19TH JULY 2018

Bus Fleet - Emission Reductions

Lisa Dipnarine
Commercial Development Manager, Bus Operations

The scale of our operation

- **6.5 million passenger trips every weekday**

- **Around 700 routes**
  - All wheelchair accessible
  - Over 100 operate 24/7

- **19,000 bus stops**
  - 95% fully accessible

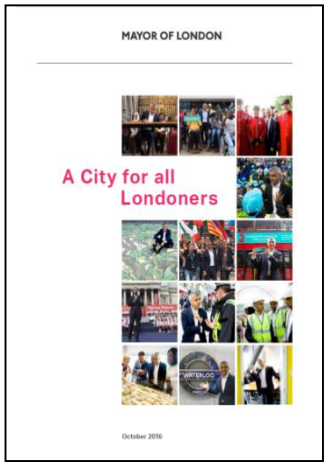
- **9,500 buses**
  - 3,000 Hybrids
  - 4,100 Euro VI
  - 96 Pure Electric, 10 fuel cell

- **24,000 bus drivers**

- **79 bus garages**

- **10 bus operators**

A new Mayor, a new agenda



"A City for all Londoners" sets out the Mayor's vision for London:

- **Environment, Transport and Public Space**
- Accommodating growth
- Housing
- Economy
- A City for all Londoners

Underpinning all of his priorities is a high quality public transport system.

Healthy Streets for London to create a healthy city:

- **Clean air**
- People choose to walk, cycle and use public transport
- Pedestrians from all walks of life
- Easy to cross
- Places to stop and rest
- Shade and shelter
- People feel relaxed
- Things to see and do
- Not too noisy
- People feel safe

Mayor Transport Strategy is to create a better place for all of those people to live in:

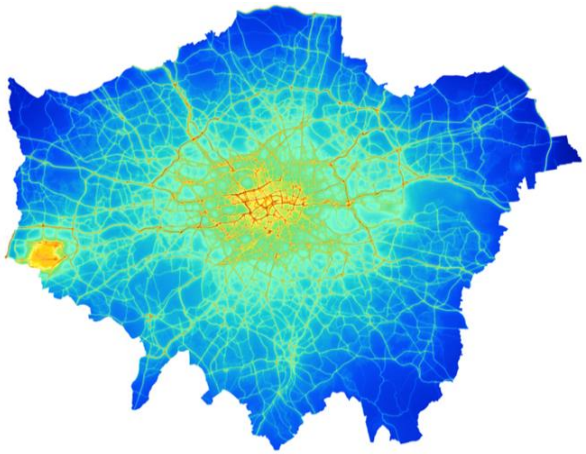
- **Improve air quality and the environment**
- Take action to reduce emissions
- **Introduce the Ultra Low Emission Zone in 2019**
- **Ensure all TfL buses meet the Euro VI standards by 2020**
- Tackle pollution in local air quality hotspots and at sensitive locations (incl Mayor's Air Quality Fund)

Clean Air Challenge

The Mayor stated that our “most pressing environmental challenge is cleaning up London’s air”

The challenges are:

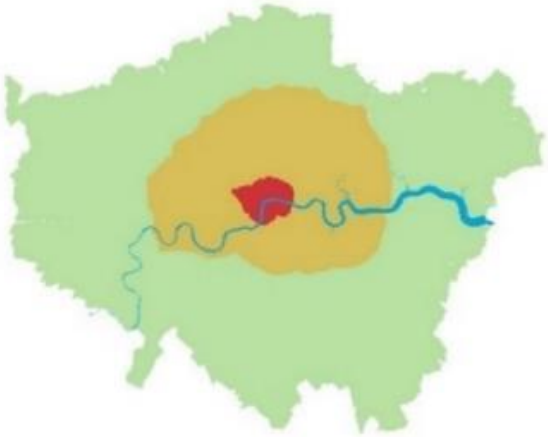
- Achieving compliance with NO_2 legal limits as soon as possible
- Further driving down Particulate Matter
- Becoming a zero-carbon city by 2050



NO_2 concentrations London, 2020 without ULEZ

To achieve this, there is an imperative to reduce emissions from vehicles in London:

- Encouraging more walking, cycling and use of public transport
- Reducing air pollutant and CO_2 emissions from transport
- Reducing motorised vehicles



