LONDON-WIDE ULTRA LOW EMISSION ZONE – SIX MONTH REPORT

July 2024

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Published by
Greater London Authority
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Key Findings

There is a well-established and growing body of scientific evidence linking exposure to air pollution with a number of adverse health effects across all stages of life. In 2021, the World Health Organization (WHO) updated its air quality guidelines, recommending more stringent targets to protect public health. The updated WHO guidelines are more ambitious than the UK national legal limits and emphasise that no safe level of air pollution exists.

On 29 August 2023, the Mayor of London expanded the Ultra Low Emission Zone (ULEZ) across all London boroughs to help tackle air pollution in the capital and improve air quality for Londoners. The ULEZ boundary is now the same as the boundary for the Low Emission Zone (LEZ) for heavy vehicles. The London-wide zone measures 1,500 km^2 and covers nine million people, making it the largest zone of its kind in the world.

This report evaluates the impact of the London-wide scheme in the first six months of its operation. The data shows that the scheme has been highly effective at reducing the proportion and number of older, more polluting vehicles on London's roads. We know that the impact of the London-wide expansion started ahead of the formal start of the scheme, with many people making changes in advance to prepare. Key dates in advance of the formal start date were the launch of the consultation in May 2022 and the announcement of the Mayor's decision to proceed with the expansion in November 2022. This pre-emptive behaviour has also been observed by independent experts, including in other cities with similar schemes[1].

This Six Month Report compares volumes of detected vehicles in February 2024 to June 2023 in the first instance. June 2023 has been used as the baseline date for this purpose as it is a typical month that does not include bank holidays or school holidays, and also uses available data from the new cameras installed for the expansion.

This report provides the "compliance rate"[2] of vehicles travelling in the zone that are subject to the ULEZ standards – that is cars, vans, minibuses, and motorcycles. This report also provides preliminary analysis of pollutant emissions and concentrations. Fuller analysis of pollutant emissions, carbon emissions, concentrations and traffic will be reported in the One Year Report, once a full year of air quality monitoring data is available.

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[1] For example, Dr Gary Fuller, a leading air pollution scientist from Imperial College London, described pre-compliance in multiple cities in his regular pollution watch column in the Guardian: https://www.theguardian.com/environment/2021/may/21/pollutionwatch-ignore-naysayers-low-emission-zones-do-work

[2] The compliance rate is the percentage of vehicles detected in the zone that meet the ULEZ standards. The higher the compliance rate the more successful the scheme has been in accelerating the transition to cleaner vehicles.

Key findings from the first six months of operation of the London-wide ULEZ are:

- **Pollutant emissions across London in 2023 are dramatically lower** than expected if we hadn't expanded the ULEZ London-wide.
    - **Nitrogen oxides (NO_X) emissions from cars and vans in outer London are estimated to be 13 per cent and 7 per cent lower** compared to a scenario without the ULEZ scenario.
    - There has been a saving of **424 tonnes of NO_X** in outer London.
    - **$PM_{2.5}$ exhaust emissions from cars and vans in outer London** are estimated to be **20 per cent lower** than they would have been had we not expanded ULEZ to outer London.
- These emissions reductions are improving air quality. In the first six months of operation, roadside nitrogen dioxide (NO_2) concentrations in outer London were up to **4.4 per cent lower** than would have been expected without the London-wide ULEZ expansion.
- All ULEZ policies in total have had a dramatic impact on improving air quality across the capital. Harmful roadside NO_2 concentrations are estimated to be:
    - **21 per cent lower in outer London** than they would have been without the ULEZ and its expansions.
    - **53 per cent lower in central London** than they would have been without the ULEZ and its expansions.
    - **24 per cent lower in inner London** than they would have been without the ULEZ and its expansions.
- **Long term trends indicate that average concentrations in all London zones improved at a faster rate than the rest of England average** over the same time period. This is particularly notable in outer London where concentrations have improved more rapidly over recent years and are now similar to the rest of England average, which has historically been lower.
- **Areas outside London are also seeing the impacts of the ULEZ**, with roadside NO_2 concentrations within 5 km of the Greater London boundary on average **nine per cent lower** in 2023 than an estimated "No ULEZ" scenario. As this is an average for the whole boundary zone, this means that some roads will be seeing even greater reductions.

- **A larger proportion of vehicles recorded driving in London are cleaner**. The London-wide compliance rate for vehicles subject to the ULEZ standards after the first six months was **96.2 per cent,** up from 91.6 per cent in June 2023 and 39 per cent in February 2017, when changes associated with the ULEZ began.
- **Compliance rates have increased for both cars and vans; 97.1 per cent** of cars and **88.9 per cent** of vans seen driving in the London-wide ULEZ met the standards after six months of operation, up from 93 and 80.2 per cent in June 2023 and 44 and 12 per cent in February 2017.
- **There are fewer older, more polluting ULEZ vehicles seen driving in the zone.** On an average day, there were **90,000 fewer** non-compliant vehicles detected in the London-wide ULEZ in February 2024 compared to June 2023. This is a **53 per cent reduction** in non-compliant vehicles between those dates.
- In the **expanded outer London area, ULEZ vehicle compliance is now 96.2 per cent**, up from 90.9 per cent in June 2023. This is nearly the same level of compliance as seen in inner and central London, with 96.5 per cent and 96.4 per cent, respectively.
- **In outer London, over 97 per cent of cars now meet the ULEZ standards**, up from 92.4 per cent in June 2023. **Van compliance in outer London has increased by 9.5 percentage points,** now 89 per cent, up from 79.5 per cent in June 2023.

What to expect in this report

The London-wide expansion of the ULEZ came into effect on 29 August 2023. This report covers the first six months of its operation and provides preliminary analysis of air pollutant concentrations, building on the previously published First Month Report. The method used for analysing the preliminary impact on concentrations builds upon a previously peer reviewed method. Fuller analysis of both emissions and concentrations will be reported in the One Year Report, which will be supported by an advisory group of external experts.

As well as preliminary analysis of pollutant emissions and concentrations, this report provides an update to the "compliance rate"[2] of vehicles detected travelling in the zone that are subject to the ULEZ – that is cars, vans, minibuses, and motorcycles.

Emissions standards for large and heavy diesel vehicles apply London-wide through the London-wide Low Emission Zone (LEZ). Tougher LEZ standards were enforced from March 2021 and the LEZ standards now align with the ULEZ standards. Vehicles that are subject solely to the LEZ are excluded from the ULEZ compliance rates reported here (see Appendix 4 for LEZ compliance rates).

This report is the latest in a series of reports evaluating the impact of the ULEZ and London-wide LEZ, all previous reports can be found on the Greater London Authority (GLA) website.

Emissions and concentrations

When we refer to air pollutant emissions in this report, this means the discharge of pollutants into the air, for example, from a vehicle exhaust. When we refer to air pollutant concentrations, this means the amount of pollution found in the air. Vehicle emissions are estimated based on average vehicle fleet composition and vehicle kilometres of cars and vans across London. Air pollutant concentrations are measured at monitoring stations located across London[3].

Reducing emissions, where policy makers have the biggest influence, has a direct impact on the amount of pollution in the air and associated health outcomes. There are also other important factors that affect concentrations, including the impact of weather, natural

[3] A Supplementary Data Sheet has been published alongside this report which includes the full list of monitoring sites considered within this report.

seasonal variations and, for NO_2, significant atmospheric chemistry processes involving other pollutants (e.g. ozone) and sunlight.

As with the Six Month Reports for the previous iterations of the ULEZ, this report does not provide the full analysis of the impacts of the scheme on air pollutant emissions and concentrations, as a longer period is needed to accurately measure these. The evidence[4,5] indicates that long-term exposure is the key driver of health impacts from air pollution. It is for these reasons that the focus for measuring air pollution concentrations has traditionally been on longer-term measurements, usually annual means. A preliminary assessment of measured pollutant concentrations is included in this Six Month Report, but the full picture will properly emerge in the One Year Report, once a longer-term comparative trend analysis is available. Traffic volumes on London's roads vary from day to day and season to season. It therefore takes more time for traffic patterns to fully emerge. As a result, it is only possible to provide a preliminary assessment of emissions reductions based on the first six months of data. We will be able to provide more detail on emissions reductions, including for carbon dioxide, in the One Year Report.

Pollutants

Nitrogen oxides (NO_X) refers to nitric oxide (NO) and nitrogen dioxide (NO_2), which are produced during combustion processes such as in the engine of a car. NO can react with gases in the atmosphere to form NO_2. NO_2 is a toxic gas and the highest concentrations in London are recorded at roadside locations. NO_2 aggravates respiratory diseases – particularly asthma – and stunts the development of children's lungs[6]. In this report, emissions are reported in tonnes of NO_X, and concentrations are reported in micrograms of NO_2 per cubic metre of air ($\mu g/m^3$).

