Integration of Efficient EuroVI Diesels

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First Bus

First Bus

- First is one of the UK's largest Bus operators, with around 6200 buses across the UK and carries 1.6million people per day.
- First operates around 1000 low carbon certified buses with in the UK.
- Fleet includes: Hybrids, MicroHybrids, Electric, Hydrogen, Virtual Electric, and we have recently trialled Bio-methane.

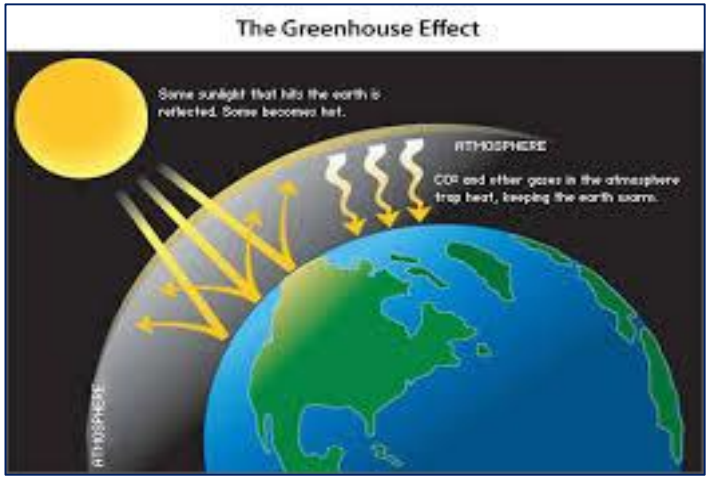
Low Carbon Vehicle Operator of the Year 2016

Low Carbon Champions Awards

THE LOWCVP LOW CARBON CHAMPIONS AWARDS

Emissions Agenda

Double Challenge for Passenger Transport

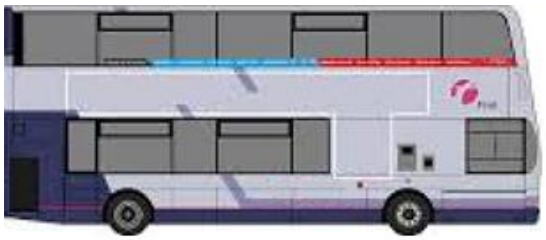


Climate Change – Impacted by Green House Gases / Carbon emissions **(CO2)** which directly relate to fuel consumption. Increasingly on Global and UK Government agenda.

Air quality – Many cities in breach of EU's Oxides of Nitrogen (**NOx)** emission limits – Reported as hazardous to human health and driving factor behind the push for Clean Air Zone introduction. Emissions rate of Particulate Matter (**PM**) is also of concern.

Emissions Agenda

Emissions in Context



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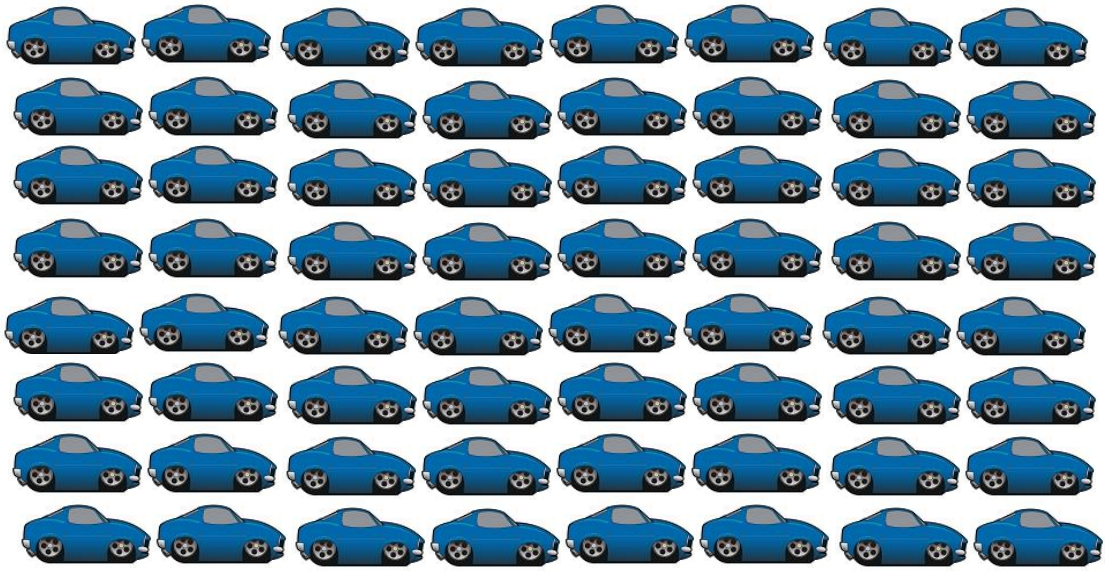