Buses contribute to 27% of NO_2 in Inner London

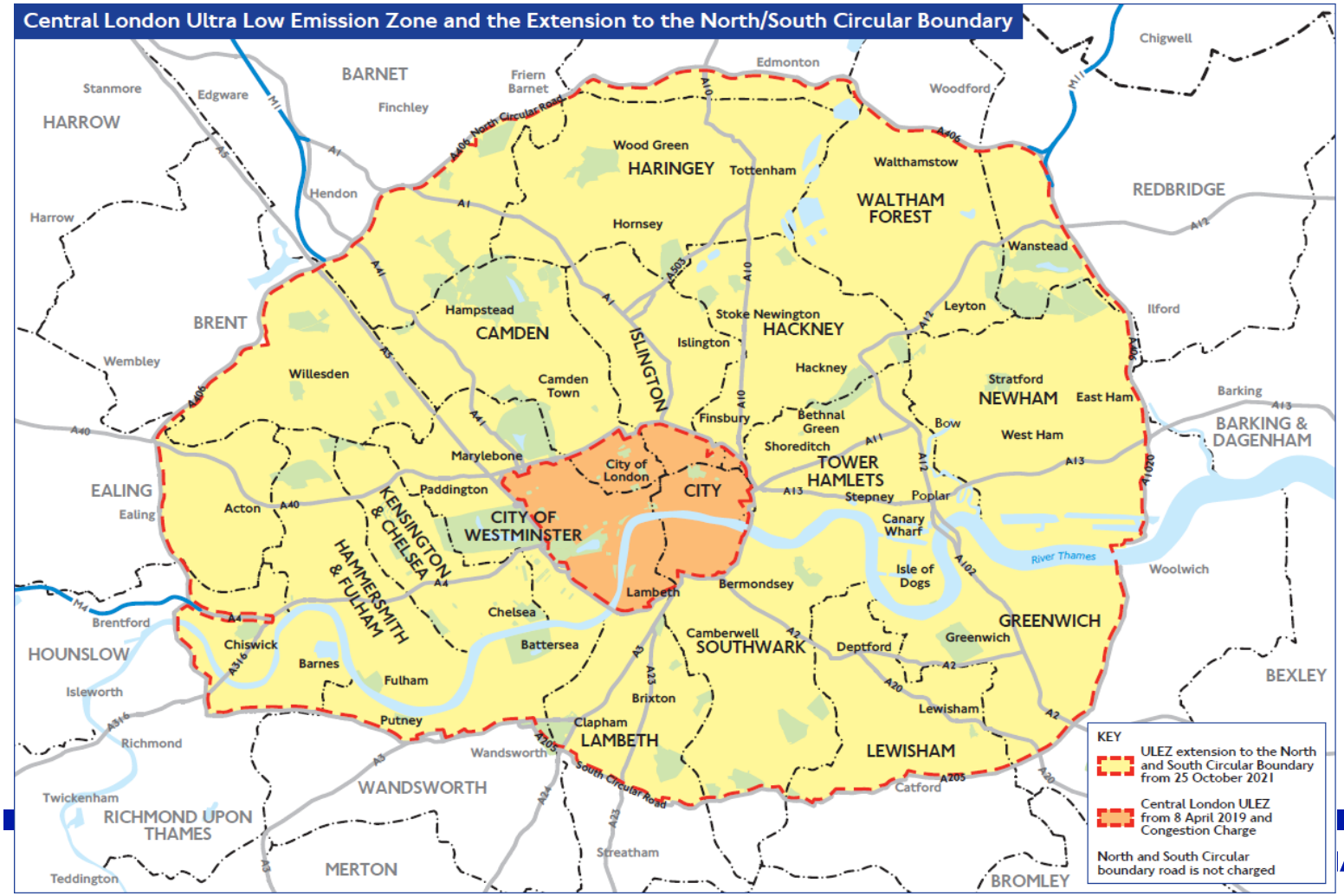
Air Quality Bus Commitments

- Delivering TfL's central London Ultra-Low Emission Zone requirements
- Delivering 12 Low Emission Bus Zones by 2020
- London-wide retrofit programme by 2020
- Hybrid buses and Zero Emission buses

Central London ULEZ and Extension

TfL Bus fleet requirements

- Up to 3,000 double deck hybrid buses – Euro VI emissions by April 2019
- Up to 300 single deck zero emission buses – by 2020



Low Emission Bus Zone (LEBZ)

Tackling the worst pollution hotspots by concentrating cleaner buses on the dirtiest routes.