$PM_{2.5}$, also known as fine particulate matter, refers to particles or liquid droplets in the air that have a diameter less than 2.5 micrometres across (that is one 400^{th} of a millimetre, about three per cent of the diameter of a human hair). Some $PM_{2.5}$ is naturally occurring, such as dust and sea salt, and some is man-made, such as particulates from vehicle

[4] Committee on the Medical Effects of Air Pollutants (2009) Long-term exposure to air pollution: effect on mortality. Available at: Long-term exposure to air pollution: effect on mortality - GOV.UK (www.gov.uk)
[5] Beelen et al. (2014) Effects of long-term exposure to air pollution on natural-cause mortality: an analysis of 22 European cohorts within the multicentre ESCAPE project
[6] Imperial College London (2023). Impacts of air pollution across the life course – evidence highlight note. Available at: Impacts of air pollution across the life course – evidence highlight note (london.gov.uk)

exhausts. In this report, emissions are reported in tonnes of $PM_{2.5}$, and concentrations are reported in micrograms of $PM_{2.5}$ per cubic metre of air ($\mu g/m^3$).

Introduction

Health impacts of air pollution

In the UK, air pollution contributes to the equivalent of between 28,000 to 36,000 premature deaths every year[7]. Studies have long shown the many adverse health issues associated with elevated pollution levels[8]. The latest evidence shows adverse health effects following long-term exposure to relatively low levels of pollution, below those experienced in London. Exposure to air pollution has negative health effects throughout the life course, including prior to birth[9]. It can impair normal foetal development in the womb and affects children's lung growth. It increases the risk of developing lung cancer, heart and lung disease, stroke, and early death[10].

The burden of disease attributable to air pollution is estimated to be on par with other major global health risks, such as unhealthy diet and tobacco smoking, and air pollution is now recognised as the single largest environmental threat to human health[11].

Air pollution was the subject of the 2022 Chief Medical Officer's Annual Report[9], which set out the effects of air pollution on health and inequalities, as well as solutions to tackling it. The report highlighted that central and local government, alongside many industries and sectors, should go further to reduce air pollution.

Road traffic is one of the main sources of air pollution, and long-term exposure to traffic-related air pollution has adverse health effects across different age groups[12]. In 2019, road transport was the single largest source of certain air pollutant emissions in London, accounting for 43 per cent of NO_X emissions and 31 per cent of $PM_{2.5}$ emissions[13]. The

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[7] Office for Health Improvement & Disparities (2022). Air pollution: applying All Our Health. Available at: Air pollution: applying All Our Health - GOV.UK (www.gov.uk).
[8]The Committee on the Medical Effects of Air Pollutants (COMEAP) publishes regular reports and statements on the health effects of air pollution. These can be found here: COMEAP: reports and statements - GOV.UK (www.gov.uk)
[9] Chief Medical Officer's annual report 2022: air pollution (2022). Available at: Chief Medical Officer's annual report 2022: air pollution - GOV.UK (www.gov.uk)
[10] The health effects across the life course are also summarised in "Impacts of air pollution across the life course – evidence highlight note." Imperial College London (April 2023). Available at: Impacts of air pollution across the life course – evidence highlight note (london.gov.uk)
[11] WHO (2021). Global air quality guidelines: particulate matter ($PM_{2.5}$ and PM_{10}), ozone, nitrogen dioxide, sulfur dioxide and carbon monoxide. Available at: WHO global air quality guidelines: particulate matter (PM2.5 and PM10), ozone, nitrogen dioxide, sulfur dioxide and carbon monoxide
[12] Systematic Review and Meta-analysis of Selected Health Effects of Long-Term Exposure to Traffic-Related Air Pollution. Health Effects Institute. June 2022. Available at: Systematic Review and Meta-analysis of Selected Health Effects of Long-Term Exposure to Traffic-Related Air Pollution | Health Effects Institute
[13] London Atmospheric Emissions Inventory (LAEI) 2019. Available at: London Atmospheric Emissions Inventory (LAEI) 2019 - London Datastore

expansion of the ULEZ to outer London means that 1,752 schools and other educational establishments, with a total of around 880,000 attendees, are now included in the ULEZ area[14]. Therefore, improving air quality in the newly expanded ULEZ area will bring cleaner air to 1,752 schools.

In London, independent research using mortality burden calculations has shown that toxic air contributed to the premature deaths of the equivalent of around 4,000 Londoners in 2019[15]. Over 480,000 Londoners have been diagnosed with asthma and are more vulnerable to the impacts of air pollution, with more than half of these people living in outer London[16]. Asthma prevalence in London is highest in outer London, with approximately 4.9 per cent of the population in outer London boroughs diagnosed with asthma, compared to approximately 4.4 per cent in inner London boroughs[17]. In London in 2022/23, there were 2,705 emergency hospital admissions for asthma in children under 19 years[18]. Exposure to air pollution is disproportionally higher for those communities that have higher levels of deprivation or a higher proportion of people from Black, Asian and Minority Ethnic backgrounds, further exacerbating existing health inequalities[19].

This Six Month Report shows a reduction in $PM_{2.5}$ concentrations, which is bringing important health benefits to Londoners. $PM_{2.5}$ reductions are associated with reduced acute respiratory and cardiovascular hospital admissions, incidence of heart disease and stroke and reduced levels of all-cause mortality[20].

[14] Air Quality Factsheet (2024). Available at: Schools, Hospitals and Care Homes in the ULEZ Expansion Area

[15] Imperial College London. (2021). London Health Burden of Current Air Pollution and Future Health Benefits of Mayoral Air Quality Policies. Available at: Health burden of air pollution in London | London City Hall

[16] NHS England Quality and Outcomes Framework (QOF) data, published in the Public Health Outcomes Framework reports the number of patients aged 6 years plus included on a GP register of patients with asthma, by borough, in 2022/23.

[17] NHS England Quality and Outcomes Framework (QOF) data, published in the Public Health Outcomes Framework reports the percentage of patients aged 6 years plus included on a GP register of patients with asthma, by borough. The average prevalence has been calculated for outer London and inner London. This does not include undiagnosed or unrecorded cases of asthma.

[18] NHS England and Office for National Statistics data, published in the Public Health Outcomes Framework

[19] Air quality exposure and inequalities study part 1 – London analysis. Aether Ltd. June 2023. Available at: https://www.london.gov.uk/programmes-strategies/environment-and-climate-change/environment-and-climate-change-publications/air-pollution-and-inequalities-london-update-2023

[20] COMEAP (2022) Summary of COMEAP recommendations for the quantification of health effects associated with air pollutants. Available at: COMEAP summary of qualification recommendations (publishing.service.gov.uk)

The WHO emphasises that no safe level of exposure to air pollution exists, therefore reductions in air pollution are important for the health of Londoners. In 2021, the WHO updated its health-based guidelines for air quality, the first update since 2005[11]. The WHO air quality guideline for NO_2 is an annual mean concentration of 10 µg/m^3 and for $PM_{2.5}$ it is 5 µg/m^3. These are more ambitious than the current UK national legal limits.

The WHO's recommendations continue to be recognised globally as the targets that should be met to protect public health. Despite significant improvements in air quality over recent years, the new WHO guidelines were not achieved anywhere in London in 2019, the latest date for which modelled London-wide data is available[13]. The Mayor has commissioned comprehensive analysis to determine how and when London can meet the new WHO guidelines; this report will be available in 2025.

What is the ULEZ?

The expansion of the ULEZ London-wide in August 2023 is the latest world-leading policy delivered in London under this Mayoralty, aimed at tackling harmful air pollution emissions from road transport, specifically NO_2 and PM. The ULEZ disincentivises the use of older, more polluting vehicles within the city through applying a daily charge to vehicles that do not meet certain emissions criteria. The emissions criteria are based on the Euro standards[21], which regulate the emissions of pollutants from road vehicles before they can be put on the market. The emissions levels permitted by successive Euro standards have progressively reduced, meaning new vehicles have become less polluting over time.

Schemes like the ULEZ have also been shown to reduce the number of vehicles that are on the road, for example, by encouraging people to switch to walking, cycling or public transport, and reduce air pollution and carbon emissions in this way. For example, the previous phases of the ULEZ saved 800,000 tonnes of carbon dioxide (CO_2) from vehicles across London between 2019 and 2022.

Importantly, the ULEZ and the LEZ sit within a wider suite of policies aimed at reducing air pollution in London. These policies include cleaning up the bus, taxi and Private Hire Vehicle (PHV) fleets, working with the London boroughs and the private sector to increase the provision of electric vehicle charge points in London, and making it easier and safer to walk, cycle, and use public transport in the city. Further detail on the air quality policies

[21] More information on Euro Standards can be found on the RAC website: Euro 1 to Euro 6 – Vehicle Emissions Standards | RAC Drive

implemented and delivered by the Mayor of London during the current Mayoralty is detailed in the Air Quality in London 2016 – 2024 report.

In October 2017, the Mayor introduced the Toxicity Charge (T-Charge) in central London, the first vehicle emissions control scheme to include cars and small vans. This was followed by the introduction of the ULEZ in central London in April 2019, the enforcement of higher emissions standards for the LEZ in March 2021, the expansion of the ULEZ to inner London in October 2021, and the London-wide expansion of the ULEZ in August 2023. Londoners and those who drive in London have been taking action to comply with these schemes since the confirmation of the T-Charge in February 2017, which is why this date is used as a reference for measuring the impact of the schemes over a longer-term period.