Regardless of the technology used

- Buses offer a significantly more efficient way of travel – therefore helping to reduce impact on climate change.
- Buses can and should be a vital part of effort to improve air quality.
- **However** - Buses are becoming stuck in the very congestion they can help to solve therefore more help and work is needed to improve journey times for bus users.

Timeline of Efficiency Development

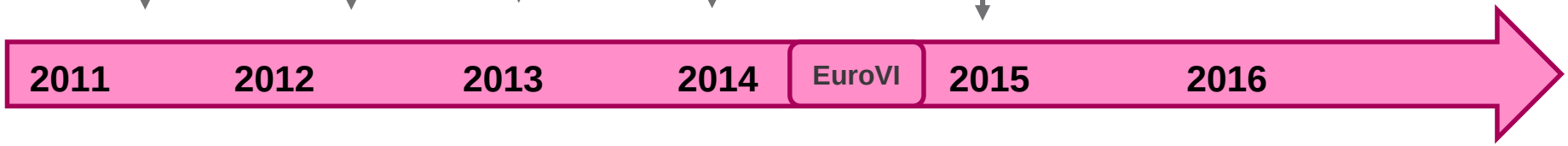
2011- Historical and continuing declining trend in diesel efficiency identified

2012 - Commenced supplier testing at Millbrook Proving Ground.

2012/13 – GPS Data capture to develop FMFET test cycle.

2014 – Continued refinement of test cycle and procedures.

2015 - Annual testing continues

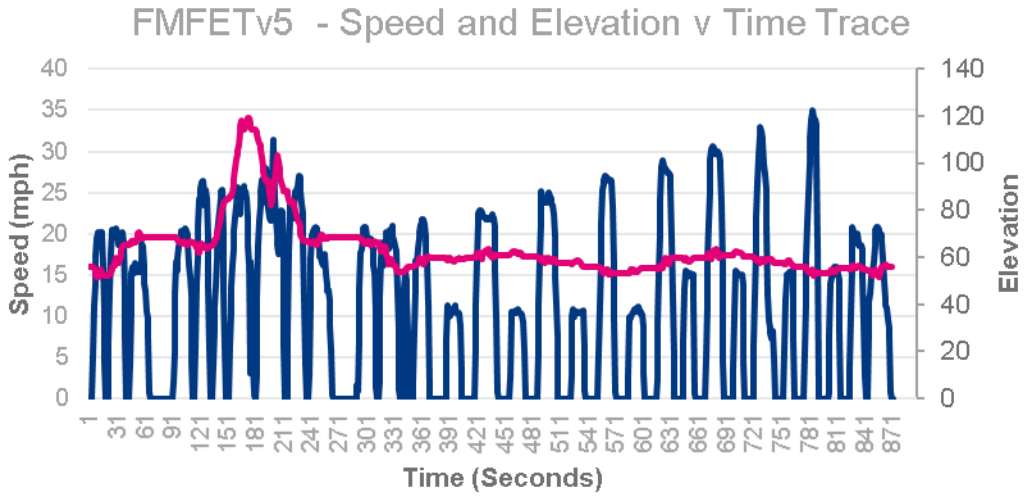


FirstGroup Millbrook Fuel Economy Test (FMFET)

FirstGroup Millbrook Fuel Economy Test (FMFET)

Millbrook Testing: Based on real word operational data to replicate what buses actually do. Test incorporates:

- Junctions
- Roundabouts
- Bus stops with door openings
- Varied idling periods
- Flat and hilly sections
- Straight and windy roads
- Varying speed profile



- Buses fitted with fuel flow meters and advanced GPS tracking
- Driven by independent Millbrook's drivers
- Process also involves Gradient and Acceleration testing