Key criteria:

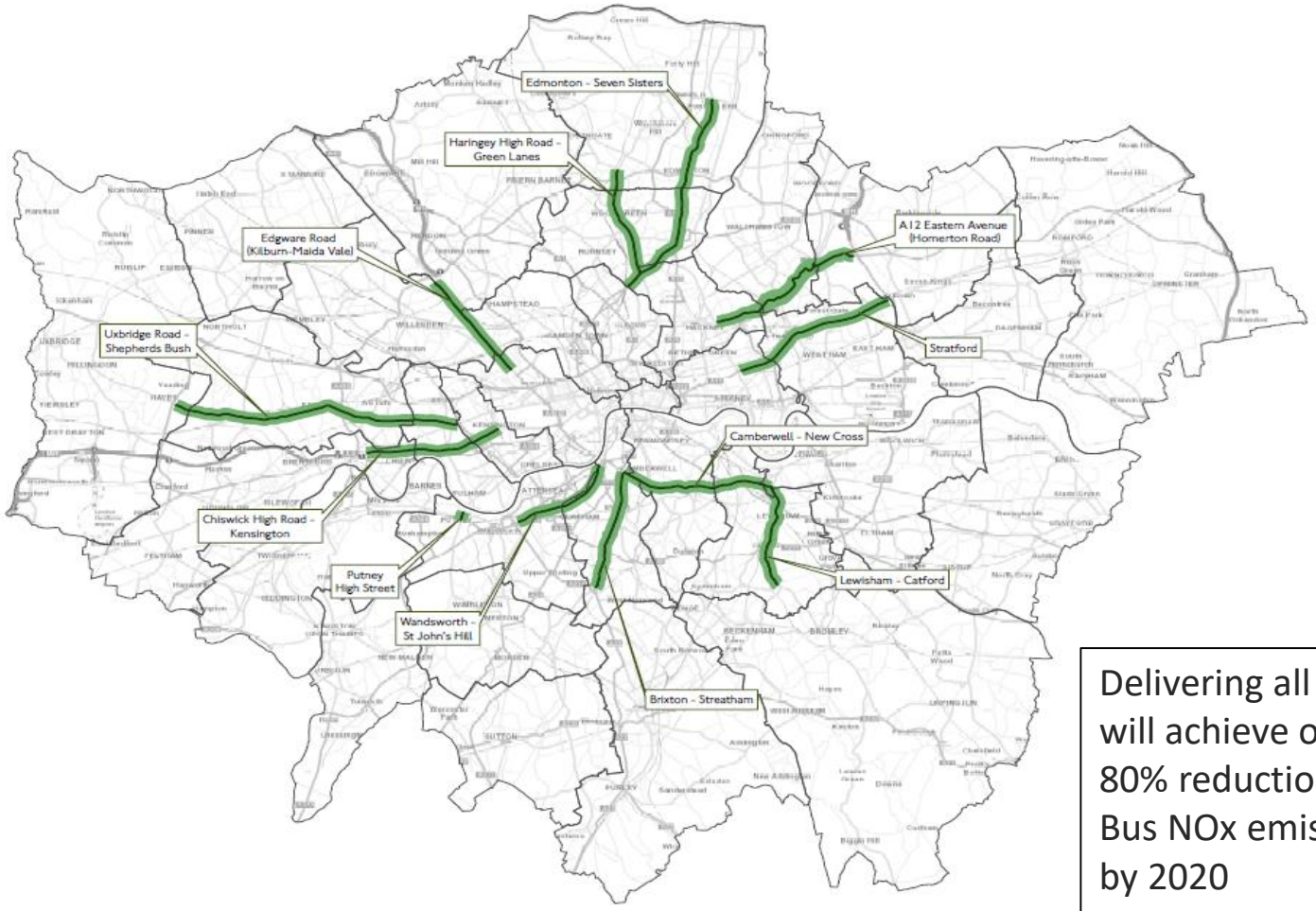
- Where buses are forecast to still be contributing 40% or more of road transport NOx in 2020;
- Where pollutant concentrations are currently above EU limit values for NO_2 and are forecast to still be exceeded in 2020; and
- Outside of the central Ultra-Low Emission Zone.