The successive emissions-based charging schemes in London are set out in Figure 1. These schemes have been transformational in improving air quality in London.

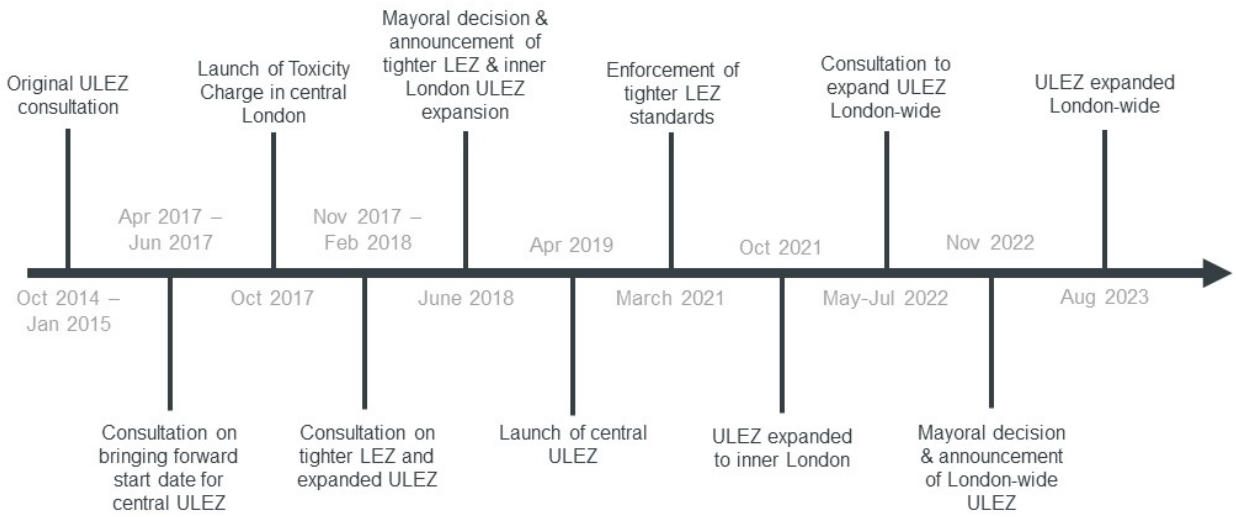

Figure 1: Timeline of vehicle emissions charging schemes in London

The ULEZ operates 24 hours a day, every day of the year except Christmas Day[22] (25 December). Vehicles must meet strict emissions standards to drive in the ULEZ area, as set out in Table 1.

[22] On 25 December there are significantly reduced public transport options in operation meaning there are fewer alternatives available to those with non-compliant vehicles.

Table 1: ULEZ Standards

Vehicle type	ULEZ standard	Date from which manufacturers had to sell new vehicles meeting the ULEZ emissions standards[23]
Motorcycles, mopeds, and other L category vehicles	Euro 3	From 1 July 2007
Cars and light vans	Euro 4 (petrol) Euro 6 (diesel)	From 1 January 2006 From 1 September 2015
Larger vans (≤3.5 tonnes gross weight) and minibuses (≤5 tonnes gross weight)	Euro 4 (petrol) Euro 6 (diesel)	From 1 January 2007 From 1 September 2016

As summarised in Table 1, all petrol cars registered new from 1 January 2006 and all diesel cars registered new from 1 September 2015 will comply with the ULEZ emissions standards, however for some vehicles these dates may be even earlier[24]. Vehicles that do not meet these standards, and are not otherwise subject to a grace period, discount, or exemption, must pay a charge of £12.50 per day to travel in the ULEZ. The charge is set to disincentivise frequent trips in non-compliant vehicles, which would otherwise contribute more to air pollution. This incentivises people to change their travel behaviour or replace their vehicle, whilst allowing occasional visitors and infrequent drivers an alternative.

Figure 2 shows a map of the area covered by the London-wide ULEZ (LWULEZ). The ULEZ is complemented by the London-wide LEZ which applies to lorries, vans and specialist heavy vehicles (all over 3.5 tonnes gross weight) and buses, minibuses and coaches (all over 5 tonnes gross weight). The LEZ standards for most affected vehicles are aligned with the ULEZ standards[25].

[23] Some manufacturers were early adopters of the relevant standards, meaning some vehicles manufactured before these dates will meet the ULEZ standards.
[24] Some vehicle manufacturers were early adopters of the relevant standards, meaning some petrol cars manufactured before 2006 and some diesel cars manufactured before 2016 will meet the ULEZ standards
[25] Diesel vans between 1.2 T and 3.5 T and minibuses under 5 T are subject to both the LEZ (if they do not meet the Euro 3 standard for PM) and the ULEZ (if they do not meet the Euro 6 standard).

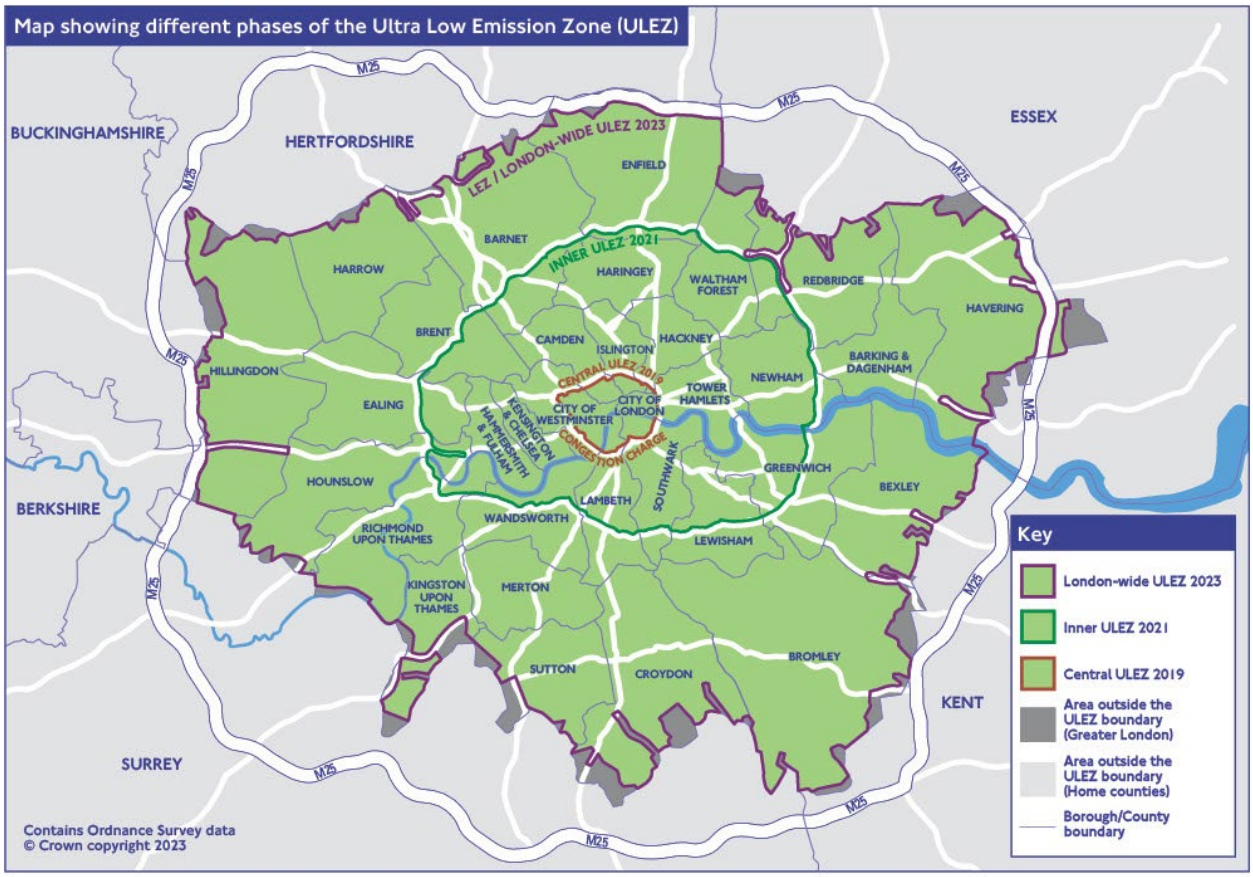

Figure 2: Map of the ULEZ

Providing support

There is a range of support available for people and organisations with non-compliant vehicles, including the scrappage scheme, temporary exemptions, a reimbursement scheme for certain NHS patients, and offers on sustainable transport alternatives.

This support was designed to build on the successful scrappage schemes and other support provided for previous iterations of the ULEZ and to respond to points raised in the public consultation and stakeholder engagement about the Mayor's decision to expand the ULEZ London-wide. This led to the extension of existing grace periods by two years, the launch of new grace periods to help more disabled people, and new retrofit and wheelchair accessible vehicle grants under the scrappage scheme. Please refer to the London-wide Ultra Low Emission Zone First Month Report, where information on these support measures was provided in detail. Since the publication of the First Month Report, the Mayor increased the scrappage scheme funding from £160 million in August 2023 to £210 million in February 2024, providing financial assistance to help more eligible Londoners

scrap their non-compliant vehicles. Additionally, since March 2024, successful scrappage scheme applicants can choose to donate suitable vehicles to Ukraine instead of scrapping them, and still receive a grant payment[26].

