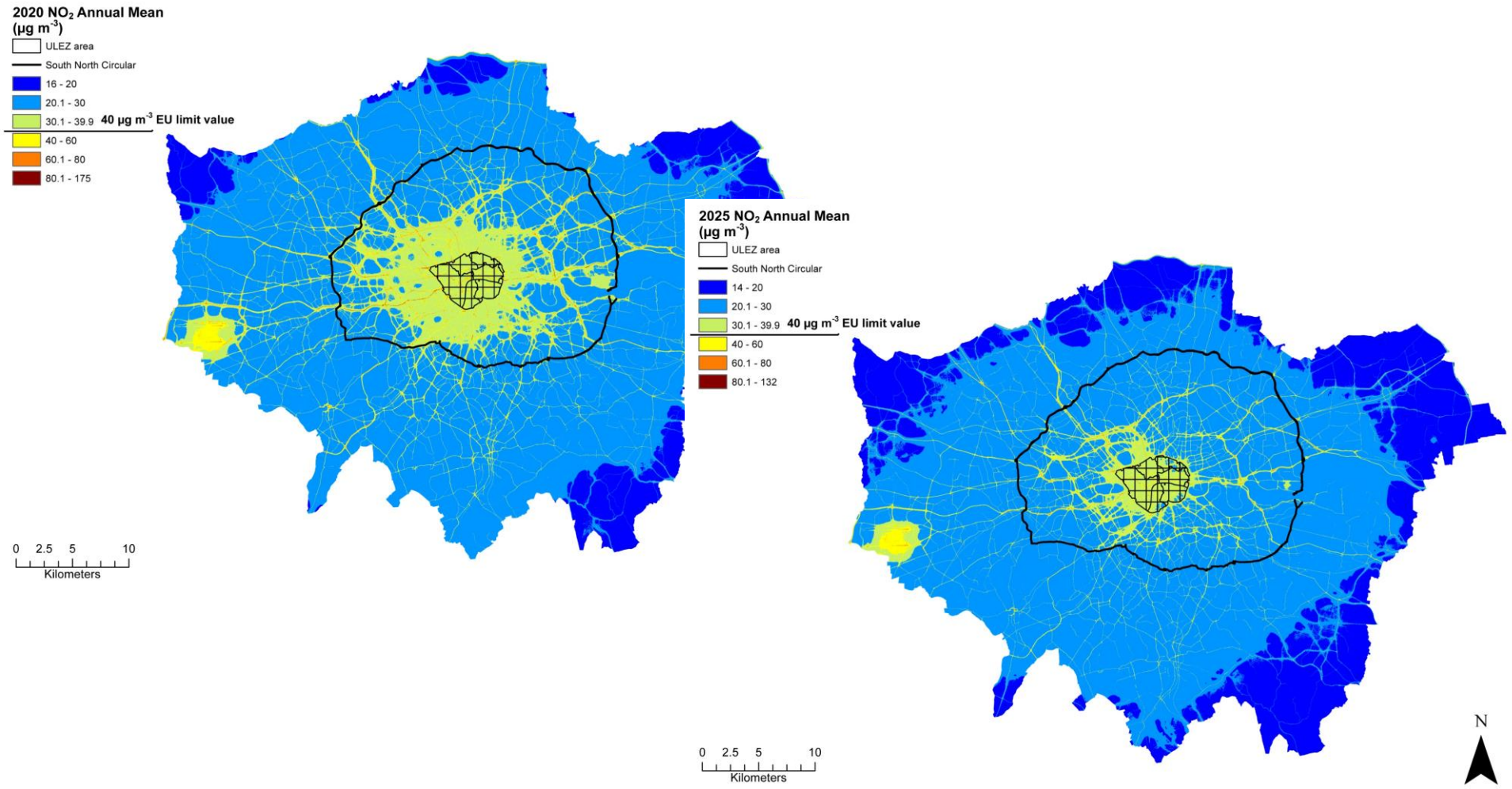
- Aircraft emissions
- Airside vehicle emissions
- Landside vehicles emissions
- Stationary emissions

MRC-PHE
Centre for Environment & Health

Public Health England | MRC Medical Research Council | Imperial College London | King's College London

