Transport Emissions Roadmap

Sam Longman, TfL Policy Manager for Environment

TRANSPORT
FOR LONDON
EVERY JOURNEY MATTERS

Harmful Emissions

Air pollutants of concern

- Fine Particulate Matter (PM_{10} and $PM_{2.5}$)

- Nitrogen Dioxide (NO_2)

Climate Change

- Carbon Dioxide (CO_2)
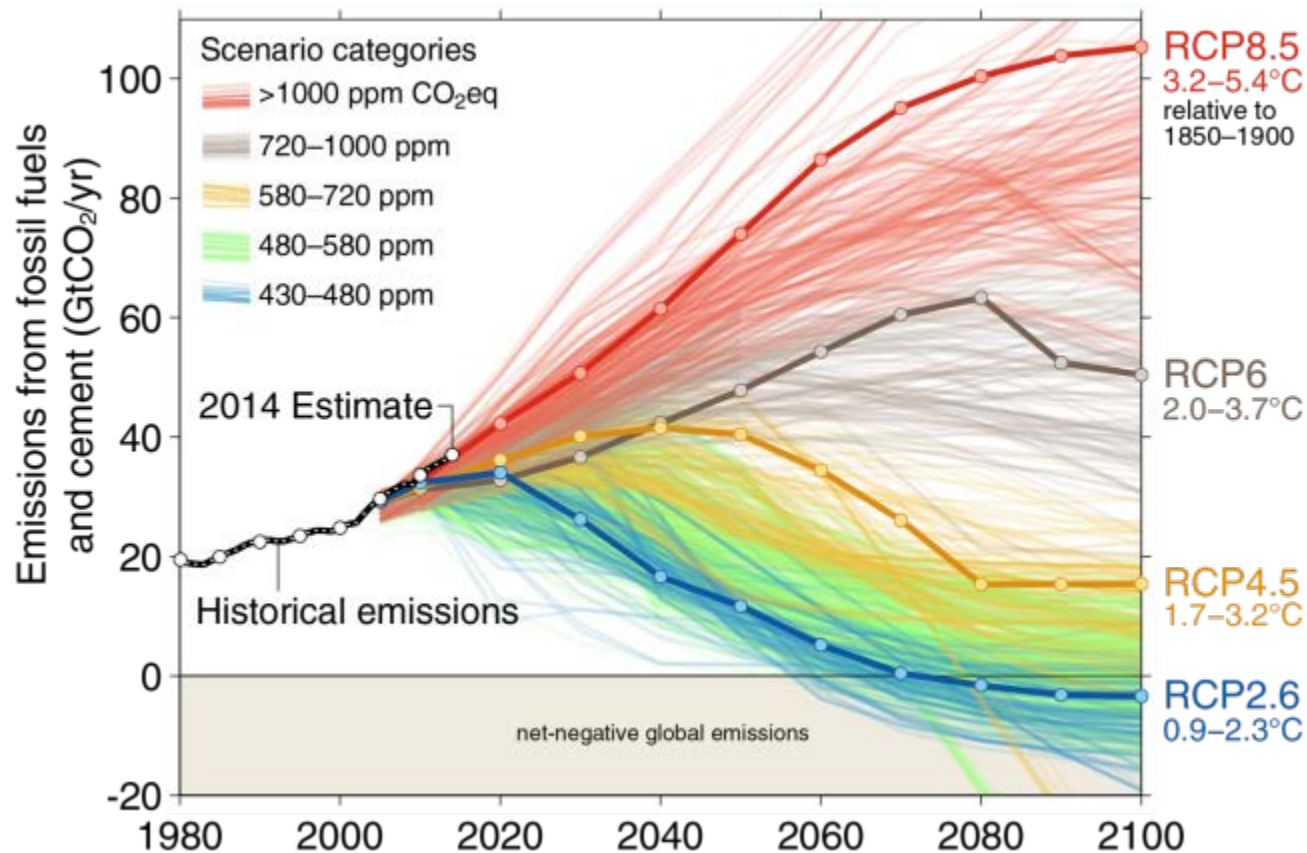
- Black Carbon

Impacts Air Pollution

- Covered by Lucy Saunders presentation later today.

- Current quantified health impacts based on PM. Growing evidence that NO_2 has impact of a similar scale.

- Although compliant with PM last time Defra reported, more action needed to further improve health particularly for fine particles (eg $PM_{2.5}$).

- Polluted air is also detrimental to the built environment (eg dirty building and some materials degrade) as well as some plants and animals (biodiversity)

CO$_2$

Emissions are on track for 3.2–5.4°C "likely" increase in temperature above pre-industrial. We've already risen by 0.85 degrees.
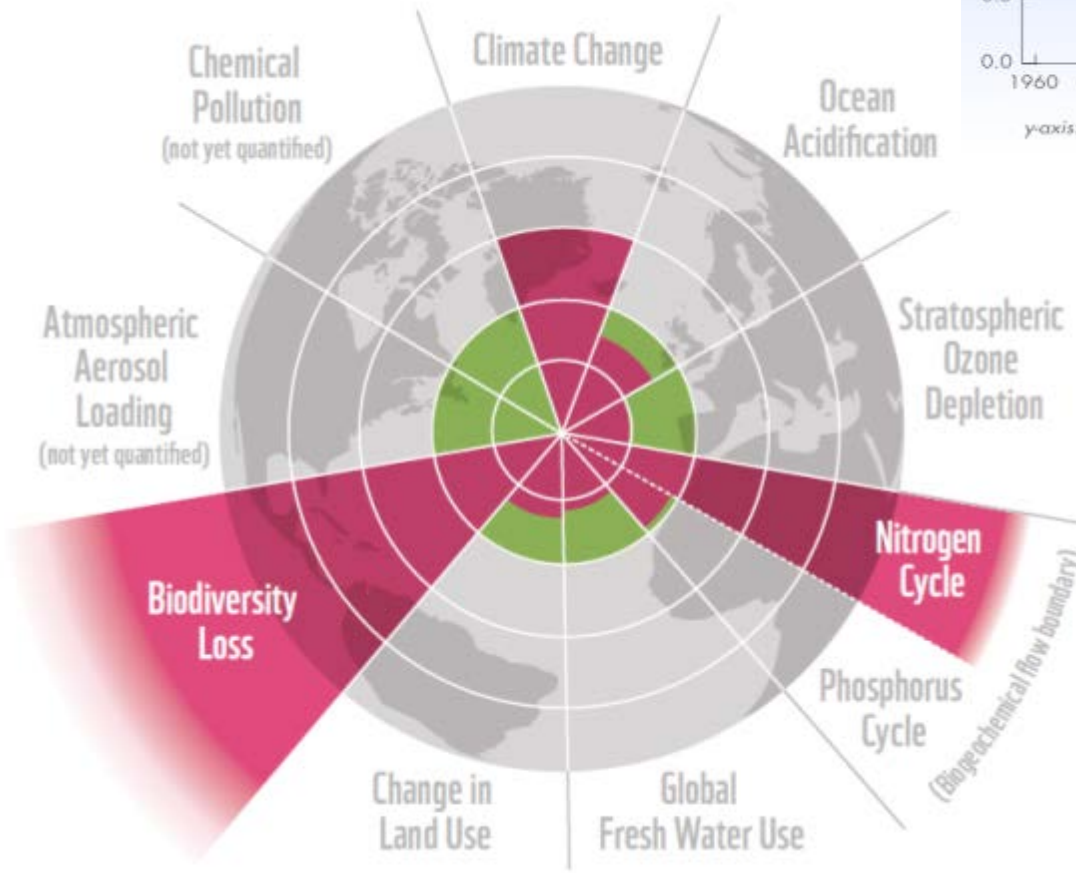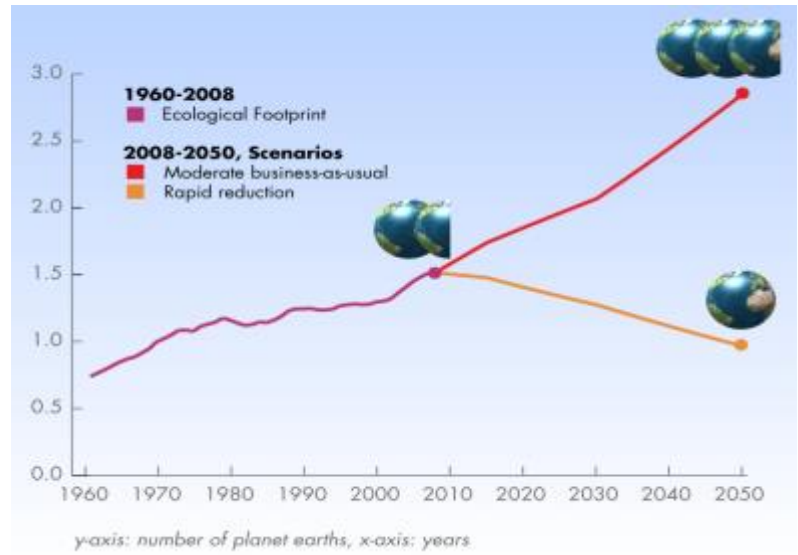

Faint line 'plumes' shows the spread of past and future projections from a hierarchy of climate carbon cycle models driven by historical emissions and the four Representative Concentration Pathway over all times out to 2100