How the ULEZ delivers change

The effect of air pollution on people's health is most often a result of long-term exposure to pollutants. This means that schemes such as the ULEZ seek to create long-term transformative change, and ensure benefits are realised over many years, both before and after the launch of the scheme. The ULEZ requires individuals, charities, organisations, and businesses with non-compliant vehicles to take action and either replace a non-compliant vehicle or change how they regularly travel. To help vehicle owners prepare for the London-wide ULEZ, an extensive public information campaign commenced in January 2023 to ensure drivers, charities and businesses were ready. This was in addition to significant stakeholder and local borough engagement and press activity, to raise awareness of the scrappage scheme and third-party support available. Stakeholder and press activity also engaged non-UK drivers, and third-party mapping apps, such as Google, Apple, and Waze, provide information on the ULEZ boundary when route planning for users.

There were also a number of changes to the vehicle scrappage scheme that were announced in the lead up to the launch of the expansion. These changes are likely to have acted as a further prompt by enabling more people to access scrappage grants and adding to the media coverage about the ULEZ expansion.

We would therefore expect to see changes in how people travel and vehicle replacement in the build-up to the launch date. However, it is still helpful to compare the immediate impact before and after launch.

[26] TfL regularly reports on the scrappage scheme. See the "Finance, operations & performance" section here: https://tfl.gov.uk/corporate/publications-and-reports/ultra-low-emission-zone

Vehicle compliance

The focus of this report is the London-wide ULEZ, which came into effect on 29 August 2023. As such, the compliance figures reported only relate to vehicles that are subject to the ULEZ standards (see Table 2). Lorries, vans and specialist vehicles over 3.5 tonnes Gross Vehicle Weight, and buses and minibuses over 5 tonnes Gross Vehicle Weight are required to meet Euro VI emissions standards through the separate LEZ[27]. Updated information on compliance for the LEZ scheme is provided in Appendix 4.

Licensed London taxis are not subject to the ULEZ as they have different emissions requirements as part of their licensing conditions and, therefore, are not included in the ULEZ compliance figures. Transport for London (TfL) has used its licensing powers to introduce tighter age limits and since 1 January 2018, all newly licensed taxis have needed to be zero-emission capable (ZEC). The Mayor does not have the powers to implement a similar phased removal of vehicles for general use. As of March 2024, 75 per cent of taxis are compliant with the ULEZ standards, including over 8,200 ZEC taxis[28]. This is up from less than 20 per cent in 2018 when the ZEC licensing requirement was introduced (when only 14 taxis were ZEC).

[27] Vans or specialist diesel vehicles from 1.205 tonnes unladen weight up to 3.5 tonnes gross vehicle weight are required to meet Euro 3 (Particulate Matter) emissions standards through the LEZ. They are additionally subject to the ULEZ.

[28] Latest licensing information can be found on TfL's website: Licensing information - Transport for London (tfl.gov.uk)

Table 2: Vehicle types included and excluded from compliance figures

Vehicle type	Included in ULEZ compliance?	Emissions limits requirement	Relevant scheme
Motorcycles	Yes	Euro 3	ULEZ
Cars	Yes	Euro 4 (Petrol) Euro 6 (Diesel)	ULEZ
Smaller vans	Yes	Euro 4 (Petrol) Euro 6 (Diesel)	ULEZ
Larger vans and minibuses (vans up to and including 3.5 tonnes, minibuses up to and including 5 tonnes)	Yes	Euro 4 (Petrol) Euro 6 (Diesel)	ULEZ
Heavy diesel vehicles (including buses and coaches over 5 tonnes and HGVs and other heavy diesel vehicles over 3.5 tonnes)	No (Appendix 4)	Euro VI	LEZ
Taxis (Black cabs)	No	All newly licensed taxis required to be “Zero-Emission Capable” since 2018 and are subject to age limits and other restrictions to reduce emissions.	Taxi licensing

TfL buses are subject to the LEZ, including the tighter standards enforced from March 2021. The entire fleet met or exceeded the standards for this scheme by January 2021, well ahead of the enforcement of the tighter LEZ standards. Following his re-election in May 2024, the Mayor committed to delivering a fully zero-emission bus fleet by 2030. As of May 2024, London has the largest zero-emission bus fleet in western Europe, with over 1,400 (one in seven) TfL buses now zero-emission[29].

[29] Zero-emission refers to tailpipe emissions. See: https://www.c40.org/case-studies/london-powers-ahead-with-zero-emission-buses/

There are a limited number of ULEZ exemptions, discounts, and temporary grace periods[30]. Drivers of vehicles that qualify for these do not need to pay if their vehicles do not meet the required emissions standards. However, these vehicles are still recorded as non-compliant in these figures.

ULEZ compliance

The data in this section has been taken from TfL's Automatic Number Plate Recognition (ANPR) camera network[31], which detects vehicles as they enter the ULEZ and when they travel within it. Drivers of vehicles that do not comply and are not subject to a grace period, discount or exemption must pay the daily charge or may be liable for enforcement action.

Compliance levels in London are monitored through ANPR data derived from anonymised daily camera detections. To check if a vehicle meets the ULEZ standards or not, TfL cross-references this data with available Driver and Vehicle Licensing Agency (DVLA) records, including information on vehicle type, age, Euro standards, and emissions. This gives daily data that is averaged over a month to give a daily average compliance rate for each month for central, inner and outer London.

Camera installations for the London-wide ULEZ commenced in December 2022, following the Mayoral decision to expand the ULEZ across all London boroughs[32]. It was delivered through a rolling programme comprising site investigations, consents processing, designs and camera installation during 2023. By May 2023, a network of new cameras was in place, which continued to evolve following the launch of the London-wide expansion in August 2023. To date, over 3,800 cameras are in place across the London-wide zone and an active programme of camera repairs and replacements is in place, including to address instances of vandalism. Changes in the camera network can lead to minor fluctuations in data in addition to usual variations in vehicular activity.

Compliance rates based on ANPR data from the camera network are provided for the whole London-wide zone. A subset of zonal compliance estimates for the central London ULEZ (the same area as the Congestion Charge zone), the inner London ULEZ (the entire area bounded by the North and South Circular Roads, including central London), and the

[30] https://tfl.gov.uk/modes/driving/ultra-low-emission-zone/discounts-and-exemptions
[31] For more information on how TfL gathers data, how it is used and protected visit: https://tfl.gov.uk/corporate/privacy-and-cookies/road-user-charging
[32] https://www.london.gov.uk/who-we-are/governance-and-spending/promoting-good-governance/decision-making/mayoral-decisions/md3060-london-wide-ultra-low-emission-zone-ulez-scheme

expanded outer London area (excluding the central and inner London ULEZ area) are also provided.

Compliance rates and vehicle detections up to November 2022 are based on the camera network in place for the LEZ at the time and do not include any cameras installed in preparation for the London-wide ULEZ. In outer London, this camera network detected unique vehicle numbers in the high hundreds of thousands per day and provided a suitable level of confidence for the assessment of compliance levels in that area before the network evolved.

General overview of London-wide ULEZ compliance

Table 3 summarises the London-wide ULEZ compliance rates at the following stages:

- February 2017 – confirmation of the T-Charge, the predecessor to the ULEZ.
- May 2019 – the first month after the central London ULEZ was introduced.
- October 2020 – one year before the implementation of the inner London ULEZ.
- October 2021 – immediately prior to the launch of the inner London ULEZ on 25 October.
- May 2022 – the launch of the consultation on expanding the ULEZ London-wide
- November 2022 – the announcement of the Mayor's decision to expand the ULEZ London-wide.
- June 2023 – baseline month for this report (includes data from new camera network rollout in outer London).
- September 2023 – one month after the London-wide expansion of the ULEZ.
- February 2024 – six months after the London-wide expansion of the ULEZ.

Table 3: Daily average proportion of ULEZ compliant vehicles detected in the London-wide ULEZ

Vehicle type	Feb-17*	May-19	Oct-20	Oct-21	May-22	Nov-22	Jun-23	Sep-23	Feb-24
All ULEZ vehicles	39.0 %	67.9 %	75.7 %	83.8 %	88.8 %	90.5 %	91.6 %	95.3 %	96.2 %
Cars (incl. PHV)	44.0 %	72.8 %	79.3 %	86.2 %	90.7 %	92.1 %	93.0 %	96.4 %	97.1 %

Vehicle type	Feb-17*	May-19	Oct-20	Oct-21	May-22	Nov-22	Jun-23	Sep-23	Feb-24
Vans (up to and incl. 3.5 tonnes)	12.0 %	34.7 %	53.8 %	66.3 %	74.4 %	79.3 %	80.2 %	86.2 %	88.9 %
Minibuses (up to and incl. 5 tonnes	12.0 %	45.0 %	61.2 %	68.4 %	73.7 %	76.5 %	76.0 %	79.1 %	80.3 %
Motorcycles	50.0 %	88.7 %	90.8 %	94.6 %	95.7 %	96.5 %	96.0 %	96.6 %	97.0 %
All vehicles (LEZ, ULEZ, taxis)	38.0 %	67.5 %	75.9 %	83.9 %	88.7 %	90.5 %	91.6 %	95.2 %	96.1 %

*February 2017 based on data from the London Atmospheric Emissions Inventory, except for motorcycles which is based on Defra fleet composition data. Minibuses compliance estimate in 2017 is assumed to be the same as vans.