2020/2025 Baseline

- Based upon the **previous London administration's** 2020 ULEZ
- All vehicles driving in central London from 2020 meet emission standards Euro 4 (petrol) and Euro 6 (diesel) including additional requirements for TfL buses (mix of hybrid and zero emission), new taxis ZEC from 2018



2025 Scenario

- In partnership with PX, IPPR and GP
- **Targeted policies for London, the UK and the EU**
- Focused on reducing NOx emissions but mindful of PM and CO_2

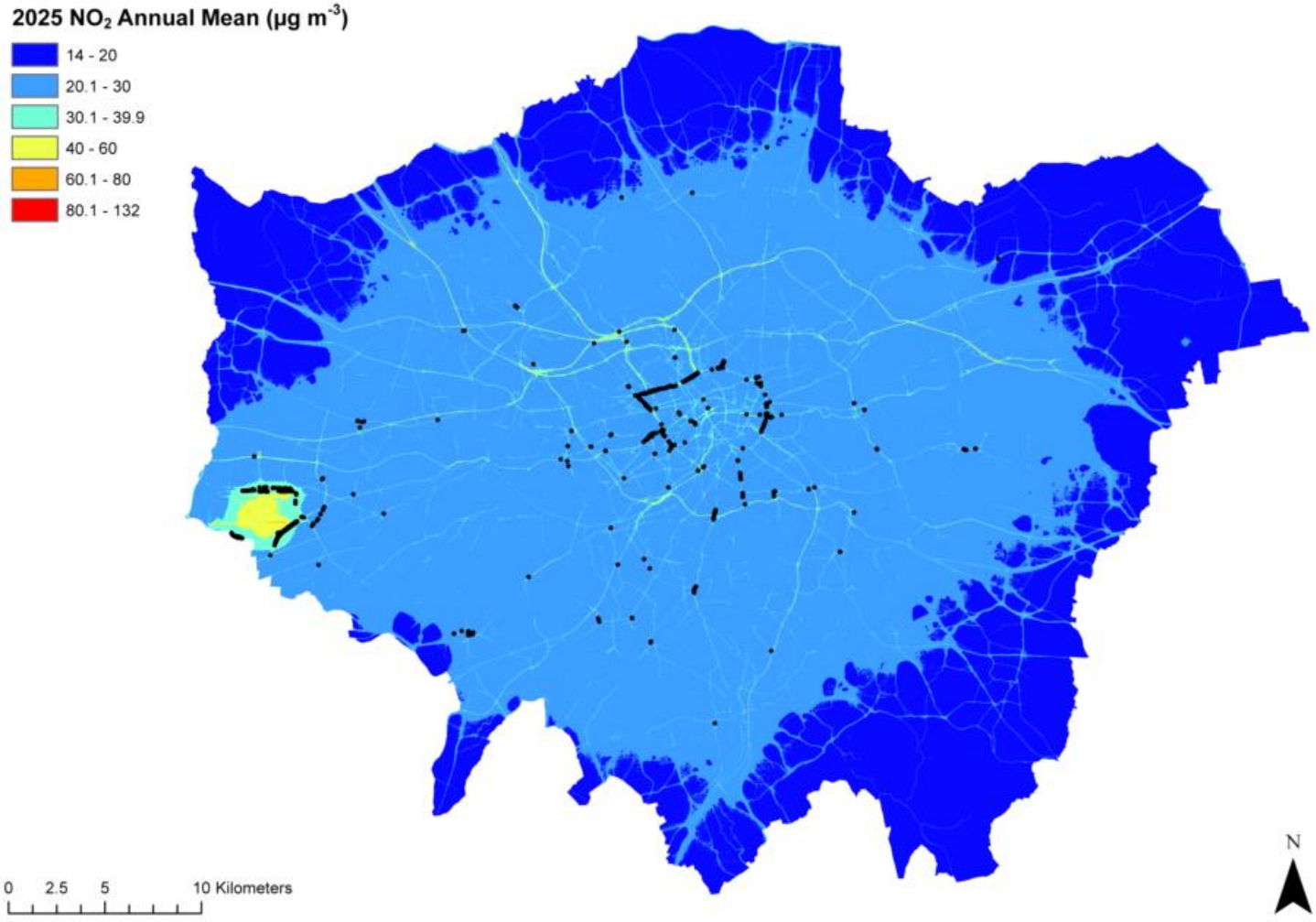
Builds on the 2025 baseline and the following set of assumptions:

- **Better Conformity Factor** (CF) for diesel cars: CF of 1.5 (0.12 gkm^{-1}) for new Euro6 bought between 2018 and 2020 and CF of 1 (0.08 gkm^{-1})
- **Diesel cars phasing out**: from 57% (baseline) to 5% diesel cars in Inner area by 2025 (97% of diesel cars assumed a CF of 1) and from 53% (baseline) to 29% in the rest of London
- **ZEC taxis**: 100% ZEC taxis everywhere in London by 2025
- **Better buses**: Zero emissions LT buses in the central area and a mixture of Euro6/Euro6 hybrid/Zero emissions in the rest of London
- **Others** (Petrol cars: 15% hybrid and 1.25% LPG across all of London; Electric cars: 6% inside Inner area and 2.8% in the rest of London; Diesel vans: from 98% (baseline) to 75% in all London; Petrol/Electric vans: remaining 25% split between 12.5% petrol and 12.5% electric in all London; Domestic and commercial gas: reduction of domestic gas by 20% from 4,025 to 3,236 tonnes and commecial gas by 7% from 3,374 to 3,129 tonnes in 2025

2025 Scenario

Impressive NO_X (45%) and primary NO_2 (56%) emissions reductions (CO_2 7% PM 2%)

Areas with NO_2 concentrations lower than 20 μgm^{-3} increased from 16% in the 2025 baseline to 36% in the scenario. Important: still health impacts below the limit value



Policy Conclusion

- Our scenario delivered **significant progress** towards the achievement of the NO_2 air quality limit

Most importantly,

- It resulted in considerable NO_2 concentration reductions, down to **healthier levels** in all parts of London.
- In the Greater London area, 81% of the scenario's total NO_X emissions reduction stems from **diesel cars**
- In the central area only, the main NO_X emissions reduction relate to **diesel cars** (46%), **taxis** (26%) and **buses** (26%).

We found the most **effective strategies** to be

- the **switch away from diesel** toward cleaner cars, taxis and buses
- **tighter emissions standards**

We advocate a combination of policy changes at **local level** (a ban of diesel vehicles in city centre), **UK** (the upward trajectory of diesel vehicle's market share must be reversed) and **EU level** (tighten emissions standard)

Human exposure modelling for public health policy

For Tomorrow

MRC-HPA Centre for Environment and Health
Imperial College London
MRC Medical Research Council
Health Protection Agency
KING'S College LONDON

