

Bus Emissions Reduction on Putney High Street

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MAYOR OF LONDON



Pollution in Putney

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POLICE CRACK DOWN ON STREET VIOLENCE OUTSIDE LONDON'S PUBS, CLUBS AND TAKEAWAYS

Polluted Putney: fumes breach limit for the year... in January

- 'London's most polluted street' smashed annual limits ten days into new year
- Fumes so bad shopkeepers advised to keep doors shut
- Putney High street pollution 'off the scale,' say campaigners



Smog: Putney High Street pollution levels have shocked residents, who include model Yasmin Le Bon, left

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POLICE CRACK DOWN ON STREET VIOLENCE OUTSIDE LONDON'S PUBS, CLUBS AND TAKEAWAYS

Air pollution in Putney and Brixton up to three times higher than EU limits



Fuming: Busy roads in Putney (pictured) and Brixton have measured high levels of air pollution

Top stories in News

Sir John Major warns Merkel of 'pushing Britain out of EU over migration'



All shook up: Elvis Presley helps Christie's art sale to a £536m record

Cyclist hit by Uber driver claims there is a 'hole in the system'

He can land a probe on a comet but can't park the car, says sister of Rosetta mission's tattooed poster boy

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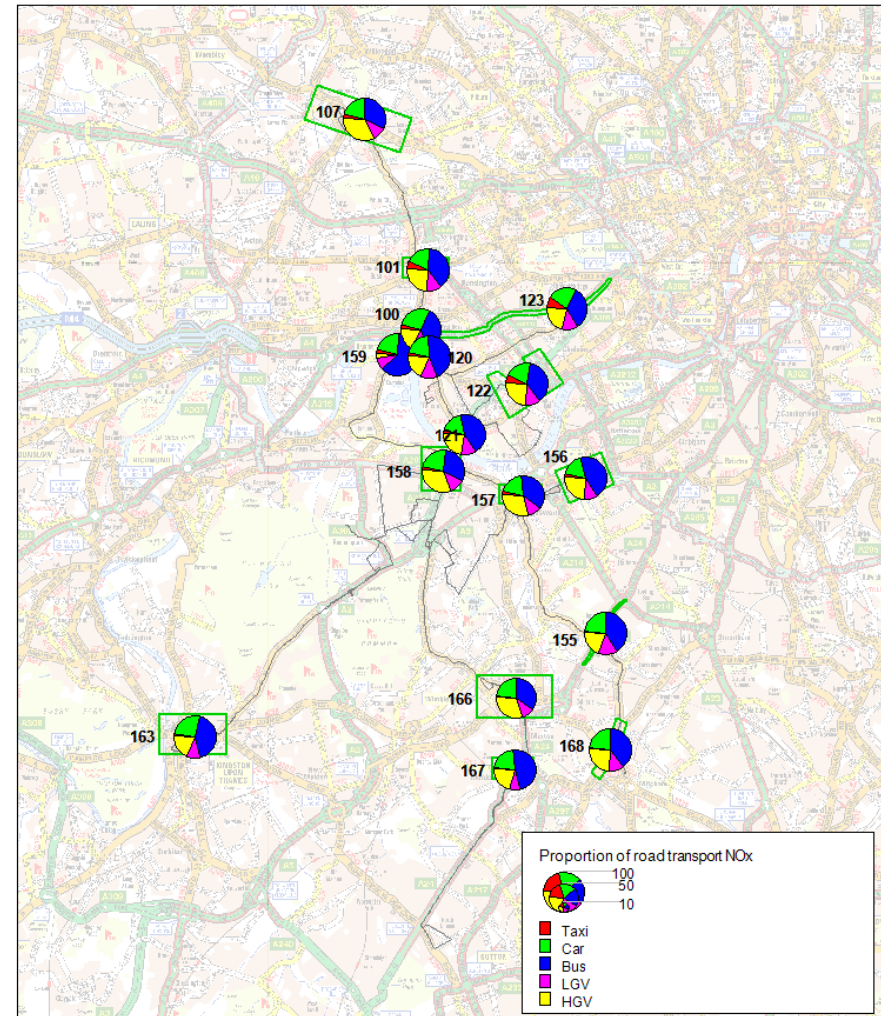
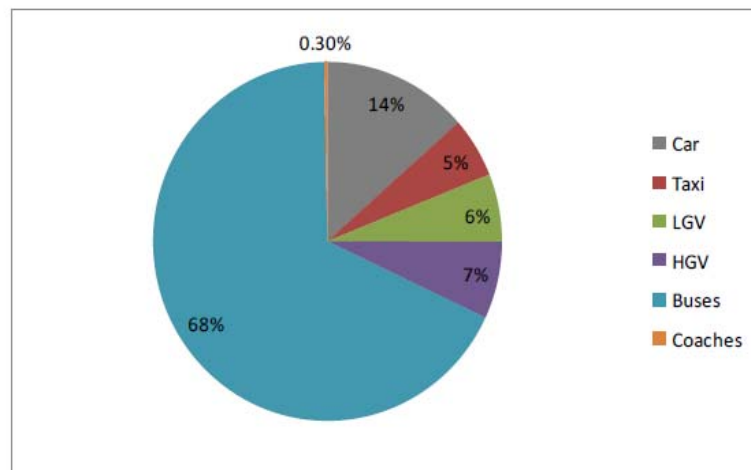
Source Apportionment for NO_x on Putney High St