Table 3 shows an overview of changes in ULEZ compliance over time. These figures are calculated based on detected vehicles from the camera network, and they show there has been a continuing and rapid improvement in the proportion of ULEZ compliant vehicles driving across London since 2017.

The average compliance for all vehicles subject to the ULEZ in 2017 was approximately 39 per cent. In February 2024, this figure has increased to 96.2 per cent for all vehicles and it has exceeded 97 per cent for cars and PHVs.

Combining information on heavy vehicles also subject to the LEZ means that after the first six months of the London-wide ULEZ over 96 per cent of all vehicles seen in the London-wide zone are now compliant with ULEZ and LEZ standards.

Assessment of the impact of the London-wide ULEZ on compliance

This Six Month Report compares volumes of vehicles detected in February 2024 to September 2023 (one month after expansion) and June 2023[33]. Whilst the London-wide ULEZ came into operation on 29 August 2023, for data clarity, whole monthly comparisons have been undertaken for this report, which will also feed into future reports.

All tables in this section show compliance rates for the entire London-wide ULEZ. Further sections provide more information on compliance rates in the expanded outer London area, and discussion of compliance rates across different areas of London over time. More detail on zonal compliance is available in Appendix 1.

The tables provide the average daily number of unique vehicles[34] seen by the camera network each month, along with compliance rates[2,35] for the different vehicle types. From May 2023, in outer London, there is an increase in the number of vehicles detected by the camera network in this area as this is when the data from new cameras installed for the expansion first became available. This also affects London-wide data as it includes new data from outer London cameras. Vehicle volume comparisons prior to this date are unsuitable for assessing scheme impacts because the development of the camera network over time has increased the rate of vehicle detections.

This report is based on the further developed camera network and allows a longer-term comparison using six months' worth of data. However, the One Year Report will provide a fuller picture of scheme impacts allowing for typical variations in traffic levels and patterns across the year.

Whilst the biggest impact of the scheme is reducing the number of non-compliant vehicles being driven, it is worth noting that the number of unique vehicles detected (both compliant and non-compliant) in the London-wide ULEZ has fluctuated. This would be expected, mainly due to the typical seasonal variation in traffic activity (for example, during school holidays).

[33] June 2023 has been used as a pre-expansion comparator as it is a typical month that does not include bank holidays or school holidays, and also uses available data from the new cameras installed for the London-wide ULEZ expansion.
[34] A daily unique vehicle means a vehicle that has been detected by at least one camera in the zone at least once per day.
[35] Compliance rate is calculated dividing the total number of vehicles which are compliant by the total overall number of vehicles.

Overall, vehicle numbers went down from two million in June 2023 (when the camera network was first expanded in preparation of the scheme) to 1.8 million in August 2023 (during school holidays). The number of detections has since increased, reaching two million again in January and February 2024 as a result of both increased activity after the winter holiday season and establishment of the camera network in outer London. Whilst the number of overall detections currently sits at around two million vehicles (average day in February 2024), the proportion of non-compliant vehicles has continued to reduce. Further monitoring over the next months will provide information on a full year trend of vehicles detected and more conclusions will be reported in the One Year Report.

> Table 4 shows that overall compliance with the ULEZ is now 96.2 per cent. This is an increase of 0.9 percentage points from September 2023, and an increase of 4.6 percentage points from June 2023 before the scheme went live.

Of the 3.8 per cent of non-compliant vehicles in February 2024, some vehicles will be non-chargeable, and the remainder will pay the charge or may have enforcement action taken against them. Non-chargeable vehicles include those with exemptions or benefitting from extended grace periods, as well as vehicles that were detected on a diversion route[36]. TfL publishes quarterly factsheets that provide a breakdown of the daily average number and proportion of vehicles detected in the ULEZ that were non-compliant broken down by those who paid the charge, received a penalty charge notice or warning notice or were non-chargeable[37].

As seen in Table 4, the average number of non-compliant vehicles detected daily in the zone has fallen in the six first months of the scheme. Non-compliant vehicles have dropped from a daily average of 170,000 in June 2023, prior to the expansion, to a daily average of 93,000 in September 2023 and to 80,000 in February 2024.

[36] Available information indicates there were 292 traffic diversions from 29 August 2023 to 29 February 2024 including 116 on the M25 related to a range of works at Junction 3, J8 - J9, and J24-J25, M40, A3, A309, and 14 on the A412 in relation to HS2 works. Note that this does not include the M25 closures at Junction 10 associated with the National Highways scheme, the first of which took place in March 2024.

[37] https://tfl.gov.uk/corporate/publications-and-reports/ultra-low-emission-zone

> This equates to 90,000 fewer non-compliant vehicles seen driving in London on an average day in February 2024 compared to June 2023 (a 53 per cent reduction).

Table 5 to Table 10 show the monthly average compliance rates and unique vehicles detected driving in the zone for all vehicles subject to the ULEZ. Table 5 reports compliance rates for all cars, while Table 6 focuses on diesel cars only.

Table 4: Daily average number and proportion of ULEZ compliant vehicles detected in the London-wide ULEZ per month (rounded to the nearest 1,000 vehicles)

Date	Unique vehicles detected in zone	Number of non-compliant vehicles	Number of Compliant vehicles	Proportion of Non-compliant vehicles	Proportion of Compliant vehicles
May-22*	1,395,000	156,000	1,238,000	11.2%	88.8%
Nov-22*	1,398,000	133,000	1,265,000	9.5%	90.5%
May-23**	1,901,000	165,000	1,735,000	8.7%	91.3%
Jun-23	2,022,000	170,000	1,852,000	8.4%	91.6%
Jul-23	1,981,000	160,000	1,821,000	8.1%	91.9%
Aug-23	1,889,000	139,000	1,750,000	7.4%	92.6%
Sep-23	1,974,000	93,000	1,881,000	4.7%	95.3%
Oct-23	1,974,000	89,000	1,885,000	4.5%	95.5%

Date	Unique vehicles detected in zone	Number of non-compliant vehicles	Number of Compliant vehicles	Proportion of Non-compliant vehicles	Proportion of Compliant vehicles
Nov-23	2,059,000	88,000	1,971,000	4.3%	95.7%
Dec-23	1,996,000	83,000	1,913,000	4.2%	95.8%
Jan-24	2,017,000	77,000	1,940,000	3.8%	96.2%
Feb-24	2,098,000	80,000	2,018,000	3.8%	96.2%
Change between June 2023 and February 2024	76,000	-90,000	167,000	-4.6 ppt	+4.6 ppt
% Change in vehicles between June 2023 and February 2024	4%	-53%	9%	N/A	N/A

* May and November 2022 are based on the camera network in place before additional new cameras were installed for the London-wide ULEZ. Detected volumes for these months cannot be compared to London-wide ULEZ volumes for the new camera network.

** Data for May 2023 included the first data available from some cameras installed as part of the network changes, as well as bank holidays (including the coronation).

ppt - Percentage points

Table 5: Daily average number and proportion of ULEZ compliant cars (M1 and PHV, excl. taxis) detected in the London-wide ULEZ per month (rounded to nearest 1,000 vehicles)

Date	Unique cars detected in zone	Number of Non-compliant cars	Number of Compliant cars	Proportion of Non-compliant cars	Proportion of Compliant cars
May-22*	1,192,000	111,000	1,081,000	9.3%	90.7%
Nov-22*	1,181,000	93,000	1,088,000	7.9%	92.1%
May-23**	1,647,000	120,000	1,527,000	7.3%	92.7%
Jun-23	1,747,000	123,000	1,624,000	7.0%	93.0%
Jul-23	1,718,000	116,000	1,602,000	6.7%	93.3%
Aug-23	1,633,000	99,000	1,534,000	6.1%	93.9%
Sep-23	1,710,000	61,000	1,649,000	3.6%	96.4%
Oct-23	1,709,000	59,000	1,651,000	3.4%	96.6%
Nov-23	1,783,000	58,000	1,725,000	3.2%	96.8%
Dec-23	1,764,000	58,000	1,706,000	3.3%	96.7%
Jan-24	1,760,000	51,000	1,709,000	2.9%	97.1%

Date	Unique cars detected in zone	Number of Non-compliant cars	Number of Compliant cars	Proportion of Non-compliant cars	Proportion of Compliant cars
Feb-24	1,825,000	53,000	1,771,000	2.9%	97.1%
Change between June 2023 and February 2024	78,000	-70,000	147,000	-4.1 ppt	+ 4.1 ppt
% Change in vehicles between June 2023 and February 2024	4%	-57%	9%	N/A	N/A

* May and November 2022 are based on the camera network in place before additional new cameras were installed for the London-wide ULEZ. Detected volumes for these months cannot be compared to London-wide ULEZ volumes for the new camera network.