Future considerations
Air pollution and climate policy

The Co-Impacts of Climate Change Policies on Air Pollution and Health

A Case Study for Great Britain

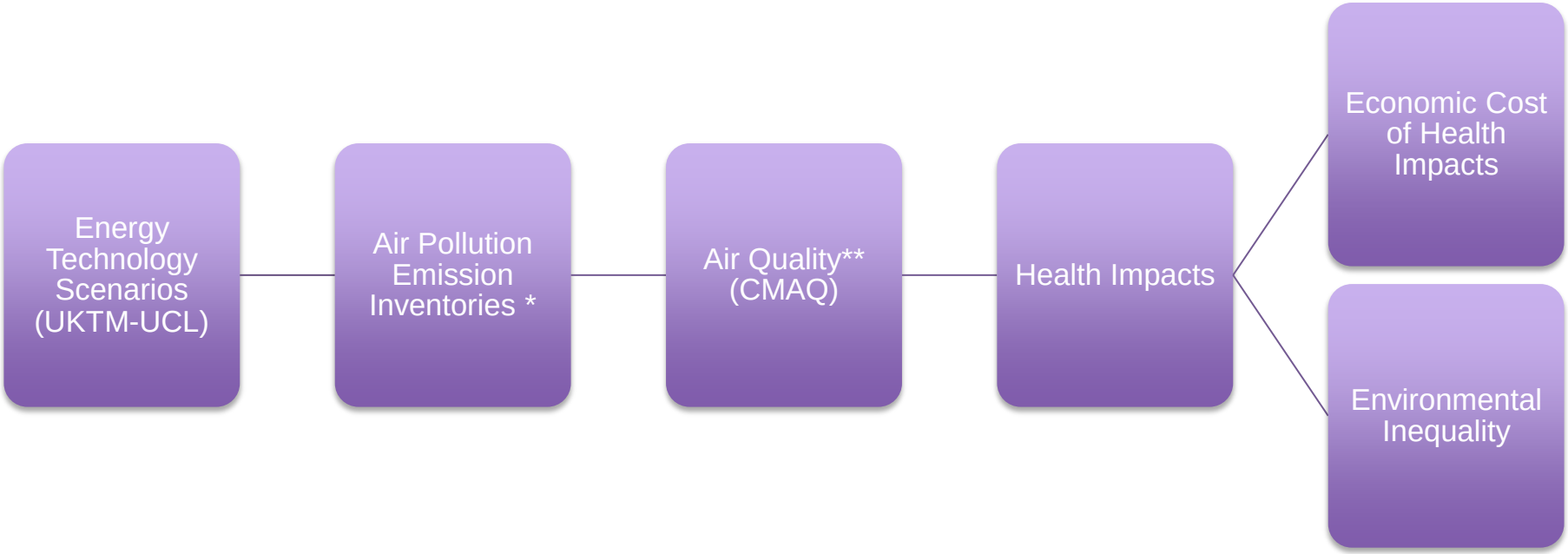
UK Climate Change Act 2008

- The UK has set a target of **80% reduction in CO_2 equivalent emissions by 2050** (on a 1990 base)
- The Climate Change Act target offers potentially the biggest **air quality & public health improvements** since the Clean Air Act of 1956
- BUT – the policies need to be *carefully chosen* to **avoid unnecessary adverse public health impacts** resulting from changes in air quality

We Developed a Set of Scenarios

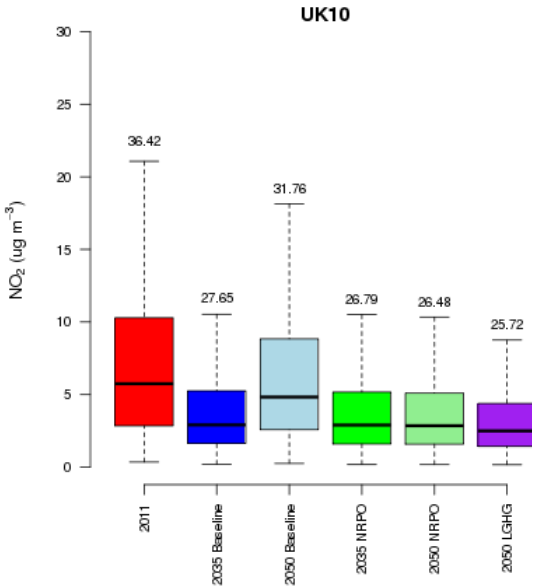
- **DECC Baseline**: Nuclear phasing out with no further carbon mitigation
- **NRPO** (Nuclear RePlacement Option) CCA scenario with limited nuclear build
- **LGHG** (Low GreenHouse Gas) CCA scenario with no constraint on nuclear build

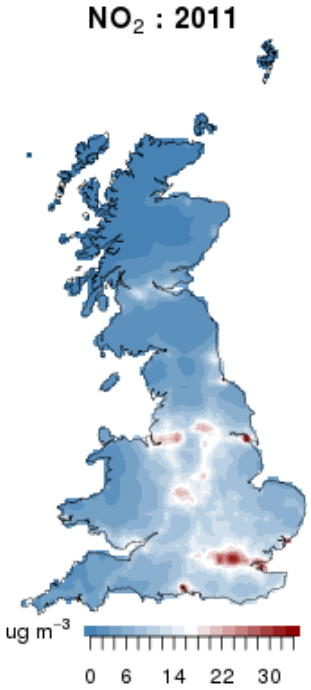
NIHR funded project (11/3005/13)
(concluded Q1 2017)