Table 11: Overview of NO_x and PM emissions by vehicle type.

| | Car | Taxi | LGV | HGV | Buses | Coaches |
|--------------------------------------|-----|------|-----|-----|-------|---------|
| Percent of movements | 67% | 7% | 14% | 2% | 10% | 0% |
| Percent of NO _x emissions | 14% | 5% | 6% | 7% | 68% | 0.30% |
| Percent of PM emissions | 35% | 14% | 23% | 7% | 21% | 0.27% |

Figure 11: Percentage of NO_x emissions by vehicle type.



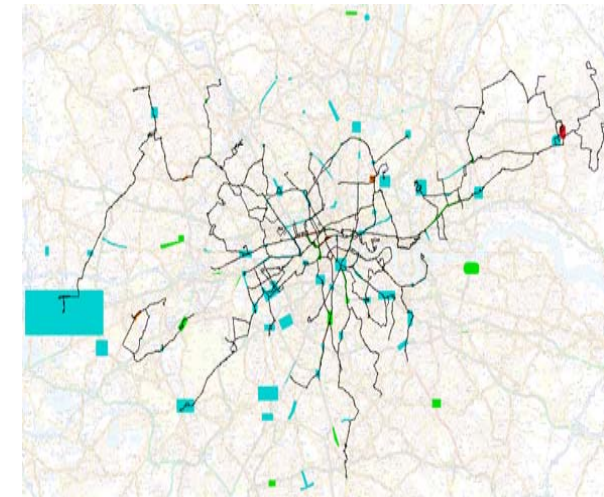
SCR Roll-out

APPENDIX B: Euro 3 routes ranked by number of intersections with significant FAs and contract end date

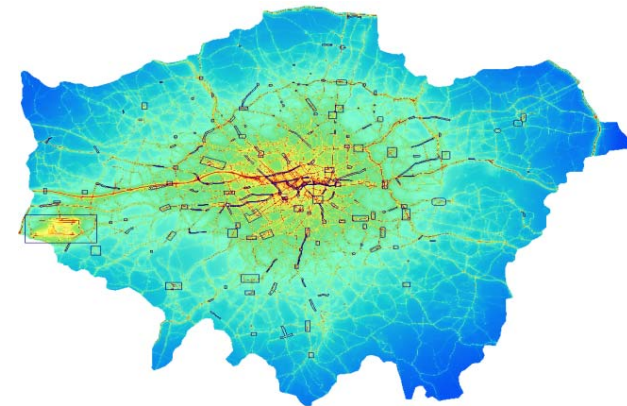
Table ordered by *Rank Final*: The ascending order of *Rank (i)* + *Rank (ii)*