Black Carbon

Black carbon is the most strongly light-absorbing component of particulate matter (PM), and is formed by the incomplete combustion of fossil fuels, biofuels, and biomass. It is emitted directly into the atmosphere in the form of fine particles ($PM_{2.5}$) and is **now known to have a powerful atmospheric warming effect.**
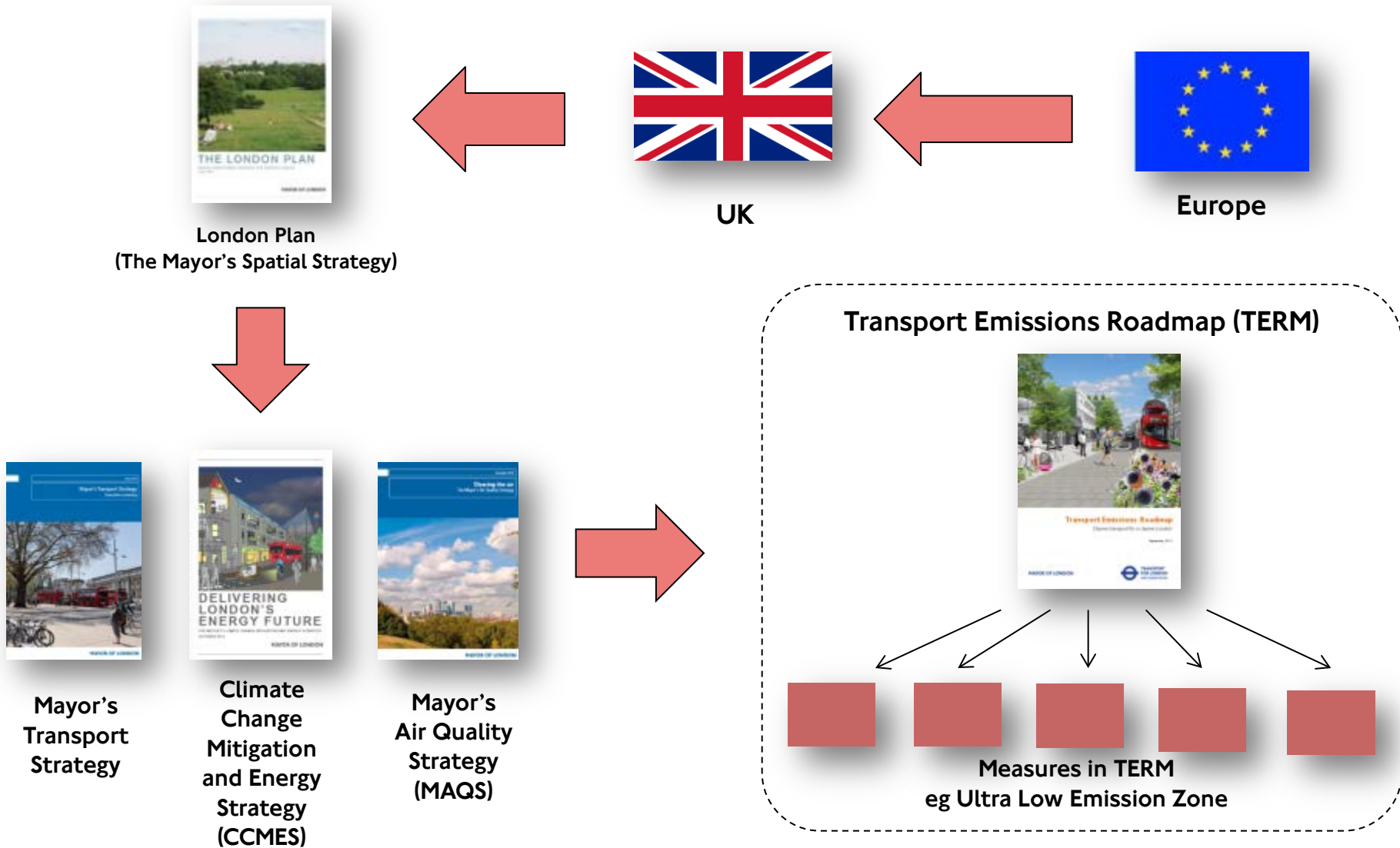
One Planet Living

y-axis: number of planet earths, x-axis: years

1960-2008
Ecological Footprint

2008-2050, Scenarios
Moderate business-as-usual
Rapid reduction

Climate Change

Chemical Pollution (not yet quantified)

Ocean Acidification

Atmospheric Aerosol Loading (not yet quantified)

Stratospheric Ozone Depletion

Biodiversity Loss

Nitrogen Cycle

Phosphorus Cycle

(Biogeochemical flow boundary)

Change in Land Use

Global Fresh Water Use

Its not all about Carbon!...for example, biodiversity loss decreases resilience to climate change, eg **60% of calories consumed globally is from wheat, rice and maze**.

Policy Context

Policy Context

London Plan
(The Mayor's Spatial Strategy)

UK

Europe

Mayor's
Transport
Strategy

Climate
Change
Mitigation
and Energy
Strategy
(CCMES)

Mayor's
Air Quality
Strategy
(MAQS)

Transport Emissions Roadmap (TERM)

Measures in TERM
eg Ultra Low Emission Zone

Targets

- Compliance with legal Limits for NO_2

- 60% reduction in CO_2 over 1990 baseline (47% reduction in transport emissions).

- Further drive down PM

Air Quality

- London are in breach of legal limits for Nitrogen Dioxide (NO_2) concentrations, which impact on human health.

- Compliance estimated to only be achieved after 2030 in London, Birmingham and Leeds, twenty years after the original deadline.

- The Supreme Court recently ruled that the Government must submit plans to the European Commission by 31st of December to bring forward the exterminated date of compliance (currently projected to be beyond 2030, with the original deadline being 2010).

- Covered in more detail later today by Anna Heslop.

Action by All

	Regulation	Infrastructure	Innovation	Lobbying	Fleet	Education & Awareness
EU	Emissions Standards	Urban clean air fund				
Central Government	Reform VED	Develop alternative fuel infrastructure	Invest in technology research	Lobby EU for funding	National incentive scheme for LEVs	National campaigns to cut car use
GLA & TfL	Low Emission Zones	Rapid Charging Network	Inductive charging & Geofencing	Lobby to revise Vehicle Excise Duty	Cleaner buses and taxis	Provide guidance for cleaner fleets
Boroughs	Differential parking charges	Improved cycling facilities	Mayors Air Quality Fund schemes	Lobby for central Government funding	Use LEVs in support fleet	Encourage more sustainable travel
Businesses &Institutions			New low emission technology	Go Ultra Low campaign	Switch fleet to LEVs	Develop travel plans
Individuals					Switch to LEV	Walk and cycle more

Scale of challenge

Projected CO$_2$ emissions from transport in Greater London from the LAEI (2010)
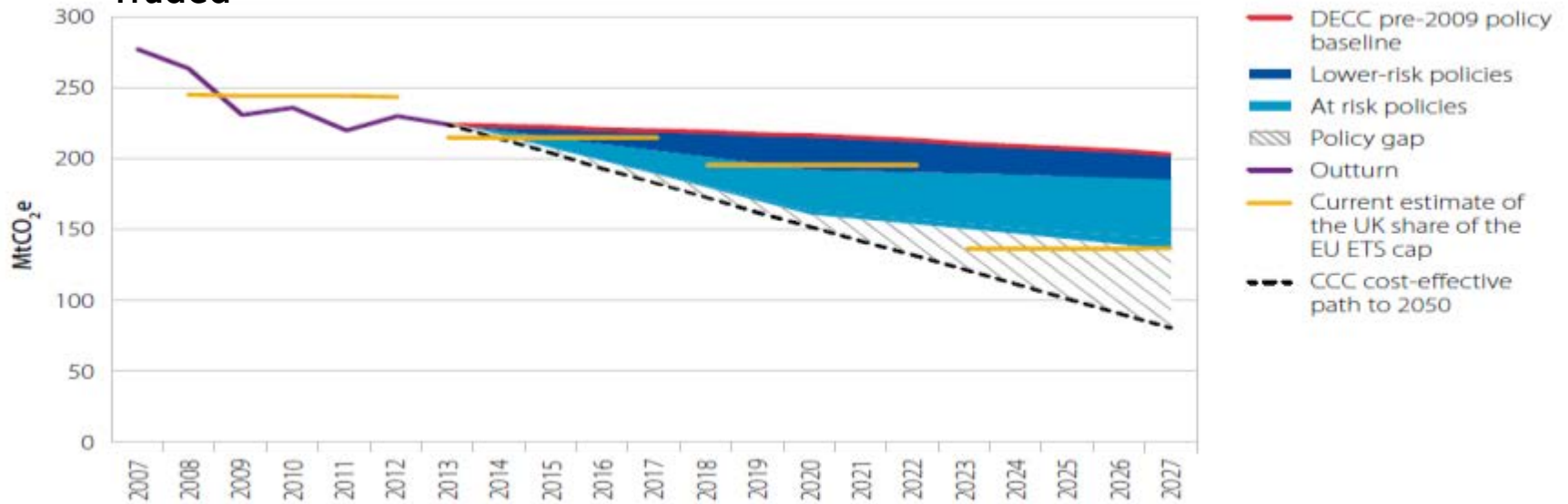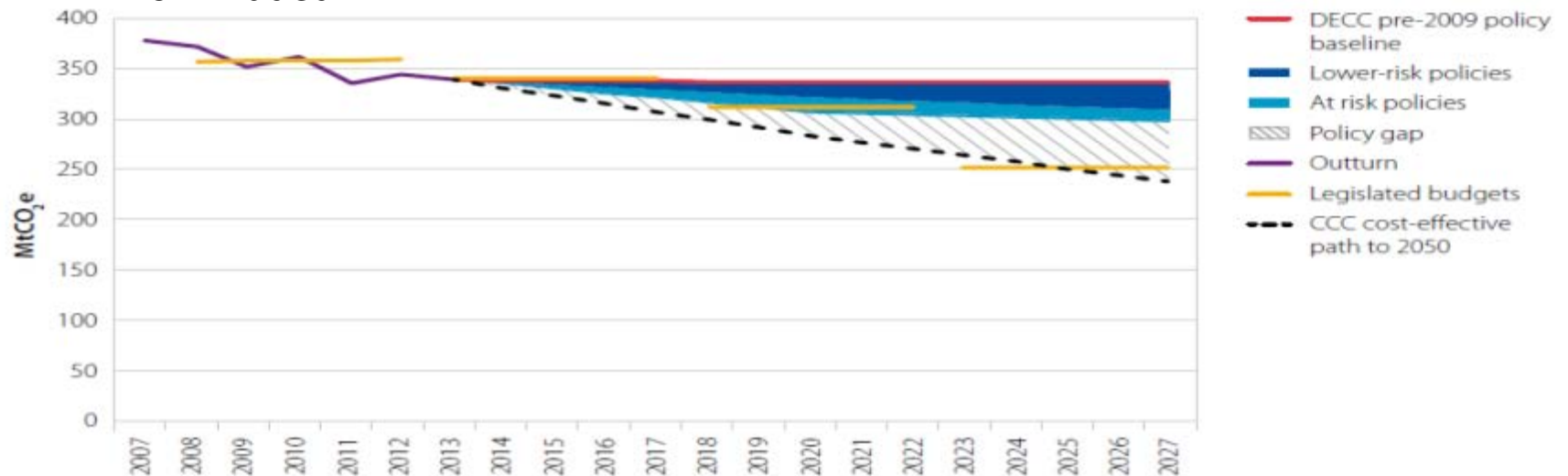

