London Buses Emissions Reduction

Santiago
1 August 2014

Finn Coyle
Environmental Manager, Transport Emissions
Agenda

• The London bus network and its environmental impact
• Environmental Challenges
• Understanding the Impact
• Hybrid and ‘Zero Tailpipe Emission’ buses
Buses operate 24 hours per day, 7 days a week

Network contracted by TfL from Private Operators

The London Bus Network

6.5 million journeys per week day

19,500 bus stops

8,500 buses

700 routes
The London bus system: organisation

The Mayor
Strategy
Chair of TfL Board
Fares

Transport for London
Service planning & contracting.
Monitoring of output and quality.
Consultation & engagement.
Vehicle Specifications.
Stops, stands, stations.
Information.
Research & advice.

Private sector contractors
Tender for services.
Run services to TfL standards.
Employ drivers, controllers, engineers and other operating staff.
Own assets, including buses and garages.
Bus usage in London 1963-2014

London bus network: service volume and usage 1963-2014

- Bus-km operated (millions)
- Passenger-km (millions)

![Graph showing bus usage trends from 1963 to 2014]
Environmental Challenges

- EU Limit Values of 40 µg/m³ for NO₂ and PM
- PM just below limit (though no safe level)
- NO₂ is 3 times higher than limit value in some areas
- Mayor has targeted 60% reduction in CO₂ by 2025 from 1990 levels
Calculating the Environmental Impact of the Bus Fleet

- TfL developed with Millbrook a ‘real world’ drive cycle based on Route 159 from Brixton to Oxford Street
- Every new type of bus is tested to ensure CO$_2$, PM and NOx emissions meet TfL’s requirements
- Enables TfL to model the impact of the Bus Fleet on London emissions and predict the impact of interventions such as hybrid buses
Fleet Emission Trends 1997-2013

TfL Retrofitted Diesel Particulate Filters (DPF) on all its Euro II and III buses
Hybrid trial and evaluation

- Hybrids chosen as the offered the most cost effective means of CO2 reduction
- The hybrid programme has spurred bus manufacturers to develop hybrid buses
- Trials consisted of 56 buses across 8 major operators
- £5.4 m London Government Climate Change fund for the additional on-cost of the vehicles and 5 year warranty
- Monitoring and evaluation period 2006 to 2010
- Four manufacturers – ADL, Volvo, Wrights and Optare – single and double deck
- 30% CO2 saving to be demonstrated over MLTB test cycle – Low Carbon Bus Certificate
Hybrid whole life cost – issues that affect contract price

- Capital cost of vehicles
- Life of batteries and replacement cost
- Drive motor and other hybrid component life costs
- Maintenance costs
- Finance leasing and residual values
- Fuel costs
Hybrid Buses - Deployment

All operators bid with prices for ‘diesel’ or ‘hybrid’ buses

A competitive price for hybrid buses will have more chance of winning the tender – hybrid buses will then be specified in the contract

800 hybrid buses now in service

1700 to be in service by 2016

£23m UK Government Green Bus fund part funded the on-cost of 334 Hybrid buses

GBF1 – 80% funding
GBF2 – 70% funding
GBF3 – 60% funding
GBF4 – 50% funding
New Routemaster

New Routemaster with second generation hybrid technology demonstrates even more significant benefits
- 47% reduction in CO2
- 78% reduction in NOx

Flywheel Technology

The Williams hybrid system utilises a high speed flywheel that stores energy (from braking for example) and releases the energy to aid vehicle propulsion

- significantly lower cost
- 20-30% CO2 reduction
- 25 single deck buses going into service this year with more planned
- No zero emission capability
Electric, Plug-in Hybrid Bus & Induction Charging Trial

- 2 Pure Electric Buses from BYD in service on route 507 and 521
- 6 more electric buses from Optare going into service this year
- 4 Inductively charged hybrid buses going into service in 2015
Hydrogen Fuel Cell Buses

- Zero ‘tailpipe’ emission buses
- A fleet of 8 hydrogen buses are in operation
- Aim to achieve operation as close as possible to diesel buses
- New maintenance and refuelling facility constructed within a standard bus depot
- Longer term strategy
Emissions Projections

**Annual bus emission trends**

- **1700 Hybrids in service**
- **Hybrid Roll-out**
- **SCR Roll-out**
- **SCR + Euro VI = -20% NOx**
Environmental Targets

- 1700 hybrid buses by 2016
- All buses to meet Euro IV standard for PM and NOx by 2015 to be met by retrofit of SCR and accelerating the uptake of Euro VI
- Ultra Low Emission Zone proposed for central London by 2020
- All double deck buses operating in central London to be hybrid by 2020
- All single deck to be ‘zero tailpipe emission’ (electric or hydrogen) by 2020
Summary and recommendations

• Hybrids biggest contributor to CO2 reduction with increasing emphasis on further electrification

• Electric and hydrogen buses offer potential to move to zero emissions policy in future

• Essential to set a CO2 reduction target for hybrids – e.g. 30% less CO2 over a real world drive cycle

• Many of the hybrid drive-lines, control and battery management systems in use and proven in London could be integrated into buses used in Chile
Questions?