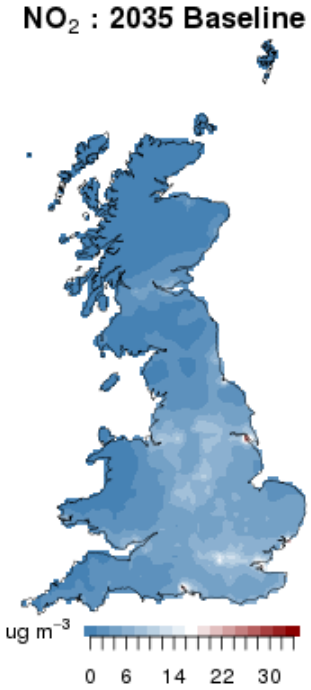


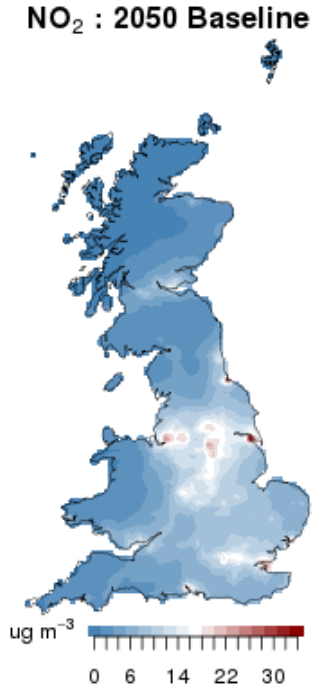
*including combustion and non-combustion (e.g. ammonia from agriculture, particles from brake and tyre wear…) emission sources