3.45 million tonne gap
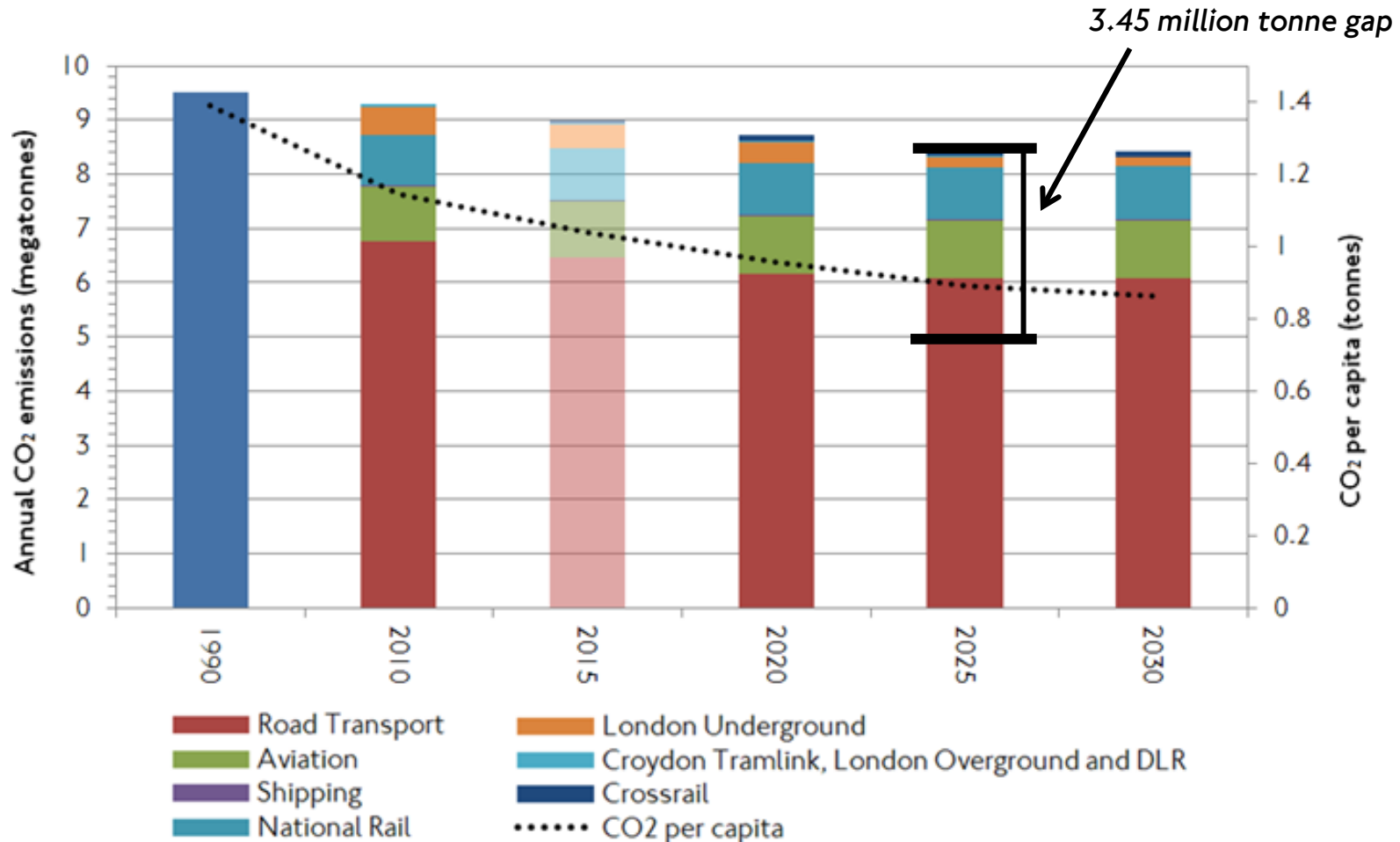
3.45 million tonne gap
-Equivalent to a 45% reduction in vehicle kilometres in 2025
- Or 7x LU's total annual Scope 1 & 2 emissions
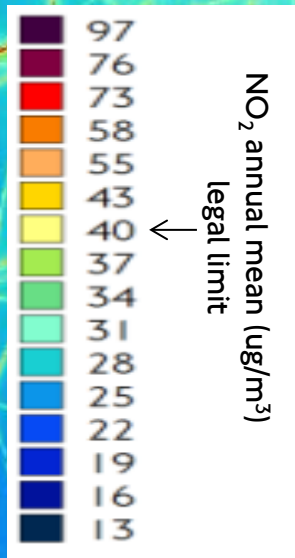
UK Progress *(DECC 2013)*

Traded

Non-Traded

Map shows NO$_2$ concentrations in 2020 with ULEZ in place. NO$_2$ limit values refer to concentrations of NO$_2$, rather than NOx emissions. Dispersion modelling is used to predict NO2 concentrations, based on NOx/NO$_2$ emissions inventories, and understanding of other conditions such as the meteorology.

NO$_2$ annual mean (ug/m³)

legal limit

| 97 |
| 76 |
| 73 |
| 58 |
| 55 |
| 43 |
| 40 ← |
| 37 |
| 34 |
| 31 |
| 28 |
| 25 |
| 22 |
| 19 |
| 16 |
| 13 |

	Central	Inner	Outer
99% compliance in 2020	50%	40%	20%
100% compliance in 2020	70%	65%	60%
99% compliance in 2025	35%	15%	5%
100% compliance in 2025	60%	50%	40%

Estimated blanket NOx emissions reductions by road length for compliance by road length in 2020 and 2025. This work will be updated and refined once the emissions inventory is updated in Autumn 2015

NO$_2$ Road Transport Problem

The majority of NOx emissions in London are from transport, particularly where concentrations are highest and legal limit values are exceeded. Therefore, achieving compliance requires a focus on transport emissions.
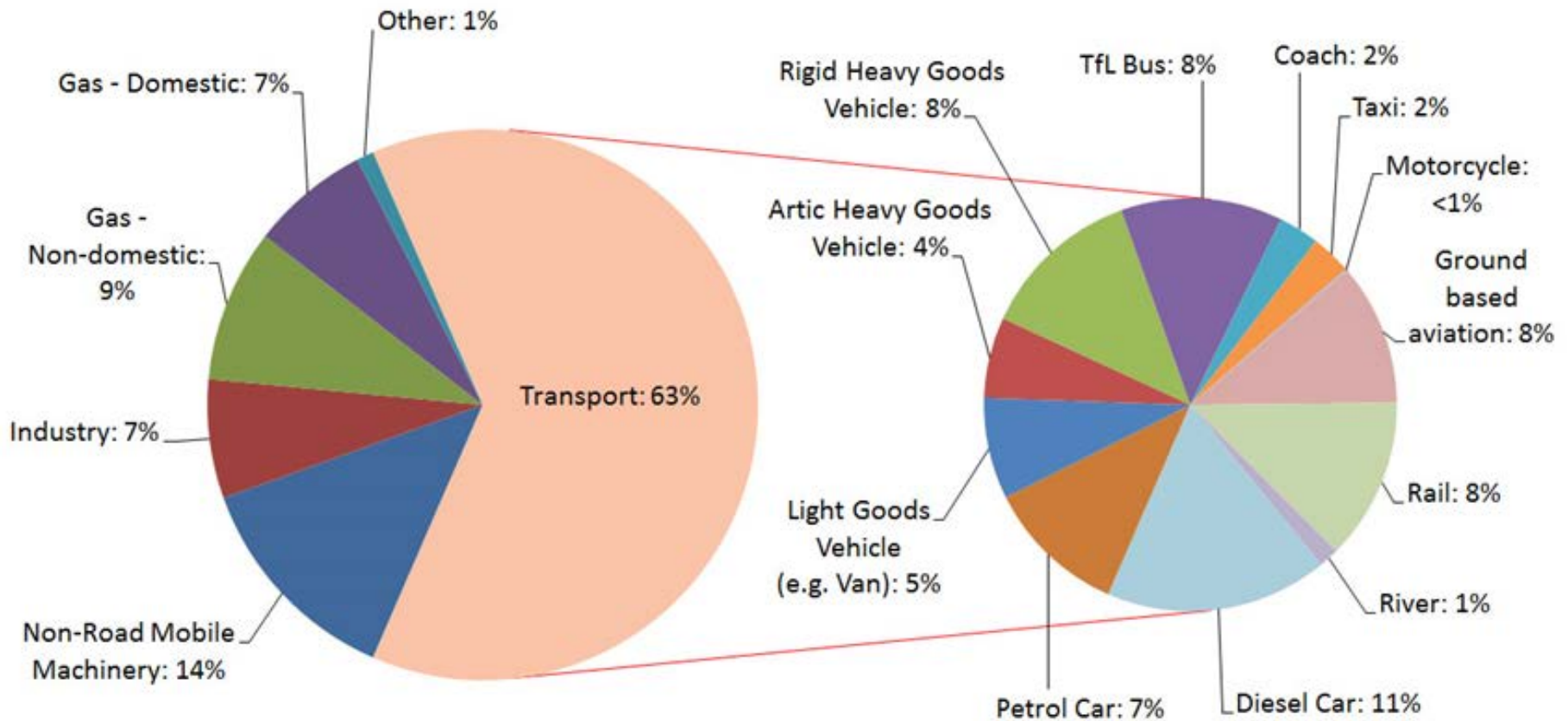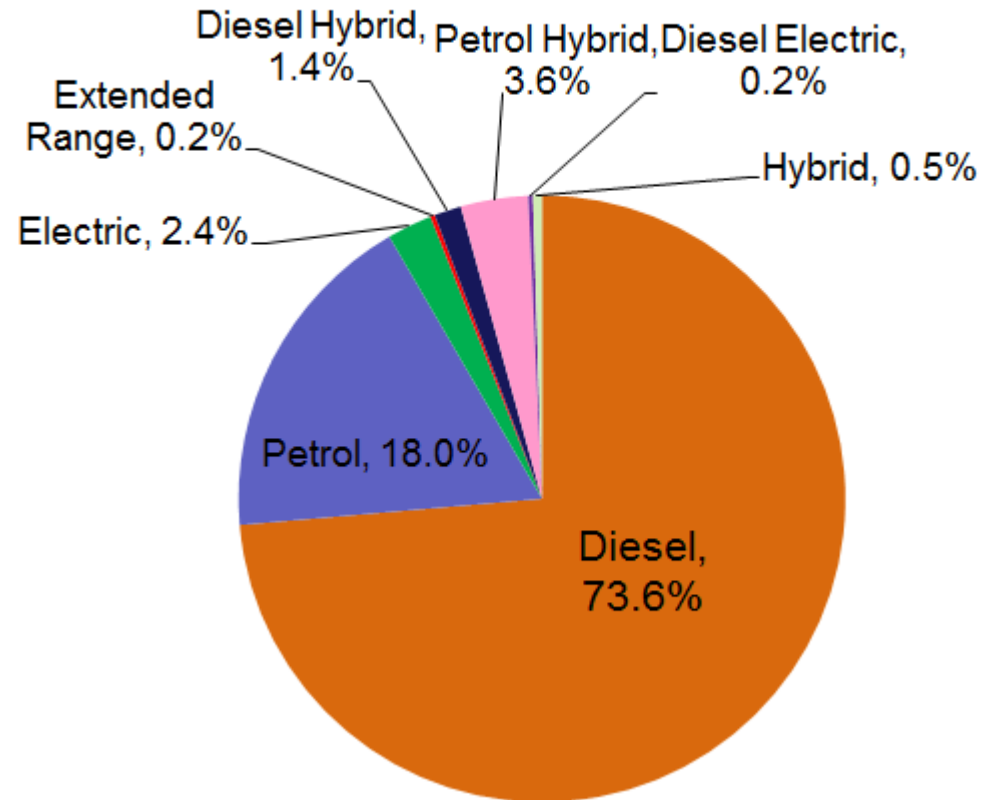