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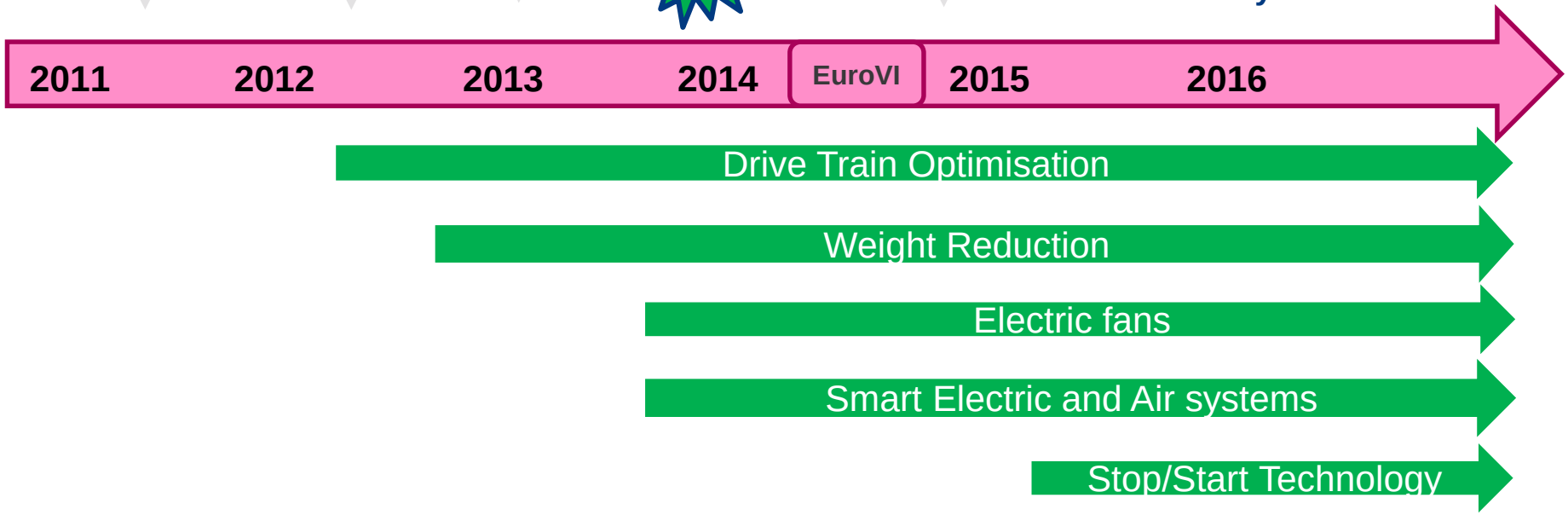
Low Carbon Emission Bus Certification achieved without need of conventional hybridisation



Air Quality – EuroVI Diesel

First moved to EuroVI engine vehicles in April 2015 and now has over 600 within its fleet.

EuroVI HD Diesel Engines –

- Widely acknowledged as delivering a huge improvement on previous standards
- verified by independent testing and further improvement is already being made.

EuroVI Diesel Double Deck Example - LEB Test Results

Test Phase	HC (g/km)	CO (g/km)	NOx (g/km)	PM (g/km)
Rural	0.000	0.011	0.005	N/A
Outer London	0.000	0.037	0.004	N/A
Inner London	0.000	0.045	0.006	N/A
MLTB Average	0.000	0.039	0.005	N/A
LUB Average	**0.000**	**0.027**	**0.005**	**0.0116**