Defined by:

- All scheduled TfL bus routes along the corridor meeting a minimum standard of Euro VI (or better)
- The corridor has effective bus priority to ensure that buses keep moving, minimising unnecessary pollution from sitting in traffic.

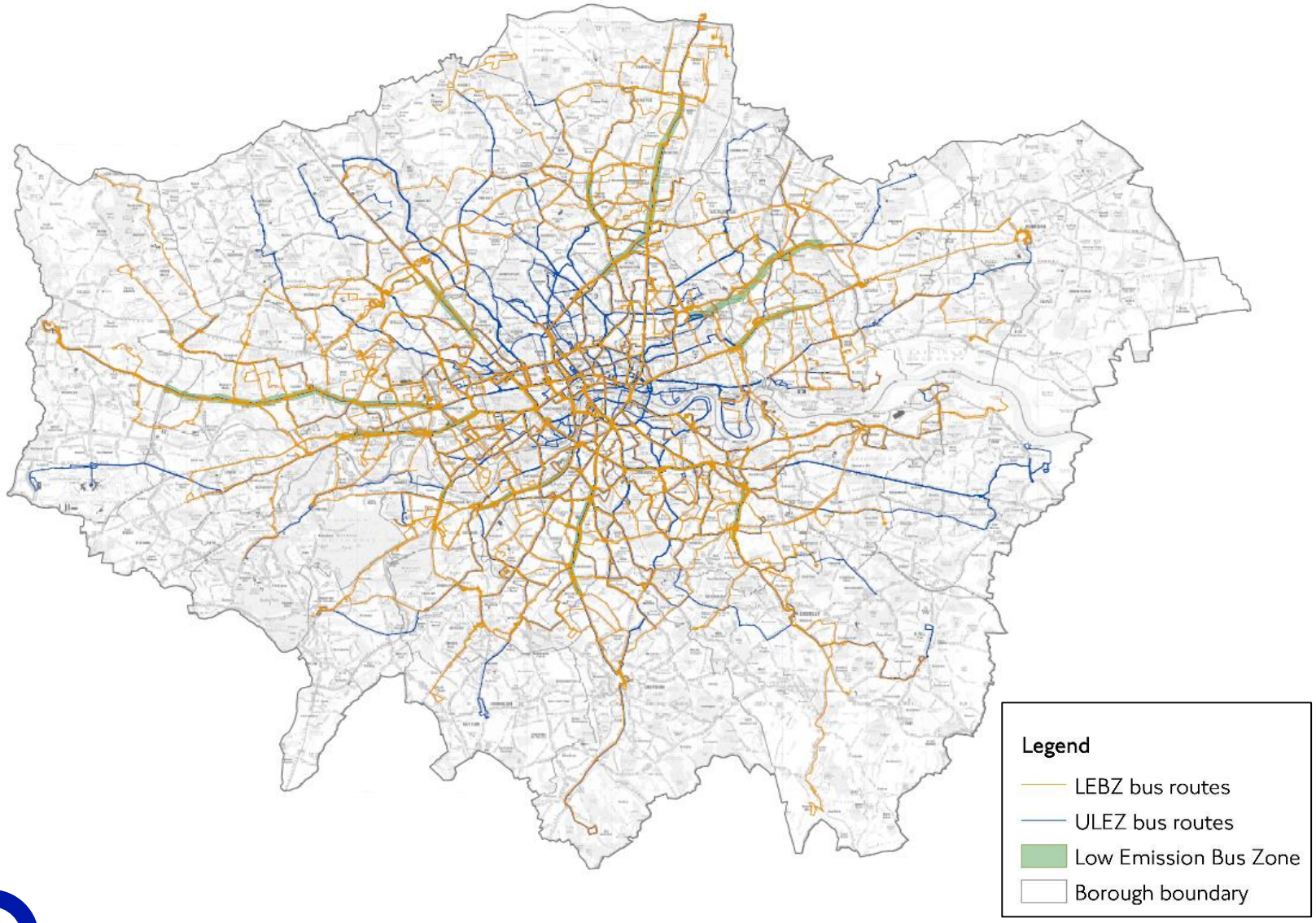
Low Emission Bus Zone (LEBZ)

Low Emissions Bus Zones



Delivering all LEBZs will achieve over 80% reduction in Bus NOx emissions by 2020

LEBZ and central London ULEZ routes



London wide Retrofit Programme

Reducing emissions from existing diesel and hybrid fleet to Euro VI standards by 2020.