Rank (ii): Rank based on contract end date. Later dates ranked more favourably than older dates

| Route IDs | Number of FAs >50% | Number of FAs >60% | Number of FAs >70% | Rank (i) | Extended contract end date | Rank (ii) | Rank Final |
|-----------|--------------------|--------------------|--------------------|----------|----------------------------|-----------|------------|
| X68 | 5 | 2 | 0 | 5 | Apr-18 | 13 | 1 |
| 68 | 4 | 2 | 0 | 8 | Apr-18 | 14 | 2 |
| 128 | 2 | 1 | 1 | 26 | Oct-19 | 1 | 3 |
| 159 | 6 | 2 | 1 | 2 | Dec-17 | 28 | 4 |
| 172 | 2 | 2 | 0 | 19 | Mar-18 | 16 | 5 |
| 9 | 2 | 1 | 0 | 29 | Sep-18 | 6 | 6 |
| 390 | 1 | 1 | 1 | 32 | Sep-18 | 7 | 7 |
| 193 | 1 | 1 | 1 | 33 | Sep-18 | 8 | 8 |
| 6 | 3 | 2 | 1 | 13 | Dec-17 | 29 | 9 |



Route Selection

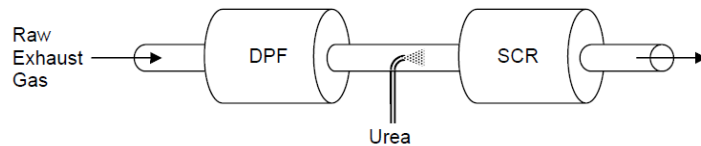


NO2 Focus Areas

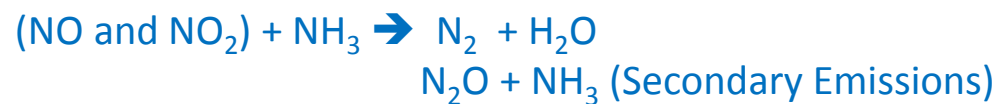
NOx Abatement Retrofit

£10 million funding (DfT/TfL) to retrofit approx 1000 Euro III buses with SCR

1015 buses now fitted to 3 types of Euro III bus



NOx reacts with ammonia over the catalyst and reduces it to nitrogen and water



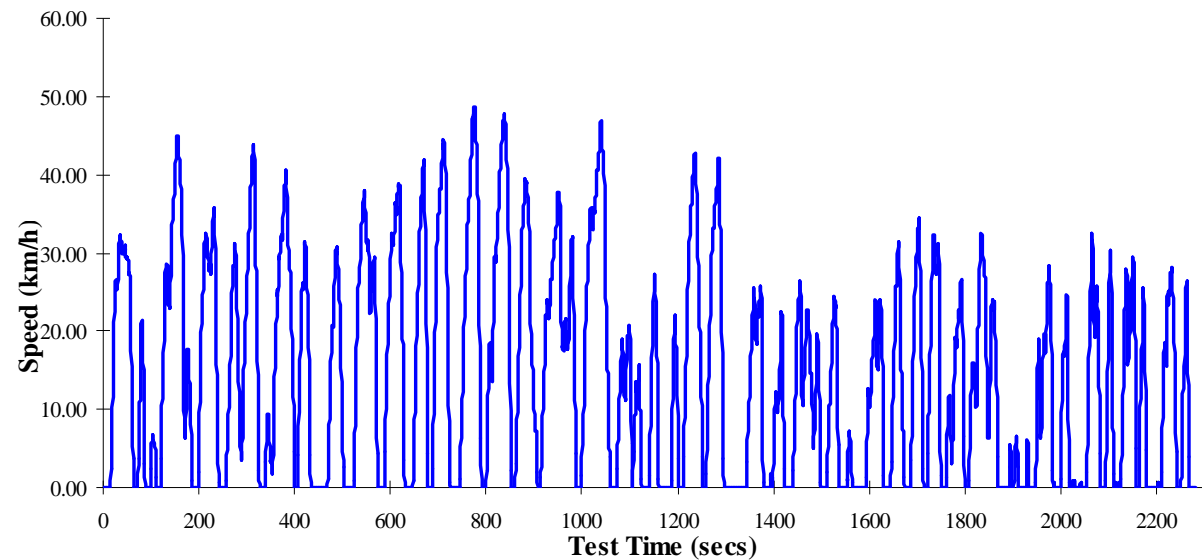
95 out of 220 buses that use Putney High Street were retrofitted with SCR