** Data for May 2023 included the first data available from some cameras installed as part of the network changes, as well as bank holidays (including the coronation).

ppt - Percentage points

Comparing June 2023 and February 2024, the average number of non-compliant cars detected in the zone has fallen by approximately 57 per cent, with around 70,000 fewer non-compliant cars seen on an average day. Out of all cars detected in London, only 2.9 per cent are now non-compliant. The compliance rate increased by 4.1 percentage points between June 2023 and February 2024 reaching a compliance rate of 97.1 per cent in

February 2024. This exceeded TfL's estimate, as outlined in the consultation document, of achieving over 95 per cent compliance by the end of 2023[38].

Table 6: Daily average number and proportion of ULEZ compliant diesel cars (M1, excl. PHVs and taxis) detected in the London-wide ULEZ per month (rounded to nearest 100)

Date	Unique diesel cars detected in zone	Number of Non-compliant diesel cars	Number of Compliant diesel cars	Proportion of Non-compliant diesel cars	Proportion of Compliant diesel cars
May-22*	294,900	101,600	193,200	34.5%	65.5%
Nov-22*	278,500	85,400	193,100	30.7%	69.3%
May-23**	361,100	109,000	252,100	30.2%	69.8%
Jun-23	378,100	111,500	266,600	29.5%	70.5%
Jul-23	366,200	104,700	261,500	28.6%	71.4%
Aug-23	335,100	89,200	245,900	26.6%	73.4%
Sep-23	326,300	55,300	270,900	17.0%	83.0%
Oct-23	323,500	52,800	270,700	16.3%	83.7%
Nov-23	331,300	51,900	279,500	15.7%	84.3%

[38] https://haveyoursay.tfl.gov.uk/15619/widgets/44946/documents/27070

Date	Unique diesel cars detected in zone	Number of Non-compliant diesel cars	Number of Compliant diesel cars	Proportion of Non-compliant diesel cars	Proportion of Compliant diesel cars
Dec-23	327,900	52,600	275,300	16.0%	84.0%
Jan-24	319,500	46,100	273,300	14.4%	85.6%
Feb-24	330,900	48,000	282,900	14.5%	85.5%
Change between June 2023 and February 2024	-47,100	-63,500	16,300	-15 ppt	+ 15 ppt
% Change in vehicles between June 2023 and February 2024	-12%	-57%	6%	N/A	N/A

* May and November 2022 are based on the camera network in place before additional new cameras were installed for the London-wide ULEZ. Detected volumes for these months cannot be compared to London-wide ULEZ volumes for the new camera network.

** Data for May 2023 included the first data available from some cameras installed as part of the network changes, as well as bank holidays (including the coronation).

ppt - Percentage points

Of the 70,000 fewer non-compliant cars detected in the zone, the vast majority (over 63,000) are diesel cars. This is similar to the pattern seen following the previous iterations of the scheme as only newer diesel cars meet the strict ULEZ emissions standards. The

data from the first six months indicates a 12 per cent reduction in the number of diesel cars seen overall. Compliance rates for diesel cars have increased by 15 percentage points to 85.5 per cent between June 2023 and February 2024.

Table 7: Daily average number and proportion of ULEZ compliant vans (N1) detected in the London-wide ULEZ per month (rounded to nearest 100 vehicles)

Date	Unique vans detected in zone	Number of Non-compliant vans	Number of Compliant vans	Proportion of Non-compliant vans	Proportion of Compliant vans
May-22*	170,300	43,700	126,700	25.6%	74.4%
Nov-22*	184,700	38,300	146,400	20.7%	79.3%
May-23**	208,900	42,800	166,100	20.5%	79.5%
Jun-23	225,600	44,700	180,900	19.8%	80.2%
Jul-23	216,600	41,600	175,000	19.2%	80.8%
Aug-23	211,800	38,100	173,700	18.0%	82.0%
Sep-23	214,900	29,700	185,200	13.8%	86.2%
Oct-23	217,100	28,600	188,500	13.2%	86.8%
Nov-23	228,400	28,700	199,700	12.6%	87.4%
Dec-23	190,700	23,300	167,500	12.2%	87.8%

Date	Unique vans detected in zone	Number of Non-compliant vans	Number of Compliant vans	Proportion of Non-compliant vans	Proportion of Compliant vans
Jan-24	213,000	23,600	189,400	11.1%	88.9%
Feb-24	226,800	25,200	201,600	11.1%	88.9%
Change between June 2023 and February 2024	1,100	-19,600	20,700	-8.7 ppt	+ 8.7 ppt
% Change in vehicles between June 2023 and February 2024	1%	-44%	11%	N/A	N/A

* May and November 2022 are based on the camera network in place before additional new cameras were installed for the London-wide ULEZ. Detected volumes for these months cannot be compared to London-wide ULEZ volumes for the new camera network.

** Data for May 2023 included the first data available from some cameras installed as part of the network changes, as well as bank holidays (including the coronation).

ppt - Percentage points

Comparing June 2023 and February 2024, the average number of non-compliant vans detected in the zone has fallen by 44 per cent, with around 19,500 fewer non-compliant vans being seen on an average day. The compliance rate for vans has increased by 8.7 percentage points between June 2023 and February 2024 to 88.9 per cent. The compliance rate for vans remains lower than that for cars. However, it is still high and

crucially it has risen at a quicker pace than the average for all vehicles. The scrappage scheme has helped drive this transition. Between May 2022, when the consultation for the London-wide scheme commenced, and February 2024 the compliance level has increased by nearly 14.5 percentage points compared to an increase of 7.4 percentage points for all vehicles over the same period.

In the consultation document[38] TfL estimated that van compliance levels at the end of 2023 would be around 91 per cent (based on vehicle kilometres). As of February 2024, the compliance rate for vans was 88.9 per cent. Compliance levels will continue to be monitored in the coming months, with updated information in future reports.

Table 8: Daily average number and proportion of ULEZ compliant minibuses detected in the London-wide ULEZ per month (rounded to nearest 10 vehicles)

Date	Unique minibuses detected in zone	Number of Non-compliant minibuses	Number of Compliant minibuses	Proportion of Non-compliant minibuses	Proportion of Compliant minibuses
May-22*	2,320	610	1,710	26.3%	73.7%
Nov-22*	2,470	580	1,890	23.5%	76.5%
May-23**	2,770	660	2,110	23.9%	76.1%
Jun-23	3,130	750	2,370	24.0%	76.0%
Jul-23	2,570	660	1,910	25.8%	74.2%
Aug-23	1,770	470	1,300	26.5%	73.5%
Sep-23	2,760	580	2,180	20.9%	79.1%
Oct-23	2,640	560	2,080	21.2%	78.8%

Date	Unique minibuses detected in zone	Number of Non-compliant minibuses	Number of Compliant minibuses	Proportion of Non-compliant minibuses	Proportion of Compliant minibuses
Nov-23	3,150	630	2,510	20.1%	79.9%
Dec-23	2,310	490	1,820	21.1%	78.9%
Jan-24	2,700	530	2,170	19.6%	80.4%
Feb-24	2,770	540	2,220	19.7%	80.3%
Change between June 2023 and February 2024	-360	-210	-150	-4.3 ppt	+ 4.3 ppt
% Change in vehicles between June 2023 and February 2024	-11%	-27%	-6%	N/A	N/A

* May and November 2022 are based on the camera network in place before additional new cameras were installed for the London-wide ULEZ. Detected volumes for these months cannot be compared to London-wide ULEZ volumes for the new camera network.

** Data for May 2023 included the first data available from some cameras installed as part of the network changes, as well as bank holidays (including the coronation).

ppt - Percentage points

Fewer than 3,000 minibuses are detected in the London-wide ULEZ on an average day. Compliance levels have increased by 4.3 percentage points since June 2023 to 80.3 per cent in February 2024. The compliance level for minibuses is lower than for other ULEZ vehicle types. This may be because minibuses owned by not-for-profit organisations for community transport are eligible for a "grace period" (temporary exemption) from the scheme until 26 October 2025. As the number of minibuses seen travelling in London is low, a reduction of a few hundred vehicles equates to a larger percentage reduction than for other vehicle types. However, the number of minibuses seen fluctuates considerably during the year and data covering more months will be required to fully assess any trends due to the small volumes detected.