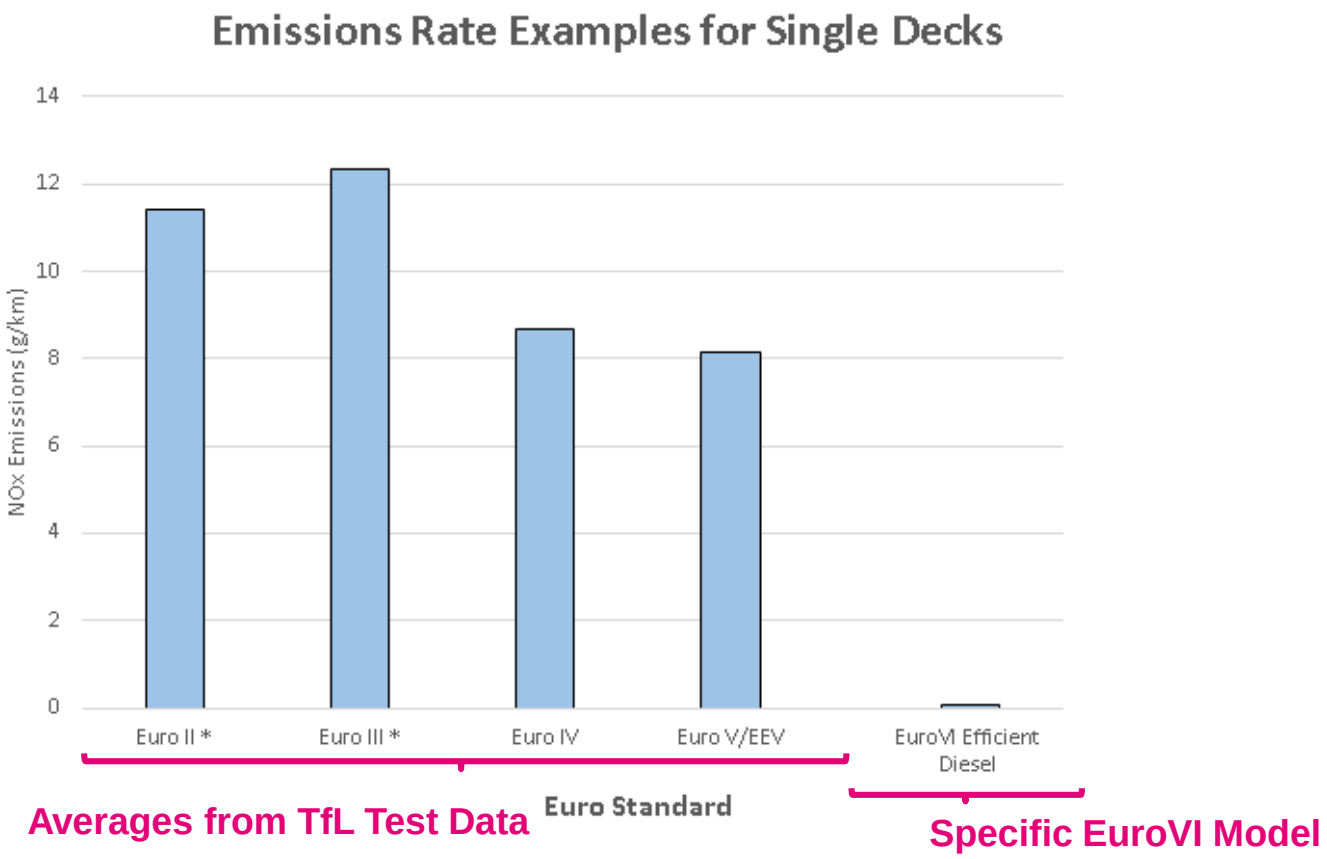
Euro6 Passenger Car Avg – DfT Test Data*

NOx (g/km)
0.5

*DfT Data based on real world testing, average of 19 diesel models.

Emissions Agenda – Vehicle Options

- **Modern efficient Euro VI diesel** most cost effective emissions reduction solution in short term. New vehicles can deliver up to 99% reduction in NOx emissions and over 30% Carbon emissions relative to end of life EuroII / III buses..



Data based on publically available and credible sources recognised by DfT, DEFRA and OLEV.

Summary

Efficient EuroVI diesel models are the most cost effective new bus solution to improving air quality.

- Offer significant improvements in both NOx and Carbon emissions
- No requirement for new infrastructure
- Technology fairly well understood
- Carries a cost premium but is commercially viable particularly with LCEB BSOG incentive.
- Emergence of new generation of Hybrids that offer even further carbon benefits.

Other technologies - Longer term outlook

- Drive towards zero emissions and further reducing carbon emissions means Electric will increasingly have a place in the long term.
- Whilst bio-methane is not zero emission it does have strong carbon credentials

- ❑ **Increasing number of technologies are becoming available**
- ❑ **The specific local objectives need to be determined and understood before the most appropriate technology solution can be chosen.**