This made Putney the ideal location for monitoring the effectiveness of SCR programme



Calculating the effectiveness of SCR

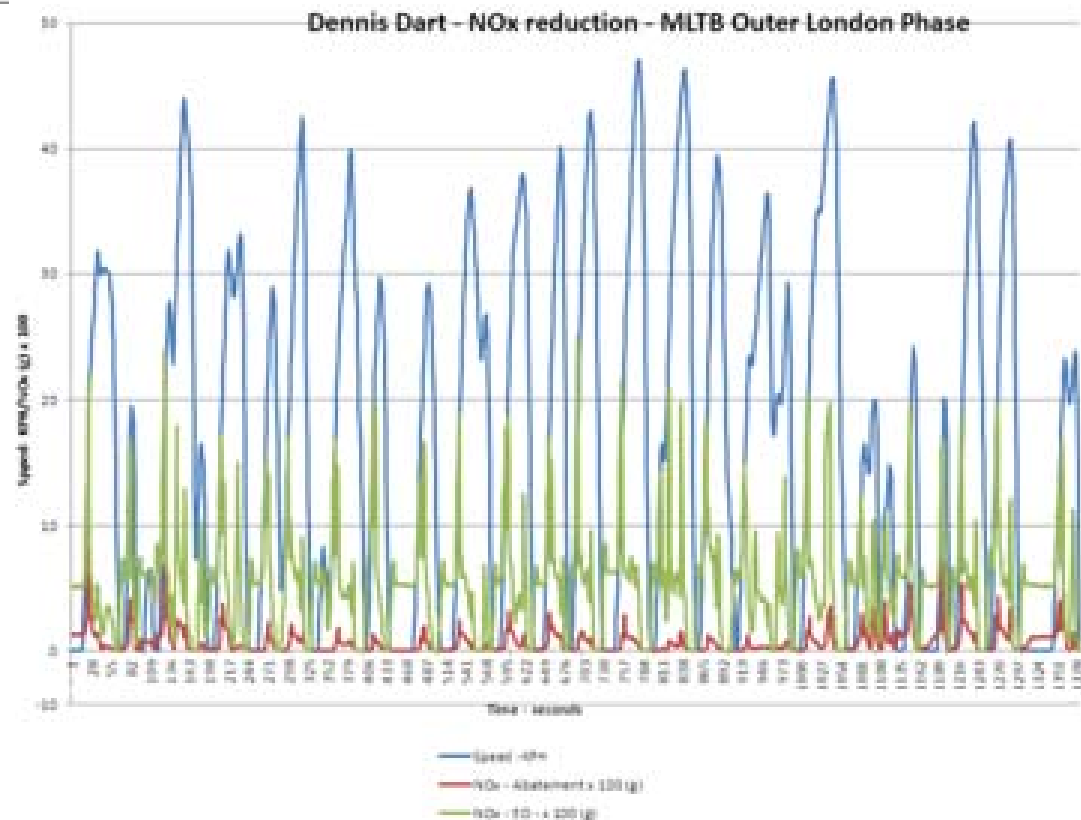
- TfL developed with Millbrook a 'real world' drive cycle based on Route 159 from Brixton to Oxford Street
- Real World test cycle with representative exhaust temperature essential for SCR development