NOx emissions in Greater London LAEI (2010)

Dieselisation

2014 VED Arrangements for Cars

Band	CO2 emission (g/km)	Annually	First year
A	Up to 100	£0.00	£0.00
B	101-110	£20.00	£0.00
C	111-120	£30.00	£0.00
D	121-130	£110.00	£0.00
E	131-140	£130.00	£130.00
F	141-150	£145.00	£145.00
G	151-165	£180.00	£180.00
H	166-175	£205.00	£290.00
I	176-185	£225.00	£345.00
J	186-200	£265.00	£485.00
K	201-225	£285.00	£635.00
L	226-255	£485.00	£860.00
M	Over 255	£500.00	£1,090.00

Engine types of 2014 car modals in bands A to C

Diesel Hybrid, 1.4%
Petrol Hybrid, 3.6%
Diesel Electric, 0.2%
Extended Range, 0.2%
Hybrid, 0.5%
Electric, 2.4%
Petrol, 18.0%
Diesel, 73.6%

However, diesel vehicles can save up to 20% on CO_2 and there are very limited alternatives for many vehicles, such as HGVs. Currently a key part of vehicle manufactures meeting their fleet average CO_2 targets.

Euro Standards

Year Euro standard introduced (1990 - 2020)
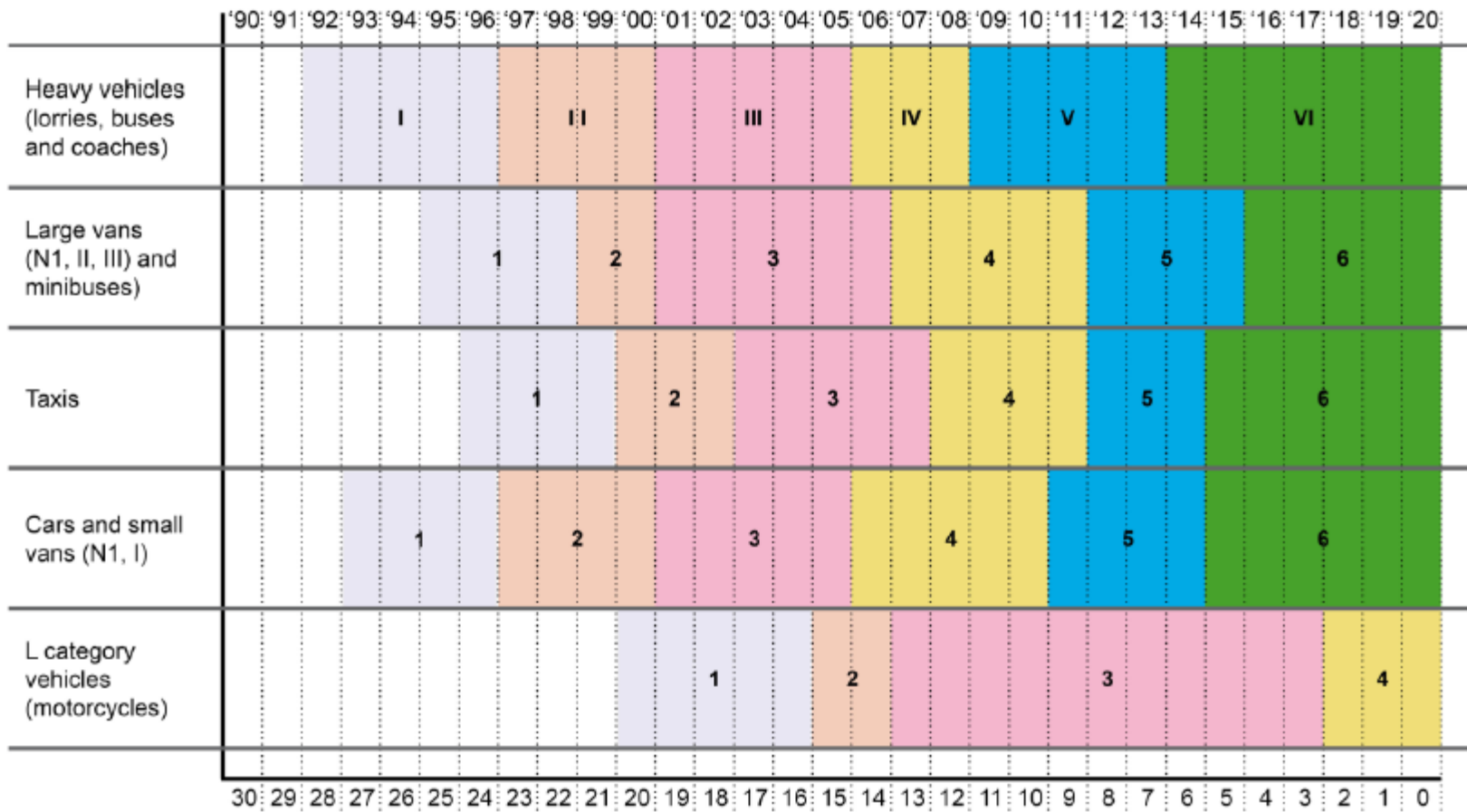
Real World Emissions

NOₓ Emissions for Type Approval and Real-World Driving (g/km)

Gasoline | Diesel

Euro 3 2000: Gasoline 0.15 / 0.2, Diesel 0.5 / 1.0
Euro 4 2005: Gasoline 0.08 / 0.1, Diesel 0.25 / 0.8
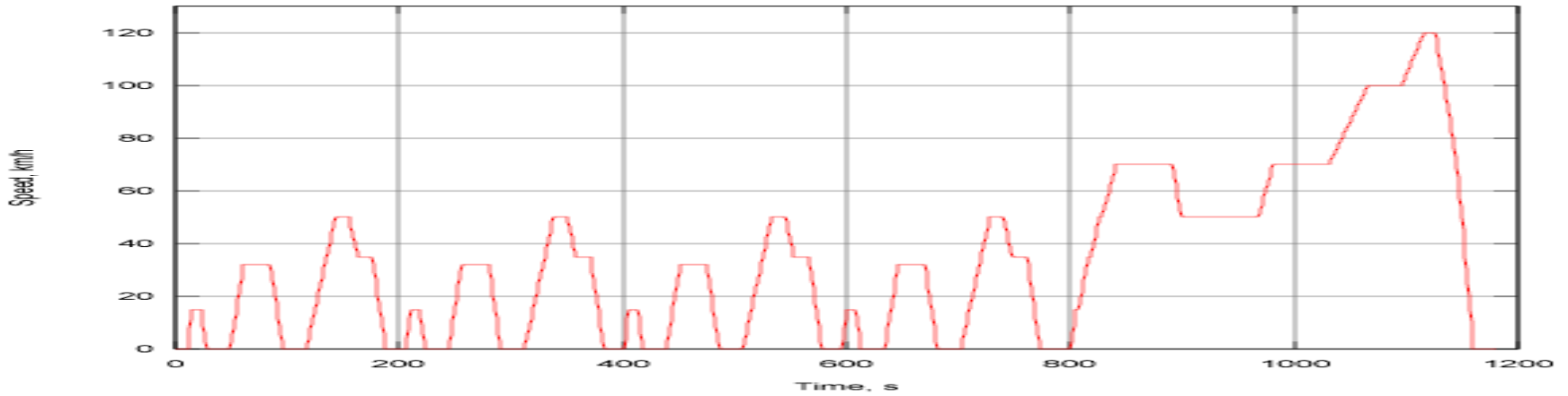Euro 5 2009: Gasoline 0.06 / 0.05, Diesel 0.18 / 0.8
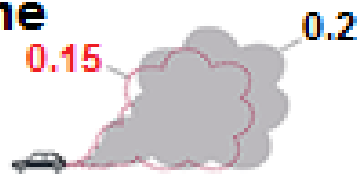
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Drive Cycles