Table 9: Daily average number and proportion of ULEZ compliant motorcycles (L) detected in the London-wide ULEZ per month (rounded to near 10 vehicles)

Date	Unique vehicles detected in zone	Number of Non-compliant motorcycles	Number of Compliant motorcycles	Proportion of Non-compliant motorcycles	Proportion of Compliant motorcycles
May-22*	31,840	1,380	30,460	4.3%	95.7%
Nov-22*	30,380	1,050	29,330	3.5%	96.5%
May-23**	42,030	1,610	40,420	3.8%	96.2%
Jun-23	46,170	1,850	44,310	4.0%	96.0%
Jul-23	43,790	1,720	42,070	3.9%	96.1%
Aug-23	43,130	1,640	41,490	3.8%	96.2%
Sep-23	45,700	1,580	44,130	3.4%	96.6%

Date	Unique vehicles detected in zone	Number of Non-compliant motorcycles	Number of Compliant motorcycles	Proportion of Non-compliant motorcycles	Proportion of Compliant motorcycles
Oct-23	45,090	1,470	43,620	3.3%	96.7%
Nov-23	44,610	1,420	43,190	3.2%	96.8%
Dec-23	38,610	1,200	37,410	3.1%	96.9%
Jan-24	40,390	1,220	39,180	3.0%	97.0%
Feb-24	44,210	1,340	42,870	3.0%	97.0%
Change between June 2023 and February 2024	-1,960	-510	-1,440	-1 ppt	+ 1 ppt
% Change in vehicles between June 2023 and February 2024	-4%	-28%	-3%	N/A	N/A

* May and November 2022 are based on the camera network in place before additional new cameras were installed for the London-wide ULEZ. Detected volumes for these months cannot be compared to London-wide ULEZ volumes for the new camera network.

** Data for May 2023 included the first data available from some cameras installed as part of the network changes, as well as bank holidays (including the coronation).
ppt - Percentage points

The compliance rate for motorcycles remains high and has increased by one percentage point since June 2023 to reach 97 per cent in February 2024.

ULEZ compliance by zone

Table 10 shows the compliance levels for the central London ULEZ area, the inner London ULEZ area, and the expanded outer London area for September 2019 (the first month where monitoring across all areas separately is available) and February 2024. This shows that, based on available data for 2019, there were large differences in the compliance levels for all vehicles subject to the ULEZ across London, with central London having much higher levels of compliance following the early introduction of the ULEZ there.

Compliance rates in outer London in September 2019 were about 10 percentage points lower for cars and nearly 20 percentage points lower for vans than in central London. By February 2024, compliance rates for vehicles using London's roads are nearly the same across all areas for all vehicles subject to the ULEZ. Vans and minibuses still have 4.5 and 2.7 percentage point difference, respectively, however these differences are expected to keep reducing over time.

This shows the substantial impact of the London-wide expansion, which operates across a wide geographical area and brings changes to a large number of vehicles, helping to reduce emissions and improve air quality across the city.

Table 10: Daily average proportion of ULEZ compliant vehicles detected in different areas of London in September 2019[39]

Vehicle type	Central London ULEZ	Inner London ULEZ	Expanded outer London area	Percentage point difference between central and outer London
All ULEZ vehicles	79.0%	71.2%	68.6%	-10.4 ppt
Cars (incl. PHV, excl. taxis)	84.0%	76.0%	73.5%	-10.5 ppt
Vans (up to and incl. 3.5 tonnes)	56.5%	43.2%	37.7%	-18.9 ppt
Motorcycles	84.0%	76.0%	73.5%	-10.5 ppt
Minibuses (up to and incl. 5 tonnes)	62.1%	50.2%	48.6%	-13.5 ppt
All Vehicles (ULEZ, LEZ, Taxis)	76.3%	70.6%	68.3%	-7.9 ppt

[39] September 2019 is the first month where monitoring across all ULEZ zones separately is available.

Table 11: Daily average proportion of ULEZ compliant vehicles detected in different areas of London in February 2024

Vehicle type	Central London ULEZ	Inner London ULEZ	Expanded outer London area	Percentage point difference between central and outer London
All ULEZ vehicles	96.4%	96.5%	96.2%	-0.2ppt
Cars (incl. PHV, excl. taxi)	97.1%	97.3%	97.1%	0.0ppt
Vans (up to and incl. 3.5 tonnes)	93.5%	91.3%	89.0%	-4.5ppt
Motorcycles	98.4%	97.7%	97.0%	-1.4ppt
Minibuses	83.1%	83.3%	80.4%	-2.7ppt
All Vehicles (ULEZ, LEZ, Taxis)	95.6%	96.1%	96.1%	0.6ppt

Compliance rates in the expanded outer London area

This section provides information on compliance rates in the expanded outer London area, which is now part of the London-wide ULEZ. The numbers of vehicles detected as provided in these tables are those seen in the outer zone (the area from, and including, the North and South Circular Roads, to the London-wide ULEZ boundary based on available cameras). However, it is important to note that many of these vehicles are also seen in the inner London ULEZ area and the central London area – these are not vehicles travelling solely in the expanded outer London area.

> Table 12 shows that the compliance rate for all vehicles subject to the ULEZ seen in outer London in February 2024 is 96.2 per cent and has increased by 5.3 percentage points since June 2023.

Compliance in outer London has reached the same level as London-wide compliance for all vehicles subject to the ULEZ. Tables in Appendix 1 for the expanded outer area show that, on an average day, there were 87,000 fewer non-compliant vehicles in the expanded outer London area – a reduction of nearly 56 per cent between June 2023 and February 2024.

> The compliance rate for cars seen in the expanded outer London area has increased to over 97.1 per cent in the first six months of the scheme, an increase of 4.8 percentage points compared to June 2023, with 68,000 fewer non-compliant cars seen on an average day, a reduction of 60 per cent.

> The compliance rate for vans seen in the expanded outer London area is now 89 per cent – an increase of 9.5 percentage points since June 2023 and over 19.9 percentage points since May 2022. The number of non-compliant vans in the expanded outer London area has reduced by 46 per cent.

Table 12: Daily average proportion of ULEZ compliant vehicles detected in the expanded outer area

Vehicle type	Feb-17*	Sep-19**	Oct-20	Oct-21	May-22	Nov-22	Jun-23	Sep-23	Feb-24
All ULEZ vehicles	39%	68.6%	74.6%	80.5%	85.1%	88.1%	90.9%	95.2%	96.2%
Cars (incl. PHV)	44%	73.5%	78.5%	83.5%	87.5%	90.0%	92.4%	96.4%	97.1%
Vans (up to and incl. 3.5 tonnes)	12%	37.7%	53.3%	62.5%	69.1%	77.8%	79.5%	86.2%	89.0%
Minibuses (up to and incl. 5 tonnes	12%	48.6%	61.7%	65.8%	69.2%	74.0%	75.4%	78.7%	80.4%
Motorcycles	50%	78.8%	79.5%	76.2%	77.3%	89.1%	95.6%	96.6%	97.0%
All vehicles (LEZ, ULEZ, taxis)	38%	68.3%	74.8%	80.8%	85.2%	88.2%	90.5%	95.2%	96.1%

*February 2017 is based on data for all of London from the London Atmospheric Emissions Inventory, except for motorcycles which is based on Defra fleet composition data. Minibuses compliance estimate in 2017 is assumed to be the same as vans.

**Compliance figures on any month before May 2023 are based on the camera network in place before additional new cameras were installed for the London-wide ULEZ. Figures from June 2023 include data available from an evolving camera network.

Compliance rates across London

ULEZ compliance rates have increased across the whole of London over time, however the rate of increase and level has varied over the past few years. The introduction of the T-Charge, followed by the early introduction of the central London ULEZ in April 2019, meant that compliance levels inside the central London ULEZ, including for LEZ vehicles, were much higher than those outside of the central zone. In 2019 (when the central ULEZ was in operation), compliance rates in the expanded outer London area were much lower, where just over 73.5 per cent of cars would have met ULEZ standards, compared to 84 per cent in central London. Similarly, a third of vans in the expanded outer London area would have met the ULEZ standards, compared to over half of those in the central London area.

Vehicles travel between different areas of London and outside of the capital and this means that the ULEZ and LEZ can bring air quality benefits to a wider area and larger population than directly within the charging area[40]. The benefits of these effects have been shown in previous monitoring reports. For example, analysis by the Environmental Defense Fund (EDF) showed that HGVs meeting the LEZ standards were driven on average for twice the distance outside the LEZ than within, with many of them driving substantially further outside the capital and therefore bringing the benefits of the London LEZ to 95 per cent of major towns and cities in England and Wales[41].

Figure 3 confirms that the benefits could be seen outside the direct charging areas. While compliance rates increased faster in the areas that would be charged, increases in compliance occurred outside these areas as well. We can see yet again a substantial step up in the compliance of vehicles in the expanded outer London area (and London-wide) as drivers responded to the launch of the London-wide scheme. The step up in compliance is smaller than for previous phases of the ULEZ but this is expected as the gap to a fully ULEZ compliant fleet is much smaller. This is due to the natural replacement of the vehicle fleet over time, and, crucially, the positive effects of the central and inner ULEZ on increasing vehicle compliance even for those based outside of the previous charging zones. Importantly, at the time of launching the London-wide ULEZ, the increase in

[40] Future information on the make-up of the fleet outside of London becomes available periodically through the National Atmospheric Emissions Inventory, published by the UK Government.
[41] Full report here: EDF-Europe-Examining-the-reach-of-Greater-Londons-Clean-Air-Zone.pdf (globalcleanair.org). Data used in the report was procured from INRIX. INRIX has no affiliation with the analysis or results.

compliance levels in the expanded outer London area affected over three times the number of vehicles than were covered by the inner London ULEZ (Table 4 and Table 27).

The London-wide expansion of the ULEZ led to a rapid rate of increase in compliance in outer London in 2023 as Londoners and businesses prepared for the scheme. As such, compliance rates across different areas of London are now similar, and over 96 per cent of all vehicles meet the standards.