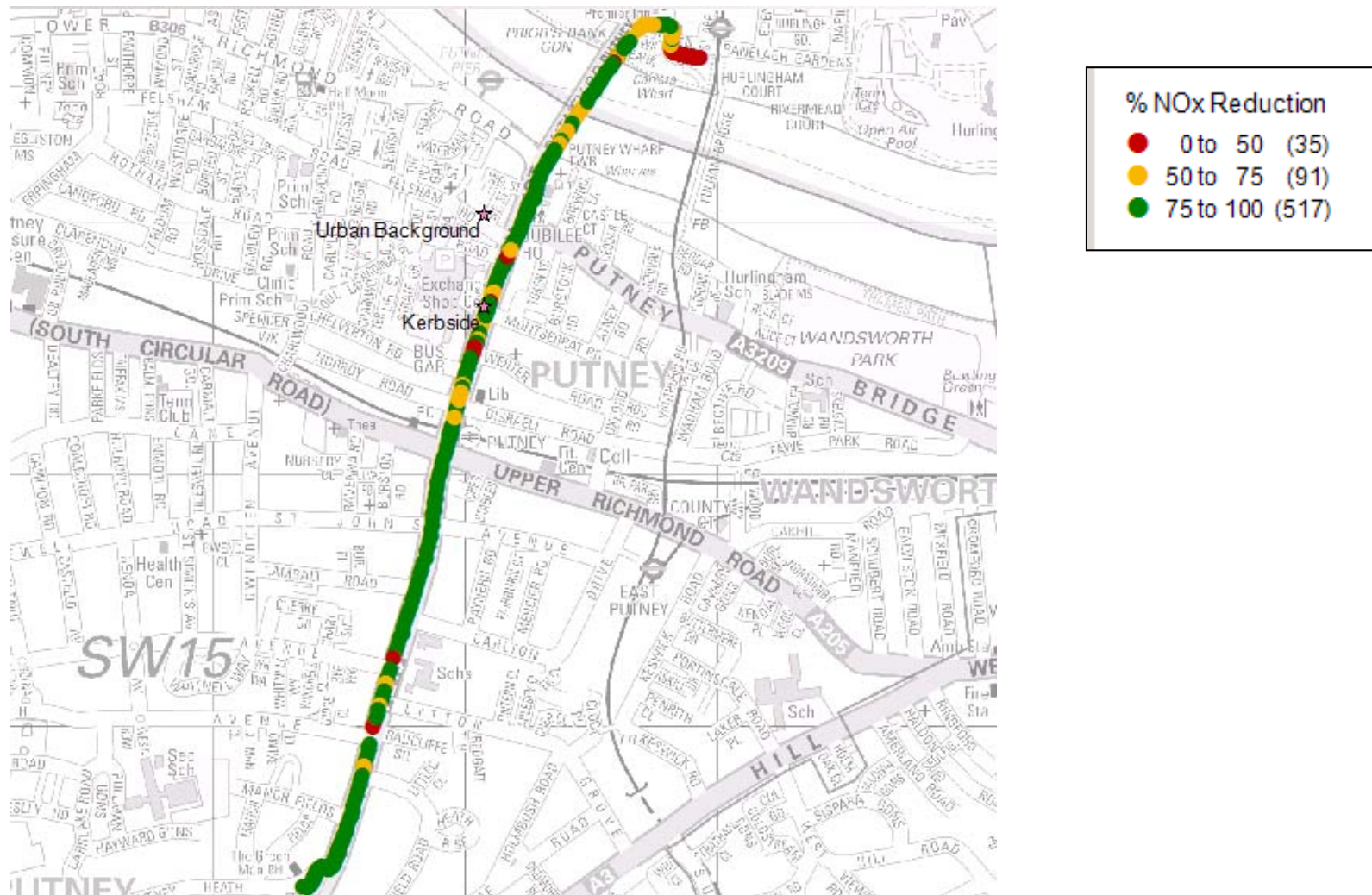
SCR Emissions Test Results

| | | |
|-----------------------------|-----------------------|-----------------------|
| Test No 11762/63, 822/23/24 | Baseline Test | |
| Date 15/11/11 & 1/12/11 | NO_x | NO₂ |
| Units: | g/km | g/km |
| Analyser: | Bag | FTIR |
| Phase 1 Outer London | 10.49 | 0.49 |
| Phase 2 Inner London | 18.43 | 0.84 |
| Combined result | 12.72 | 0.59 |