Current Test Cycle

A real world London drive cycle
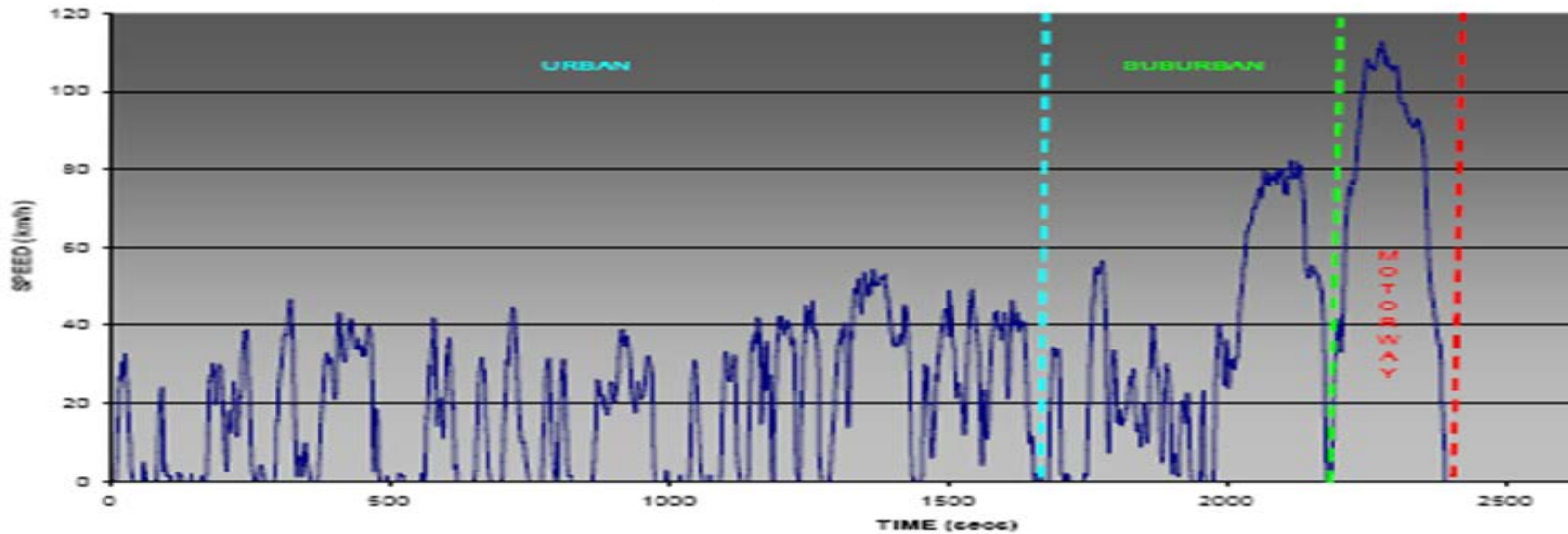
Euro 6/VI addresses these problems

- TfL is currently undertaking testing on Euro 6/VI.

- Euro VI HGVs & Buses are proving to be effective in controlling NOx emissions, in addition to the other legislated pollutants. This is helped because it includes on-road verification of emissions using portable measuring equipment (PEMS).

- Early indications are that Euro 6 petrol (light vehicles) is effective and there is a significant improvement for Euro 6 diesel as well.

- We expect future vehicles to be even more effective following in a switch to a more representative laboratory drive cycle called the World Light-duty Test Procedure (WLTP) in 2017 and then an on-road verification process being introduced in 2018 (Euro 6c), known as Real Driving Emissions test (RDE).

Population Growth

POPULATION (MILLIONS)

Within the coming few months we expect to surpass London's 1939 population peak of 8.6 million

High 13.4 million

Central 11.3 million

Low 9.5 million

Future congestion

% Change in Congestion from 2007 (y-axis)

Legend:
- SCOOT (orange)
- ATM (light orange)

X-axis categories:
- Baseline
- Intelligent systems & management (SCOOT + ATM)
- Changing behaviour & managing demand (Freight schemes + TDM)
- PT enhancements beyond MTS package

Increase in London's Congestion by 2031
- 60% Central London
- 25% Inner London
- 15% Outer London

The provision of more space and / or more radical demand management measures would be needed to tackle this congestion

The Solution

"A Game of Two Halves"

'Clean' Motorised Transport   +   Reduce Demand For It

Top 10 Measures in TERM

1. Implementing an **Ultra Low Emission Zone (ULEZ)** in central London

2. Tightening the **Low Emission Zone**

3. Making **traffic management** and regulation smarter

4. **Helping Londoners** tackle air pollution and climate change

5. Driving the uptake of **Low Emission Vehicles**

6. **Cleaning up electricity** for London's transport (CO2 measure)

7. Transforming London's **bus fleet**

8. Delivering zero emissions **taxi and private hire** fleets

9. Transforming London's **public and commercial fleets**

10. Developing **Low Emission Neighbourhoods**

'Cleaning transport' through a combination of:

'hard measures' to remove the oldest polluting vehicles (ULEZ, LEZ, parking charges), by setting minimum standards with a charge for non-compliance. Plus things like traction efficiency, decarbonising the grid (CO_2 reduction).

'soft measures' to encourage the uptake of the cleanest vehicles, eg preferential parking & loading, charging/refuelling infrastructure, grants, tax incentives, discounts (eg C-charge & parking charges), demonstration fleets, procurement requirements, education, awareness and behaviour change campaigns, Planning requirements (e.g. travel planning, delivery, servicing and construction management plans).

A reduction in vehicle km is also required…

- Delivery and servicing consolidation and reduction initiatives

- Education and awareness

- Modal shift to walking, cycling, public transport, rail and water freight, through provision of infrastructure

- Parking controls and low car developments

- Limiting access

- The way road use is paid for

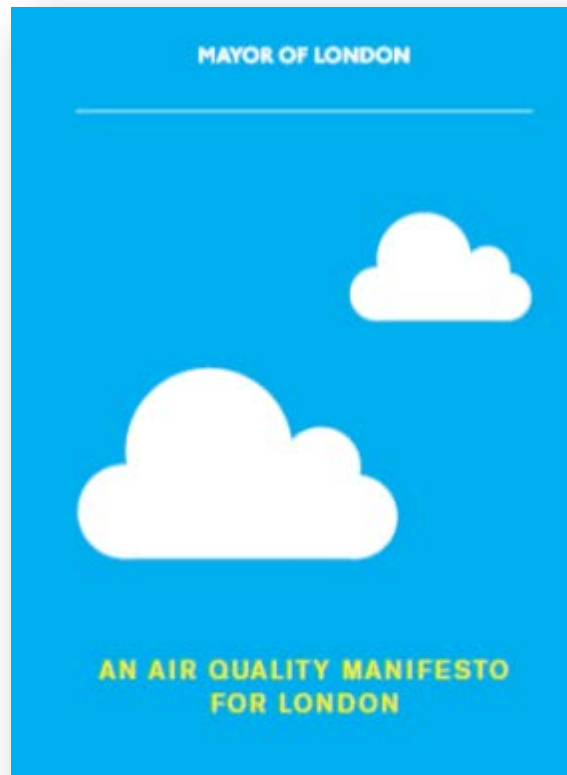- Spatial planning

- Remote communication

Nitrogen Dioxide (NO$_2$)

Compliance by 2020

- This is possible and is the Mayor's ambition as set out in his Air Quality Manifesto launched last year, but requires significant action by Government and EU.

Mayor's ask of Government and EU (1 of 2)

London calls on the **European Commission** to:

- Improve testing of the new Euro 6 engine emission standard and use it to address vehicle emissions; and

- make it easier to get EU funding to tackle pollution and create an Urban Clean Air Fund for European cities.

London calls on **central government** to:

- Provide additional financial support to London;

- encourage and promote the cleanest vehicles through fiscal incentives that incorporate both carbon and air pollutant emission standards;

- update the Clean Air Act to give councils the right powers to deal with pollution and address emissions from construction;

Mayor's ask of Government and EU (2 of 2)

- support a local approach to air quality in London with extra cash for pollution hotspots (eg Low Emission Neighbourhoods);

- help London's public transport go ultra-low emission by 2020 with funds for hybrid/electric buses and zero emission capable taxis where air quality is worst;

- tackle building emissions by considering air quality alongside CO_2 in the Department for Energy and Climate Change's priorities;

- put air quality at the heart of health by using Public Health England to help tackle exposure to air pollution; and

- national diesel scrapage scheme, which can be cost neutral or even raise revenue through increased tax receipts.

Example scale of reduction by 2020
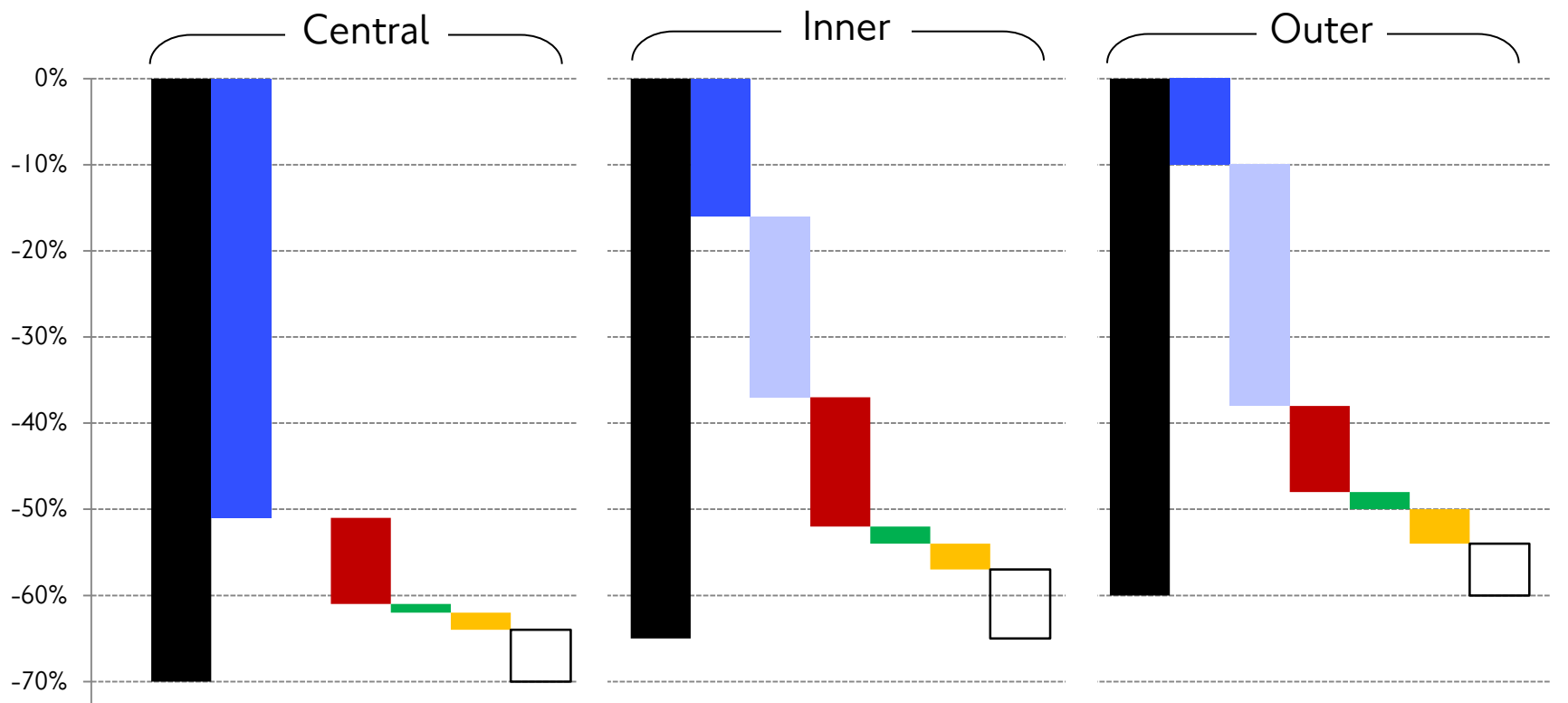
Required NOx reduction

ULEZ (as confirmed 2020 scheme)

LEZ (Euro 4 petrol and Euro 6/VI diesel)

Traffic Reduction

Behaviour Change Campaigns (including demonstrator public and commercial fleets)

Uptake of ULEVs

Gap – closed with LENs?