**particulate matter ($PM_{2.5}$), nitrogen dioxide (NO_2), ozone (O_3)

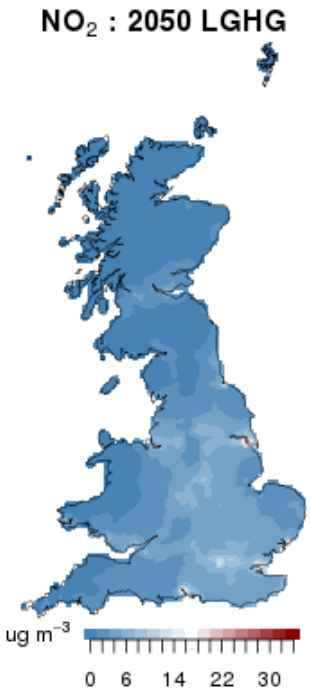


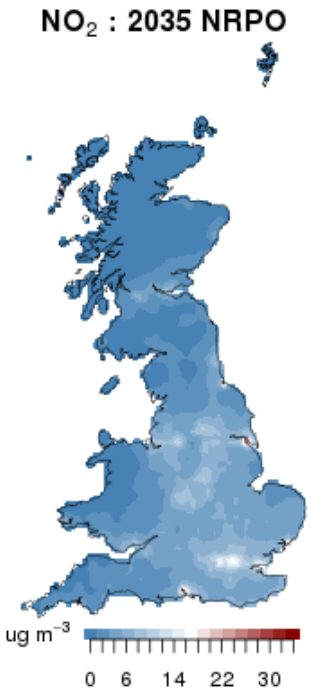


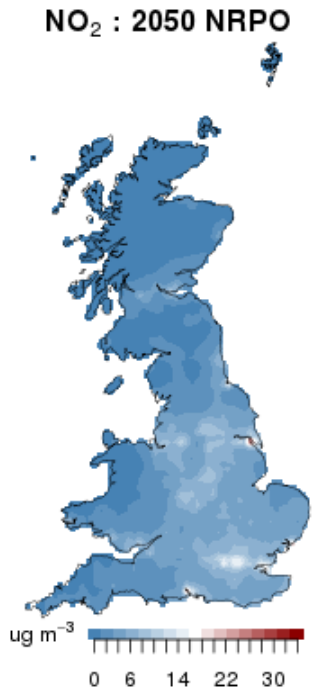


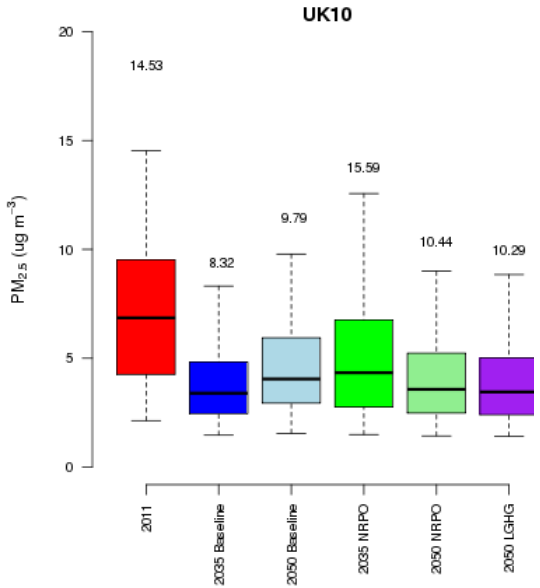


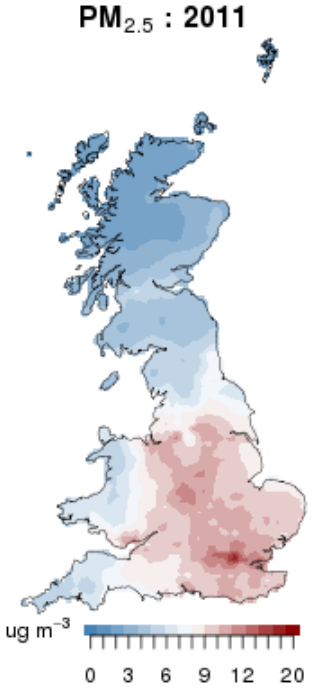
- **Concentrations of NO_2 in urban areas declined significantly due to cleaner vehicle fleet in the future**
- **The Baseline scenario showed large increases in NO_x emissions as a result of increases in combined heat and power sources**
- **By 2050, NOx is much lower in the scenarios**