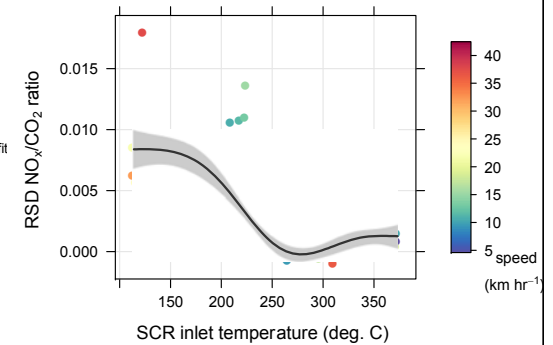
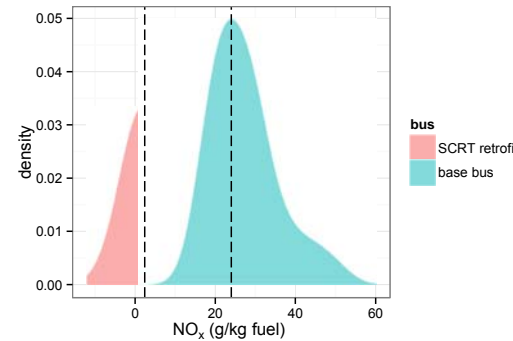
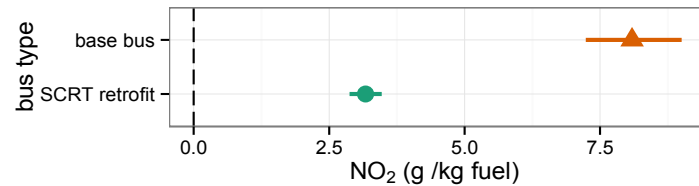
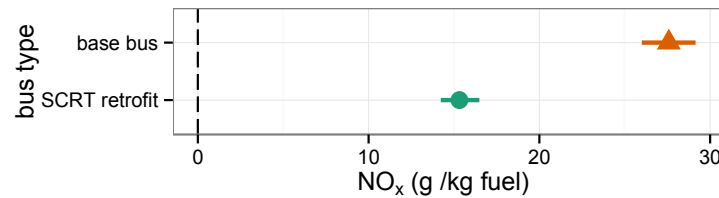
| | | |
|----------------------------|---|-----------------------|
| Test No 11775, 11827 & 829 | With NO_x Abatement Device | |
| Date 17/11/11 & 2/12/11 | NO_x | NO₂ |
| Units: | g/km | g/km |
| Analyser: | Bag | FTIR |
| Phase 1 Outer London | 1.12 | 0.21 |
| Phase 2 Inner London | 2.38 | 0.42 |
| Combined result | 1.47 | 0.27 |
| Change vs Baseline | -88.4% | -54.6% |