Note: Bus, taxi and PHV standards driven by ULEZ and LEZ so reductions from these fleets are captured in these schemes. Traffic reduction figures have been updated since publication of TERM

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Example scale of reduction by 2025
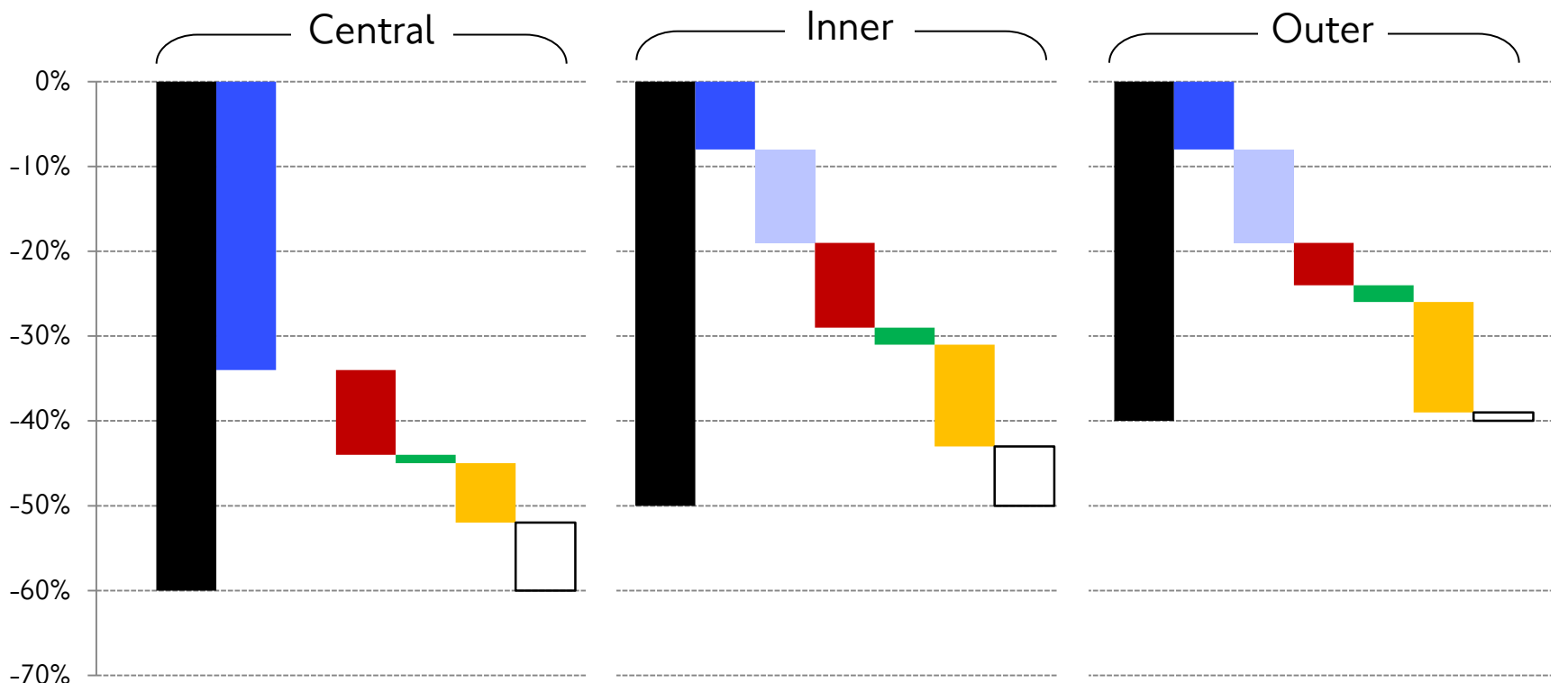
Required NOx reduction

ULEZ (as confirmed 2020 scheme but tightened again in 2025 so that all light vehicles must be ZEC*)

LEZ (Euro 4 petrol and Euro 6/VI diesel)

Traffic Reduction

Behaviour Change Campaigns (including demonstrator public and commercial fleets)

Uptake of ULEVs

Gap – closed with LENs?

Note: As note on previous slide

* Zero Emission Capable (eg plug-in hybrid or zero emission at tailpipe such as pure electric of hydrogen)

Emission Zones

- **London-wide LEZ -** The largest Low Emission Zone in the world, sets standards for emissions of fine particulate matter (PM) for heavy goods vehicles, buses, coaches and large vans.

- **Ultra Low Emission Zone** – Worlds most progressive scheme. Recently approved by the Mayor, coming into effect in 2020.

ULEZ

Upgrade or switch to a compliant vehicle by 2020	🚛🚌	Euro VI *(<6 years old in 2020)*	🚗🚐🏍️	Euro 6 (diesel) *(< 4-5 years old in 2020)* or Euro 4 (petrol) *(<13-14 years old in 2020)* Euro 3 *(<13 years old in 2020)*
Stay and pay a ULEZ charge	🚛🚌	£100 daily charge	🚗🚐🏍️	£12.50 daily charge
Adapt journey	*A proportion of drivers will instead change route or destination, change mode or reduce the amount they travel.*			

Additional requirements for TfL services

PRIVATE HIRE BUSES 🚕

ULEZ Impacts

47% compliance in the central area

NO2 Annual
Mean (ug/m3)

EU limit value →

Without ULEZ proposal

83% compliance in the central area
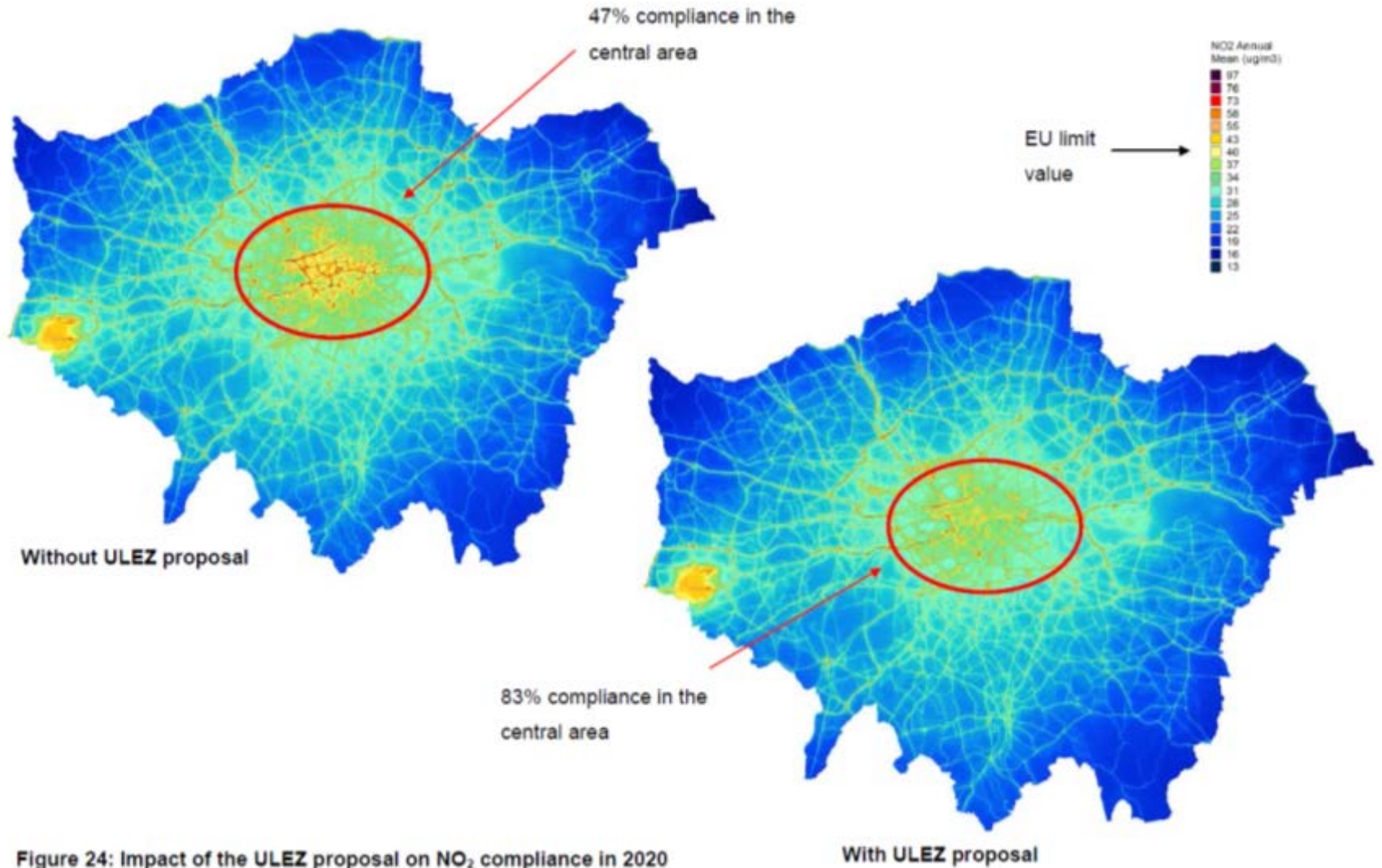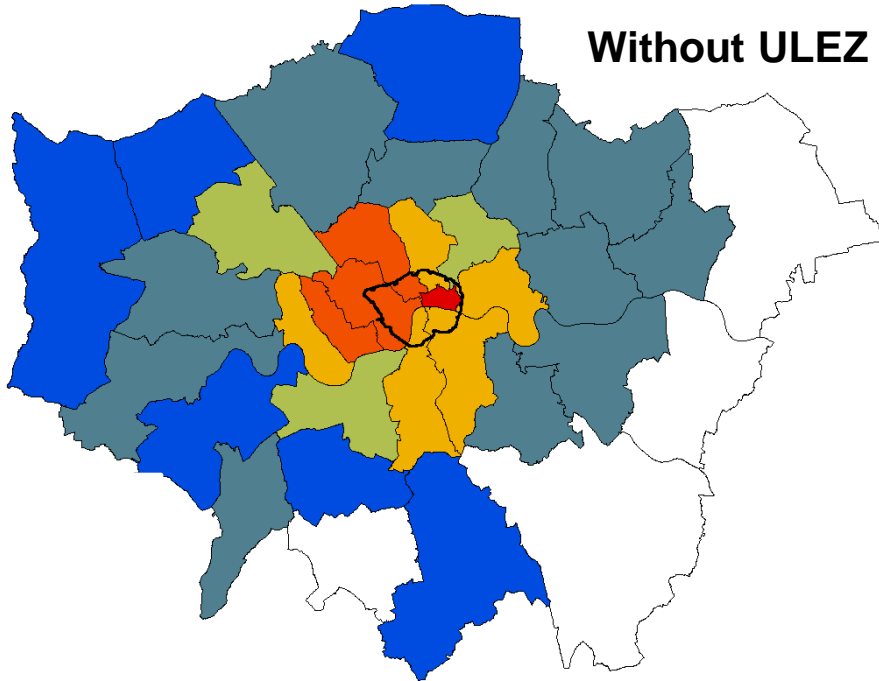
With ULEZ proposal