Scope of work

- Up to 4,200 buses

Euro V – VI: Up to 3,200 vehicles in fleet

Euro IV – VI: Up to 1,000 vehicles in fleet

Up to 15 bus models (each might require different retrofit kit) – not just plug and play

Euro III + SCR: 1,000 vehicles in fleet

No solution, however, we expect all of the Euro III + SCR buses to leave the fleet naturally between now and 2020.

London wide Retrofit Programme

What we have achieved

- Procurement (mid 2016) - Open competition via OJEU process
- Five suppliers on Framework (May 2017) – some systems signed off, trials and development of others continue
- Installation and approval for funding in TfL's Business Plan (Summer 2017)
- Developed a Technical Specification – Retrofit suppliers must meet emissions criteria at Millbrook and 6 months on road testing
- Regular meetings with suppliers and bus operators to agree detailed schedule for retrofits

- Over 1,430 buses retrofitted
- 4 companies fitting almost 40 buses a week
- On target to complete programme by 2020

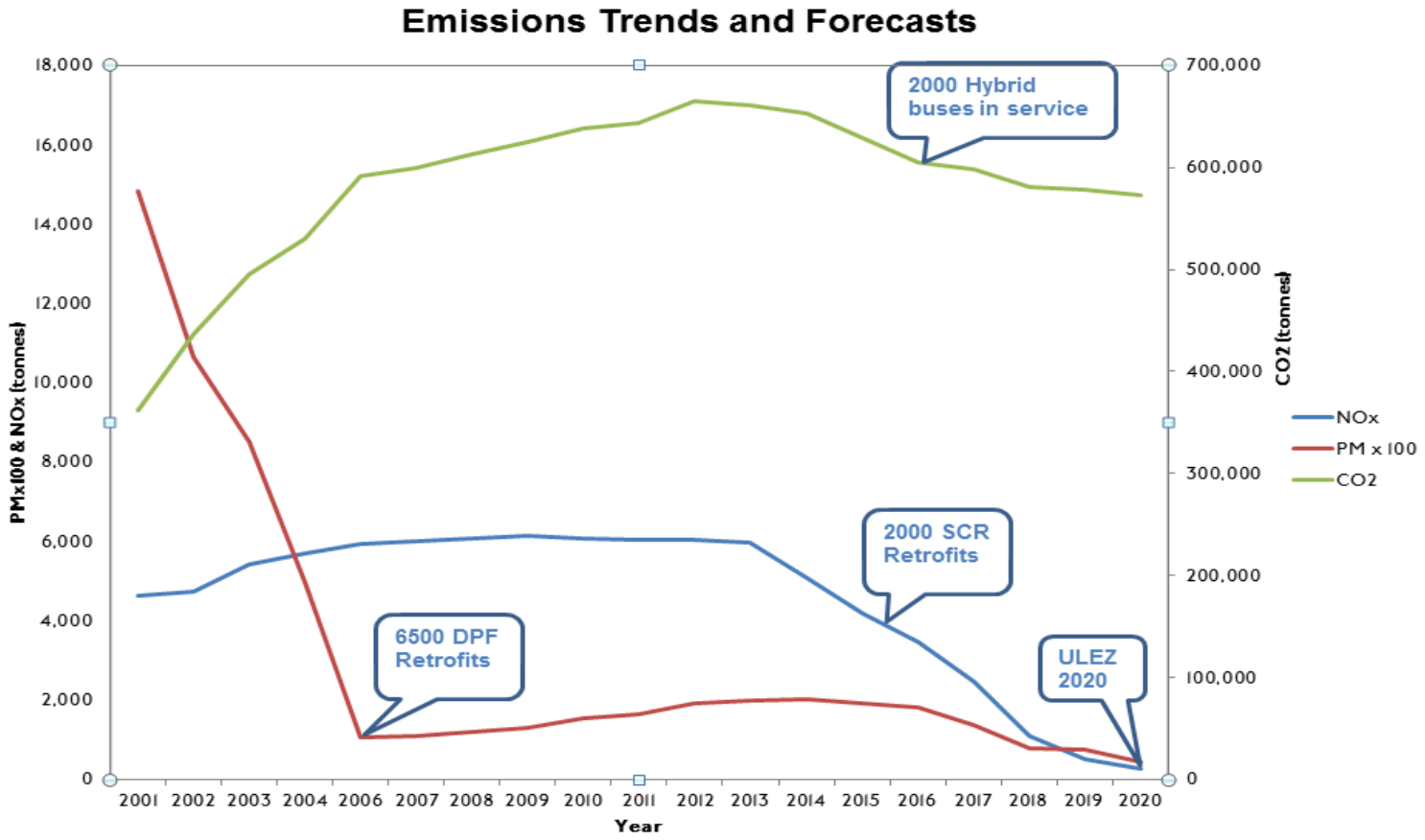
London wide Retrofit Programme

The Challenges

- Limits of the technology
- Greater pressure to deliver
- Tougher financial environment
- Variety of vehicle types in scope

Fleet emission trends – Diesel buses

- The DPFs have shown a 90% reduction over TfL's real world test cycle.
- CO2 and NOx increased due to fleet enlargement, current retrofit programme significantly reducing Nox.



Hybrid buses

- Offer the most cost effective means of CO_2 reduction (30%)
- 2006 to 2010 – Trials with 56 buses across 8 operators