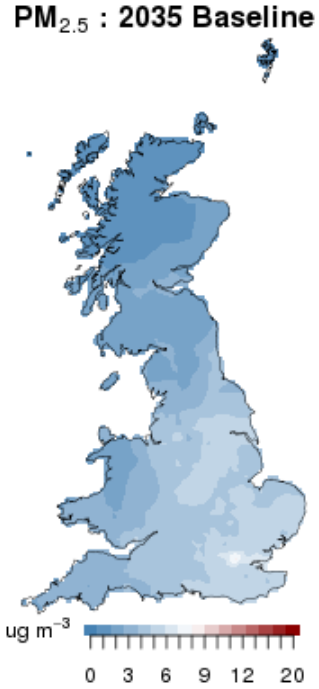


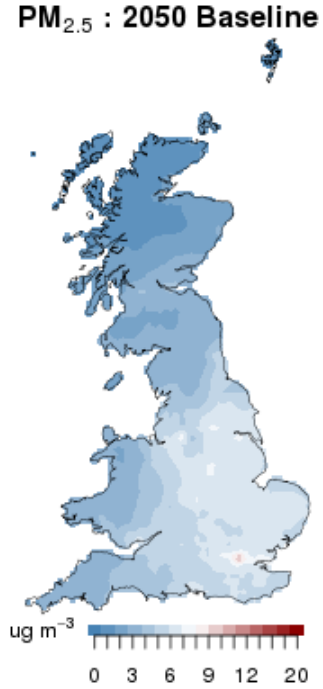


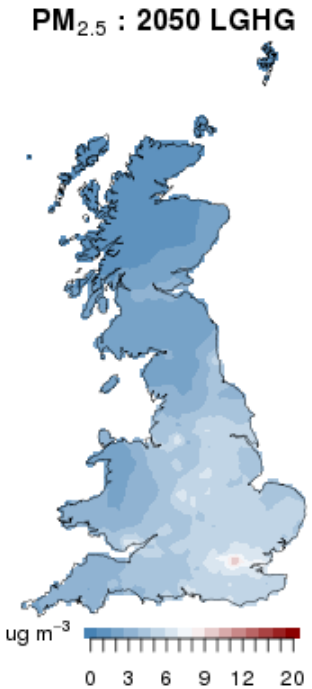


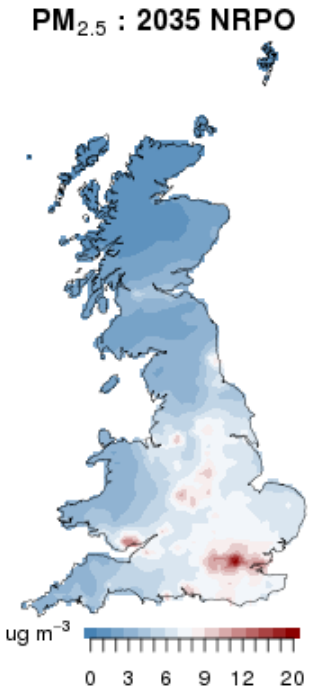


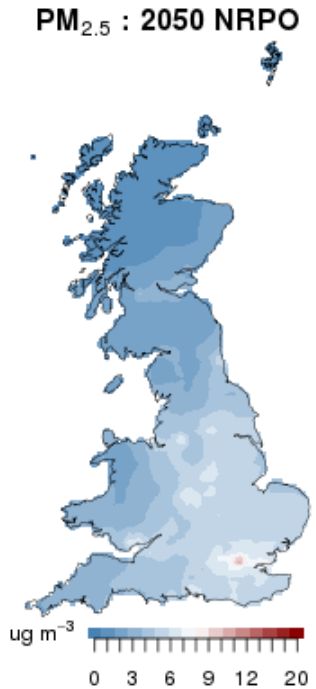












- **PM declined significantly due to cleaner vehicle fleet and NRMM**
- **Reductions in PM are tempered**
- **by a 2035 peak in biomass (wood burning)**
- **by increase in demand for transport leading to increases in non-exhaust PM emissions**

CCA Conclusions and Policy Messages

The UK's Climate Change Act results in significant…

- **decreases in urban** concentrations of **NO_2 and PM**
- **improvements** in urban air quality for both **public health and legal compliance**

BUT

- **Non-exhaust PM** concentrations increase in all scenarios by 2050 without further intervention (need to investigate regenerative braking solutions) – how toxic are they?
- **High biomass** use in CCA-compliant scenarios demonstrate **modest PM decrease by 2050**
- **High biomass** leading to a **peak** in exposure to *primary PM combustion products*, including carcinogens in the period **2030-2035**

Conclusions

- People want to **live in healthy areas**
- Companies want to invest in areas where people want to live
- The technology is here but **past policies** (shift towards diesel and periods of inaction) have **failed Londoners**
- Our publications have generated **high media attention**, a better understanding of the health impacts of air pollution
- Air quality issues have now risen **up the political agenda**
- The **new London administration** is drafting a new and **ambitious strategy** (T-charge in 2017, ULEZ in 2019/2020/2021, meet WHO standards by 2030, all taxis ZEC by 2033, all buses zero emissions by 2037, best AQ of any major city by 2050, zero carbon city by 2050)
- **Policies** at **London level** need to be complemented by immediate action at **UK and EU scale**

Solutions to London's Air Quality Problems

MRC-PHE
Centre for Environment & Health
Public Health England | MRC Medical Research Council | Imperial College London | King's College London

In light of the evidence that **no exposure is safe**, **pollution** must be reduced to **negligible levels** using a **policy package** which could include

- **Priority**: phasing out the **most polluting vehicles**
- **Shifting all diesel vehicles** in favour of the cleanest available alternative
- Introducing **diesel scrappage schemes**
- Increase tax on **new diesel** purchase
- Accelerating **fiscal incentives** and **rollout of EV**
- Increasing the number of **smart charging systems**
- Reducing vehicle km driven, increasing **freight consolidation**, providing better public transport and **sustainable alternatives** (walking/cycling)
- Introducing **tougher laws and regulations** on vehicle manufacturers
- Accelerating **development of new technologies** such as regenerative braking
- Promoting **eco-driving**
- Maximising reduction in air pollution from **climate change** and energy strategy

MRC-PHE
Centre for Environment & Health

Public Health England | MRC Medical Research Council | Imperial College London | King's College London

Thanks for your attention…

Thanks to colleagues in the ERG modelling group:
Sean Beevers, Gregor Stewart, Martin Williams, Nutthida Kitwiroon, Heather Walton, James Smith and Mellissa Lott (UCL)

Transport for London and the Greater London Authority

Policy Exchange, Client Earth, Greenpeace and IPPR

We thank the Natural Environment Research Council, Medical Research Council, Economic and Social Research Council, Department of Environment, Food and Rural Affairs and Department of Health for the funding received for the Traffic Pollution and Health in London project (NE/I008039/1), funded through the Environmental Exposures and Health Initiative (EEHI). The research was also supported by the National Institute for Health Research (NIHR) Biomedical Research Centre based at Guy's and St Thomas' NHS Foundation Trust and King's College London.