

Real-world emissions from London buses

New data collected by The Real Urban Emissions initiative (TRUE) provides a clearer and more detailed picture of real-world pollutant emissions from London buses, and of the effects of policy efforts to reduce those emissions, than has been available before now.

Current programs and policies to reduce emissions from buses in London:

- **Retrofits.** In 2013, Transport for London (TfL) retrofitted more than 1,000 Euro III buses with selective catalytic reduction systems to achieve Euro IV emissions performance. An earlier retrofit program had by 2006 put particulate filters on all TfL-operated buses. In 2017 a new initiative was launched to retrofit 5,000 Euro IV and V diesel buses with exhaust systems capable of achieving Euro VI emissions performance.
- **Procurement.** London began procuring buses meeting Euro VI emissions performance ahead of the full implementation of that standard, and TfL has prioritized the purchase of hybrid buses. As of November 2018, diesel-electric hybrid buses accounted for approximately 30% of the fleet, and all new double-deck buses will be Euro VI hybrids, battery electric, or hydrogen fuel cell. TfL operates one of the world's largest zero-emission bus fleets outside China, including 117 battery electric

buses and 10 fuel cell buses. The city has committed to making all single-deck buses operating in central London zero-emissions by 2020 and the entire TfL fleet zero-emissions by 2037.

- **Low emission zones:** In 2017, Mayor Sadiq Khan announced 12 Low Emission Bus Zones in areas outside of central London. Buses operating in these zones are required to meet Euro VI emissions performance. The first two zones were delimited in 2017, five more in 2018, and the remaining five will be delineated in 2019. Additionally, beginning in April 2019, all buses operating in the central London Ultra Low Emission Zone must meet Euro VI standards or pay a surcharge. Similar requirements will be extended to the whole of Greater London in October 2020.

TRUE deployed remote-sensing equipment to measure “real-world” emissions from vehicles at several sites around Greater London from November 2017 through February 2018. Among the more than 100,000 vehicles sampled during the project were approximately 3,305 diesel buses.