- Double decks most effective
- 2012 – 300 vehicles in fleet, followed by a series of milestones
- 2012 – New Routemasters introduced (1,000 now in service)
- **2018 – Over 3,000 in service, and TfL procuring only hybrids (and/or zero emission) double deck buses**
- Technology evolves, to reduce costs for the same outcomes - supercapacitors or lower voltage systems are being introduced.

Hydrogen fuel cell buses

- Trial buses - 10 single deck fuel cell buses in service
- 2 new Van-Hool buses recently joined the fleet
- Most of the current contracts run out in 2020
- Tendering for 20 more single or double decks and new hydrogen fuelling station using European project grant funding (JIVE)
- Outcome expected later this year
- Vehicle cost is still a challenge.

Electric Buses – Single Deck

- Currently 91 single deck

Vehicle Type	Operator	Route	Charging Strategy
Irizar i2e 2 Buses	Go-Ahead	108	Overnight
BYD K8SR 5 Buses	Metroline	98	Overnight
9 Buses	Arriva	312	Overnight & Fast charge mid duty at depot
Optare Metrocity 4 Buses	London United	H98	
ADL/BYD E200 51 Buses 13 12	Go-Ahead	521/507 360 153	Overnight

Electric Buses – Double Deck

- 5 buses have been on trial since 2016
- Awarded contracts for two trunk double deck routes to operate with electric double decks
  - *Route 43 – 37 BYD / ADL buses*
  - *Route 134 – 31 Optare buses*
- The largest fleet of double deck zero emission buses in Europe
- Stimulate market, encourage development of zero emission double deck buses
- Currently, limited models in market, but the tendering process has accelerated development.