NOx Reduction operating on Putney High Street



Remote Sensing on Putney Hill - *David Carslaw*

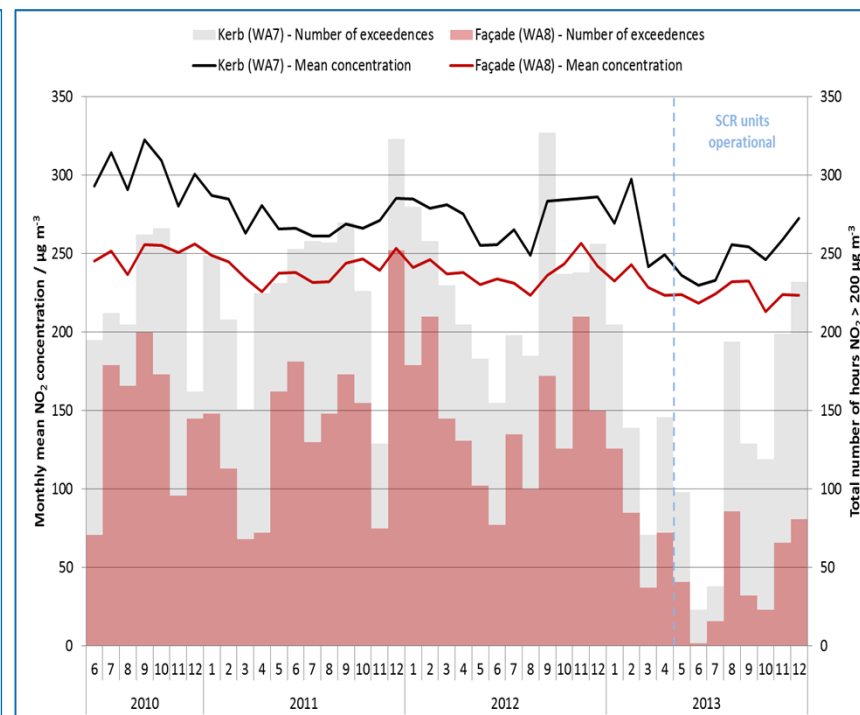
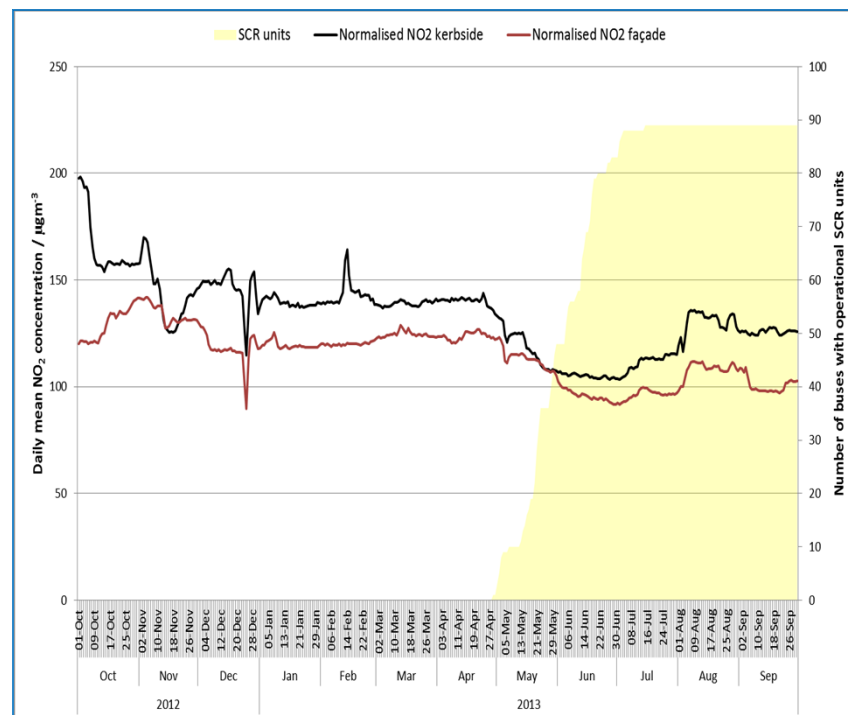


- On average we see a **61%** reduction in emissions of NO_2
- **45%** reduction in emissions of NO_x
- These reductions are substantial compared with the average performance of the bus fleet in London including OEM SCR systems

- Emissions distribution
 - SCRT buses sometimes behave like base buses
 - Other times there is ~90% reduction in NO_x
- Test track results
 - Importance of SCR inlet temperature
 - $>200^\circ\text{C}$ gives 90% reduction in NO_x
- Expect greater reduction in NO_x where engine runs hotter



Monitoring Scheme Effectiveness – Putney High St



“a sustained decrease in ambient NO₂ concentrations of 16% (during normalised meteorological conditions) at the façade is an encouraging result”

“there were 42% and 71% fewer exceedences at the kerb and façade respectively in the second half of 2013 when compared to the second half of 2010 to 2012”

Putney High St NO2 Monitor Trends

| Year | Pollutant | Objective | Achieved? | Value |
|------------------------------|------------------|--|-----------|-----------------------|
| 2010 | Nitrogen Dioxide | 200 ug/m3 as a 1 hour mean, not to be exceeded more than 18 times a year | NO | 2480 |
| 2011 | Nitrogen Dioxide | 200 ug as above | NO | 2768 |
| 2011 | Nitrogen Dioxide | 40 ug/m3 as an annual mean | NO | 154 |
| 2012 | Nitrogen Dioxide | 200 ug as above | NO | 2740 |
| 2012 | Nitrogen Dioxide | 40 ug as above | NO | 155 |
| 2013 | Nitrogen Dioxide | 200 ug as above | NO | 1580 |
| 2013 | Nitrogen Dioxide | 40 ug as above | NO | 124 |
| 2014 to 1 st June | Nitrogen Dioxide | 200 ug as above | NO | 482 (1157 annualised) |
| 2014 to 1 st June | Nitrogen Dioxide | 40 ug as above | NO | 109 |

Summary and Conclusions

- The SCR Retrofit Programme has been successful in reducing NO₂ concentrations on Putney High Street
- Euro VI and 3rd Generation SCR systems offer the potential for further savings going forward



Questions?