KEY FINDINGS

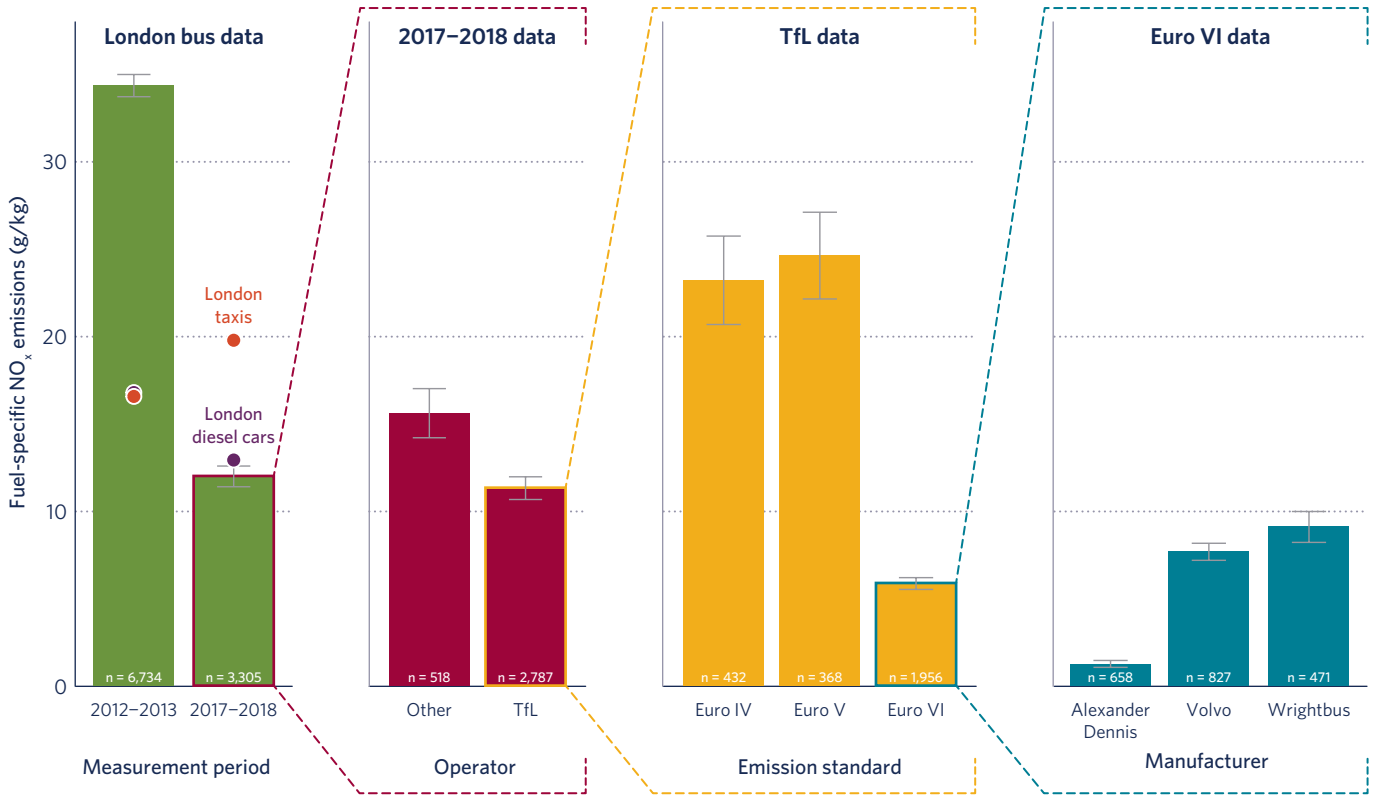
- NO_x emissions (g/kg of fuel burned) from buses sampled were 65% lower than those from buses sampled in similar studies conducted in 2012 and 2013, a significant decline over that five-year period.
- Average NO_x emissions from buses were slightly lower than emissions from diesel passenger cars and 39% lower than emissions from black taxis on a fuel-specific basis. Conceptually, this means that, on average, a London bus will emit less NO_x than a diesel car or taxi would by burning the same amount of fuel.
- TfL buses have lower NO_x emissions on average than buses operated by other companies. TfL buses in the sample set tended to be newer—70% of sampled TfL buses were certified to Euro VI standards, as compared with 36% of other buses—which could explain this result.
- No statistical difference was observed in emissions from TfL buses certified to Euro IV and V emission standards, even though the Euro V type-approval NO_x limit is 40% lower than the Euro IV limit. This is consistent with previous research showing poor performance of Euro V emission control systems in urban operating conditions.
- The average fuel-specific NO_x emission rate for Euro VI buses is 74% lower than for Euro V buses, lending empirical support to procurement policies favoring Euro VI buses and to low emission zones advantaging them over others.
- Emissions performance in Euro VI buses varied somewhat by manufacturer. While average NO_x emissions from all Euro VI buses were well below Euro IV and

Euro V buses, Alexander Dennis buses had average NO_x emissions significantly lower than buses from other manufacturers. Further investigation of the characteristics of the best performing Euro VI buses in the TfL fleet (e.g., engine

and aftertreatment calibrations, maintenance practices) would be warranted.

- Average fuel-specific particulate matter (PM) emissions were comparably low for Euro IV

through Euro VI TfL buses, at levels consistent with the use of diesel particulate filters. DPFs were not required prior to Euro VI, so this result confirms the effectiveness of TfL's retrofit program, which equipped older models with filters.



Average fuel-specific NO_x emissions from London buses. From left, results are shown by measurement period, operator, emission standard, and manufacturer.



TO FIND OUT MORE

For details on the London remote-sensing project and related questions, contact **Rachel Muncrief, rachel@theicct.org**. For more information on TRUE, visit **www.trueinitiative.org**.

DOWNLOAD THE PAPER

"Remote sensing of motor vehicle emissions in London" **www.theicct.org/publications/true-london-dec2018**