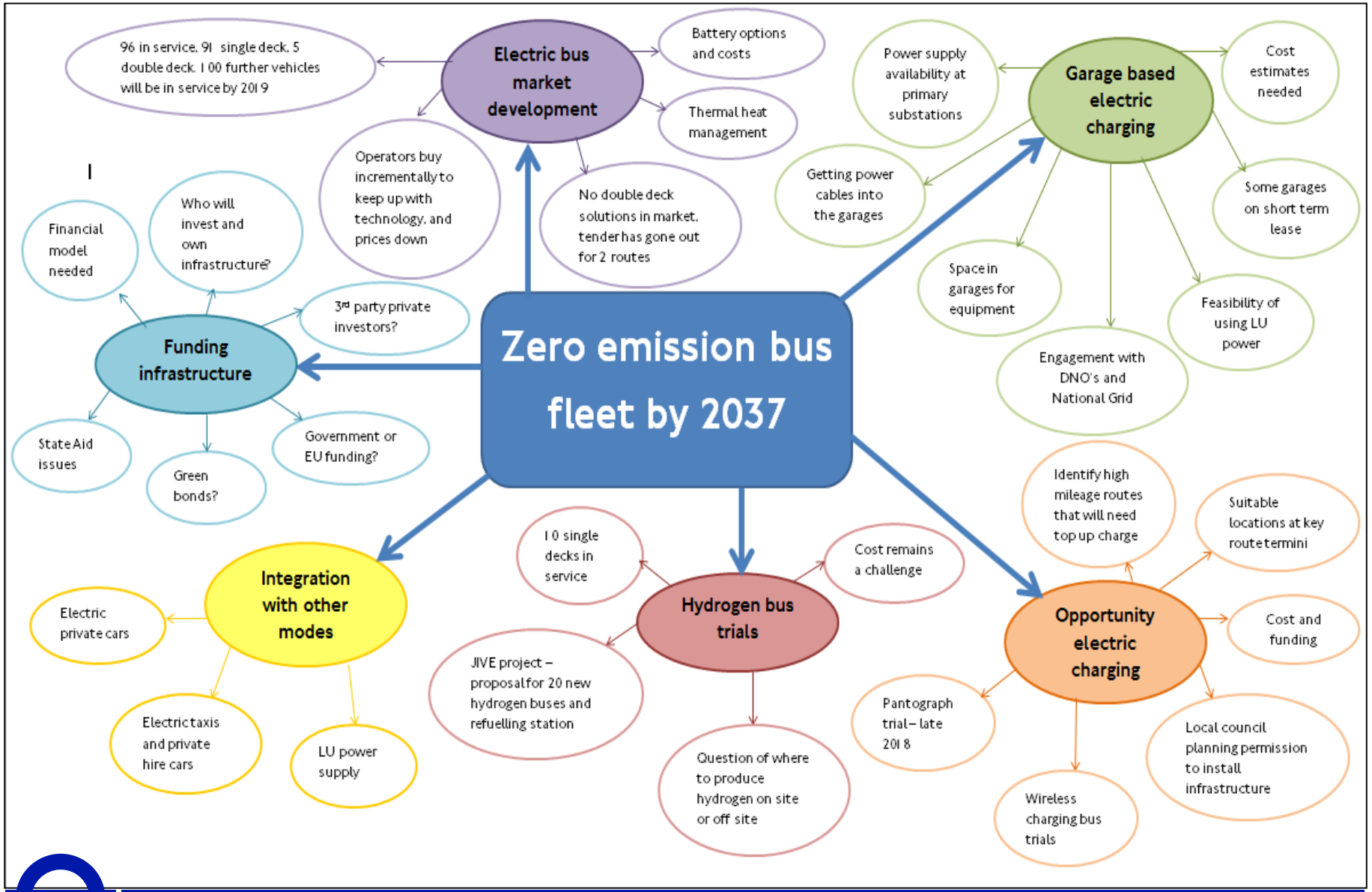
Electric Buses - Charging Infrastructure

- Operators bid for entire cost of running a route – includes vehicles and charging infrastructure
- Current focus on garage based charging – 79 garages across London – every site different
- Opportunity on route charging will also be required on longer routes
- Power supply upgrades required at some locations i.e. new sub-stations
- Waterloo bus garage – first electric bus garage in London
- TfL is looking at how to supply electricity to all 79 bus garages and associated costs
- Electrification of garages comes with challenges.

Electric Buses - Challenges

- Overall costs remain higher than diesel
- Suitable vehicle weight / range/ capacity for London environment
- Battery Life – we do not know yet the life of a battery
- Heating – impact on the battery range?
- Ability of Distribution Network Operator(s) to support rollout – mainly garage based charging supplemented by opportunity charging
- Energy storage – need to better understand alterative solutions
- Space limitations in some garages
- Limited funding available.

Roadmap to Zero Emission - 2037



Summary...

- Clear agenda for air quality from now until 2020
- Developing a roadmap to achieve 2037 target
- Technology is constantly developing
- We are all learning – wrong decisions could be expensive.