Figure 24: Impact of the ULEZ proposal on NO₂ compliance in 2020

Impact on proportion of borough population living in areas of NO$_2$ exceedance in 2020

Without ULEZ

With ULEZ

Percentage of population living in areas of NO2 exceedence

- 50 to 60
- 30 to 50
- 10 to 30
- 5 to 10
- 1 to 5
- 0 to 1
- 0
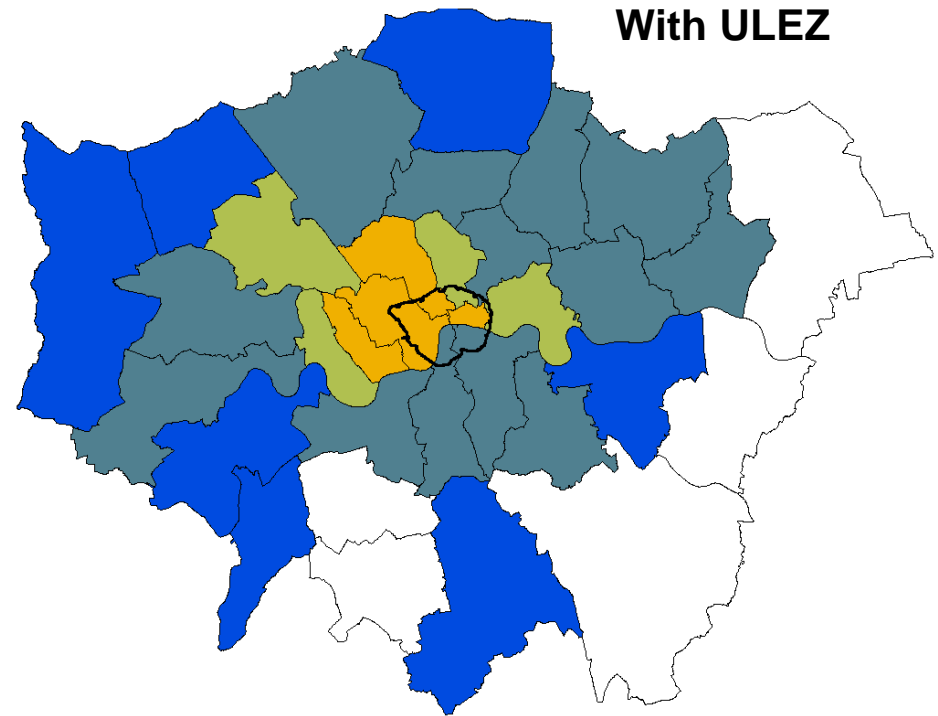
Area	Proportion of population living in areas of NO$_2$ exceedance in 2020	
	Without ULEZ	With ULEZ
ULEZ	63%	16%
Inner London	13%	6%
Outer London	2%	1%
Greater London	7%	3%

Traffic Reduction

Population Growth and Traffic Growth (2000 = 100%)
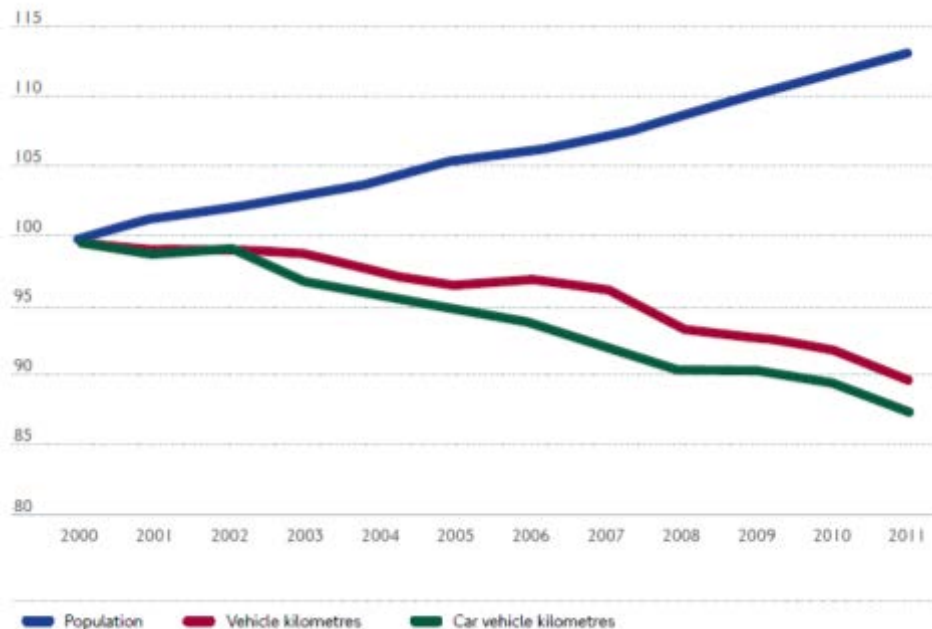
However, vehicle km are forecast to start rising again in inner and outer London.

TERM analysis suggests the following reduction in vehicle km (Excluding buses and taxis) is needed to make the NOx savings:

- 17% to 19% central London

- 12% to 25% inner London
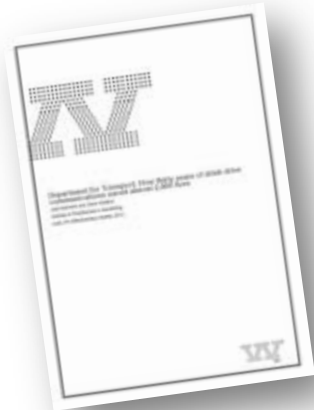
- 6% to 23% outer London

The scale of reduction depends on how much exceedance is left to in the 'gap' to be dealt with through targeted/local measures (eg LENs).

Education and Behaviour Change

- Limited direct impact on emissions, but important for generating support for strong measures.

Sustained Messages Required

Case Study: DfT: How thirty years of drink drive communications saved almost 2,000 lives (2012)

Where are we with air quality and climate change?

Period	1	2	3	4
Years	1979 - 1987	1987 - 1992	1992 - 2002	2002 - 2009
Behaviour change focus	Attitudes	Norms & drink driver perceptions	Norms & Attitudes	Attitudes
Communications strategy	Heightening the perception of risk	Creating social unacceptability	Confronting drivers in denial	Pinpointing the moment of decision

ULEVs

- Currently less than 0.1% of vehicle km is ULEVs. Emissions savings included in TERM analysis suggests this needs to increase to 1% in 2020 and 4% in 2025.

- The forthcoming ULEV DP will be critical to helping drive the uptake of ULEVs.

Detailed work on potential ULEV uptake underway. Table gives sense of the number that might be targeted. Important to remember a lot are infrequent visitors

Vehicle type	Total km in 2013 (000's)	Unique veh. in London (000's)	Number that are ULEVs (000's / %)
Car's & Taxis	22,800	8,100	4.6 (<0.1%)
Buses & coaches	6,000	22	1.0 (4.5%)
LGVs	3,900	1,000	1.0 (0.1%)
HGVs	1,000	180	0.1 (<0.1%)

- 2.5 million unique cars registered in London, around 1,000 are ULEVs. 390 new UELV registrations in London in 2013.

- 31m cars in UK, 1.7m scrapped a year (5.5%)

Life Cycle Emissions

- *Vehicle Cycle:* Vehicle production, maintenance and disposal.

- *Fuel Use:* Direct (i.e. tailpipe) emissions from the fuel/vehicle use.

- *Fuel Production:* Upstream emissions from fuel/energy production and distribution. Incudes charging losses for EVs.

- *Fuel Infrastructure:* Estimated impacts from refuelling infrastructure.

- *ILUC:* Estimates for potential additional GHG from indirect land use change for biofuel use only.

New Private Cars (2020)
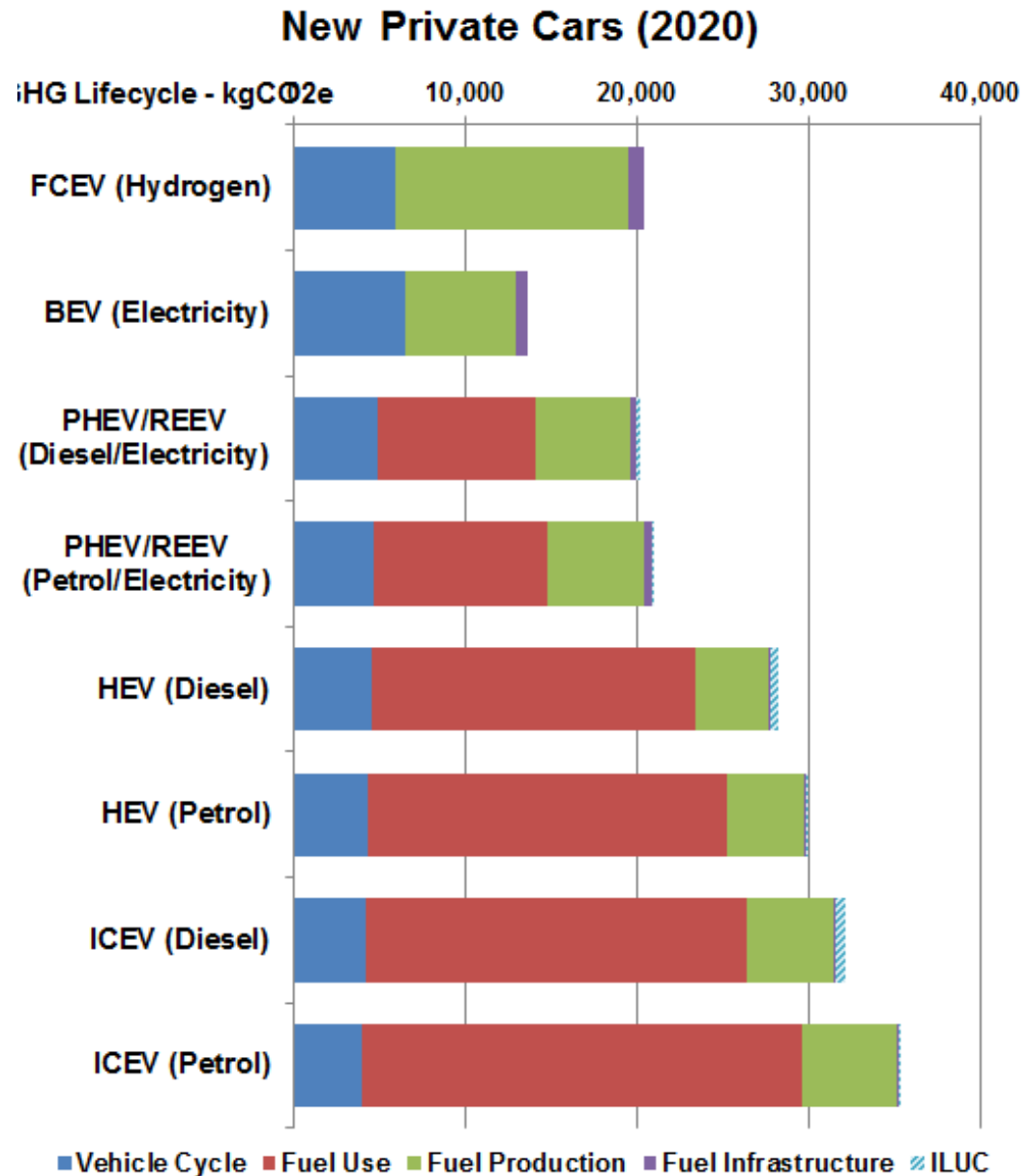
TfL Buses

- Particulate filters
- Selective Catalytic reduction
- Hybrid buses
- Hydrogen buses
- Electric buses
- Biodiesel

ULEZ will require all double deck buses in central London to Hybrid and all single deck to be zero emission (300) by 2020. 1,700 hybrids by 2016 increasing to 3,400 by 2020 (of a fleet of 8,700).

Cleaner Taxis and PHVs

Proposing ZEC requirement for PHVs also.

- Introduction of a 15 year age limit for taxis, retiring more than 6,000 of the most polluting vehicles from the roads and reducing PM emissions as a result.

- A trial of 8 hydrogen taxis.

- Proposed that all new taxis must be zero emission capable (eg plug-in hybrid) from 2018. This has helped unlock a £200m investment in a new factory in Coventry, creating over 1,000 jobs

- Considering further reduction of the age limit.

Freight, Delivery and Servicing

- 'The Mayor's Freight Strategy is currently being developed. A series of internal and external engagement activities have taken place to identify and inform the range of potential measures it may contain'

- A key part of this will be the Low Emission Commercial Vehicle Programme that provides guidance to fleet managers around Low Emission Vehicles

- Some of the measures being considered would have air quality benefits, particularly those that improve efficiency, and there is crossover with Low Emission Neighbourhoods work in terms of local coordination of servicing and micro-freight consolidation.

- More on this later today.

Low Emission Neighbourhoods

Transform existing areas and shape new development

Business/Resident commitments

Traffic management
- *Filtered permeability*
- *Through traffic restriction*
- *Timed closures*
- *Pedestrian/cyclist priority*

Parking and Loading
- *Restrictions*
- *Emissions based charges*
- *Priority loading for low emission consolidated servicing*
- *Area wide coordination of servicing*

Behaviour change
- *Smarter Travel commitments*
- *Cycle parking, lockers and showers*

Results

- Local economy boost & increased rent and property values
- Better air quality & climate change mitigation
- Improved health and wellbeing
- Reduced road traffic casualties

TfL/GLA/Borough commitments

- *Better Urban Realm*
- *Green infrastructure*
- *EV Charging*
- *Cleaner buses*
- *Better walking and cycling infrastructure*
- *Support and guidance*
- *Design and implementation*
- *Maybe future geo-fencing?*

A LEN will include a range of activities and will need a tailored set of measures to address these activities. LEN measures will need to reduce vehicle numbers, reduce emissions from vehicles or reduce exposure.

Example Suburban Town Centre LEN

Major road

High St (retail)

Office and retail area

Car parks

Hospital

Schools
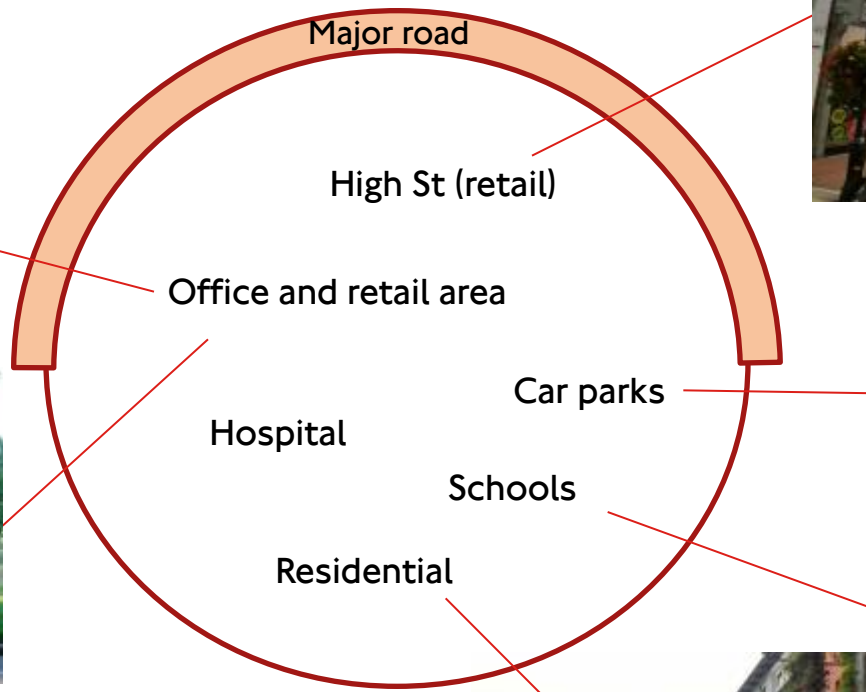
Residential

Identifying and Developing a LEN

Factors in identifying potential LEN areas
- Is the area polluted or high trip generator?
- Significant local traffic?
- Existing elements of a LEN?
- Plans for large scale redevelopment, eg Growth area?
- Large potential for improvement?
- Start and/or end point of a large number of journeys?

Defining a LEN
- Determined by the local circumstances.
- A successful LEN is dependant on the involvement of local people and businesses. Define boundary by the community within it, eg town centre, business park.

Identifying Measures
Identify: • types of roads and their proportions
•local activities, and their proportions
•active groups and likely level of local support
•relevant designations for the area
Use this information to build package of measures for ambitious and transformative change, based on TfL measures matrix, existing survey data and quantification.

TfL Support for Developing LENs

TfL / GLA Data
- Air quality concentration data
- Variety of traffic data
- Road Task Force Street Type data
- Property surveys

Borough Data
- Local traffic data
- Area servicing survey
- Land Use Maps
- Local Development Frameworks
- Local knowledge

Other Data
- Census and property traffic data
- Data on other issues: quality of urban realm, accessibility; traffic accidents and casualties.

Tools
- Methodology to assess potential savings
- Basic spreadsheet to identify potential savings
- London Atmospheric Emissions Inventory
- Valuing the Urban Realm Toolkit

Assistance and Guidance
- Advice on LEN identification
- Advice on LEN development and measures
- Advice on LEN quantification
- Advice on assessing measures, including pre- and post- pollution and traffic monitoring
- Signposting to existing sources of advice, support and funding for LEN elements
- MAQF
- LLAQM

Shape Development

New development – Greenwich Millennium Village

- Close to O2 arena, of res and commercial buildings (plus schools, health centres, etc)
- Sustainable transport was designed into redevelopment.
- Lower car use
- Good public transport connections
- Public transport accounts for 79% of commuter mode share.

Vauban, in Freiburg, Germany

- Very low car ownership
- No on street parking
- Cars restricted to walking speed on local streets

'**Bedzed**' - Beddington Zero Energy Development is an environmentally friendly housing development in Hackbridge, London, England. It is in the London Borough of Sutton, 2.0 miles north-east of the town of Sutton itself.

Transform (Retro-fit) Existing Areas

Braham Street

Walking and Cycling

- Car occupants are typically exposed to higher levels of air pollution than cyclists or pedestrians

- The health benefits of taking up cycling are similar to those of giving up smoking

- Reduced obesity rates

- Better mental health

- Reduced cardiovascular disease

Covered by Lucy Saunders presentation later today.

...urning Bankside Power Plant during the 'Great Smog' of 1952, before the Clean Air Act in 1956.

Thank you.

TRANSPORT
FOR LONDON
EVERY JOURNEY MATTERS

Appendix - Questions

Supplementary Questions raised

What are the environmental impacts of high vehicle turnover where consumers are expected to scrap vehicles to meet compliance with limit values?

The air quality benefits of scrapping older diesel vehicles need to be weighed up against the disbenefits of emissions associated with production and disposal of vehicles. This is perhaps an area that requires more research.

The current population stands at 8.6 million and is projected to grow to 10 million by 2030. How is the LEN targeting this specific issue?

Harder measures are required with alterations and provisions being made to the London plan. Create a master plan based on a feasibility study to include a housing plan and an increase in parking provisions.

Planning measures are being implemented to sustain a growing population but this is not sufficient. Land use planning requires working together with both local boroughs and central government to achieve results.

Has the ULEZ conducted any forecasting on revenue generation?

Yes, the expectation is that vehicles will be 90% compliant. The first year will be used to pay for maintenance of the infrastructure. After this the money will be re invested into developing the Mayors Transport Strategy