Further tables in Appendix 1 provide compliance rates for the central London ULEZ and inner London ULEZ areas over similar dates.

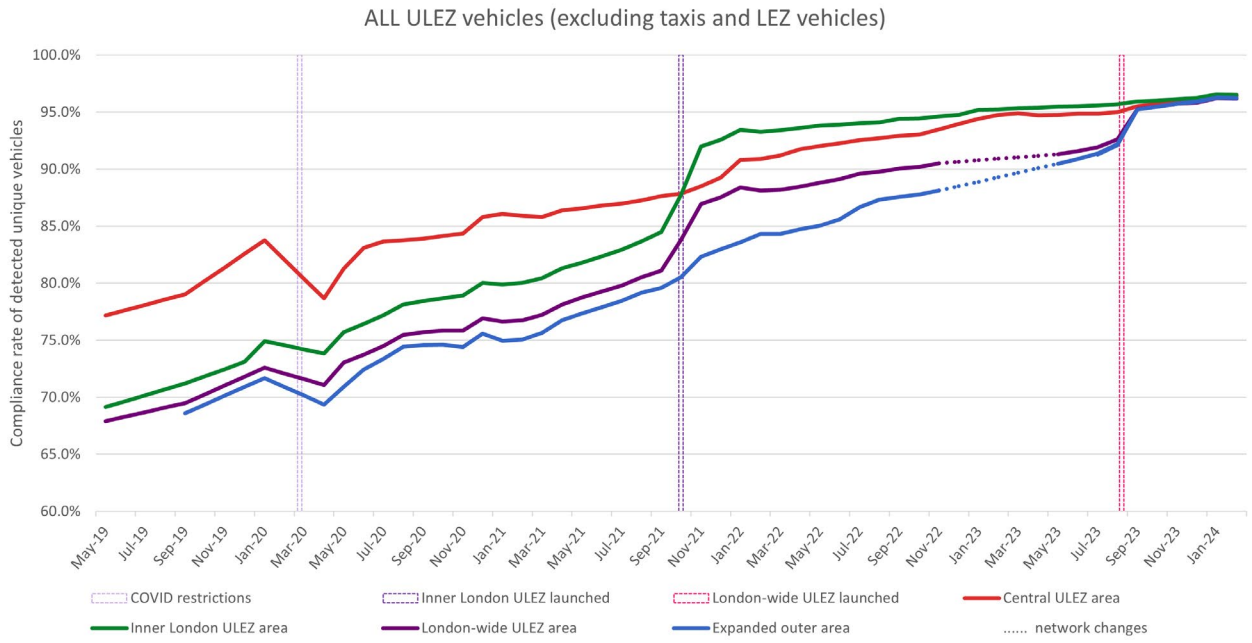

Figure 3: Monthly average ULEZ compliance rates split by zone – all ULEZ vehicles

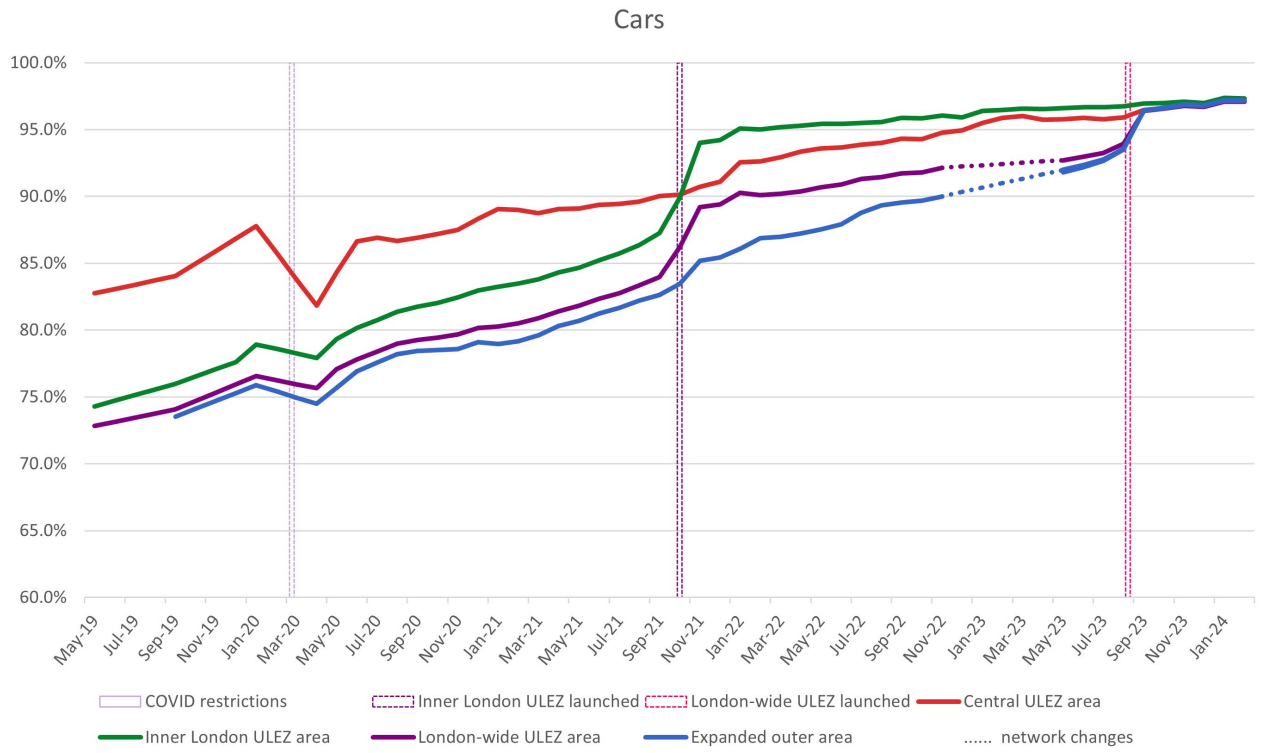

Figure 4: Monthly average ULEZ compliance rates split by zone – cars

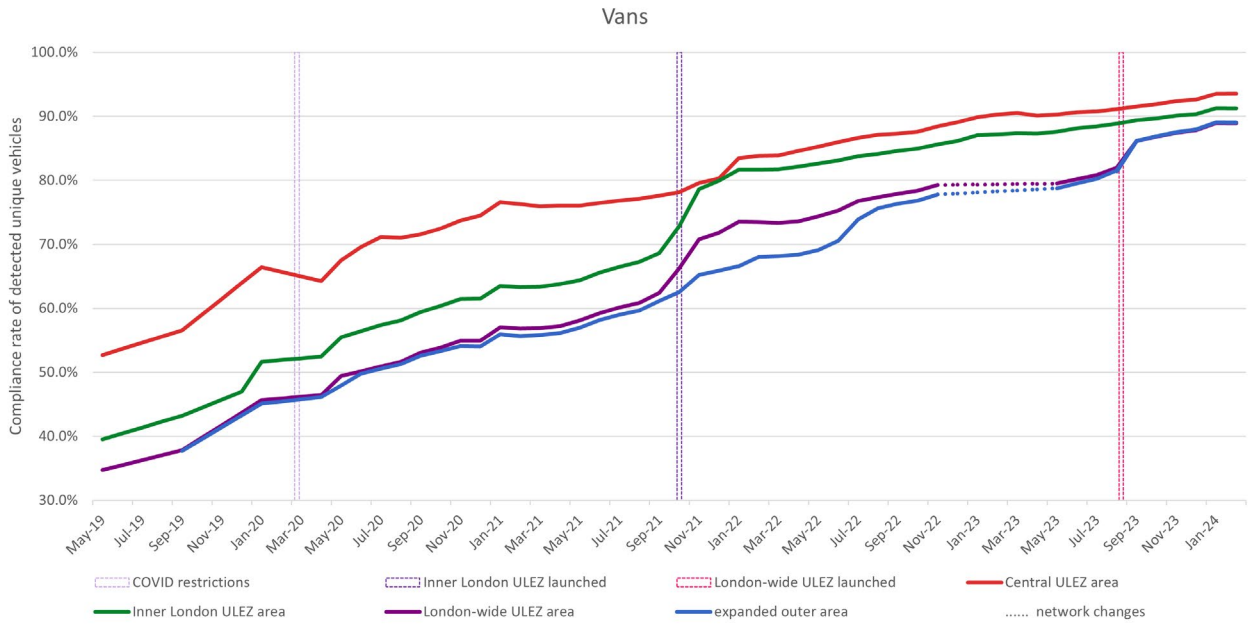

Figure 5: Monthly average ULEZ compliance rates split by zone – vans

Emissions

The ULEZ is based on road vehicle engine emissions standards and disincentivises the use of older vehicles with higher pollutant emissions in the zone. Therefore, the ULEZ policy directly influences emissions reductions from vehicles.

This report presents the initial analysis of the impact of the London-wide ULEZ expansion on air pollution emissions. Emissions of NO_X and $PM_{2.5}$ have been estimated for 2023 under two scenarios: with and without the London-wide ULEZ expansion. Trends comparing emissions between 2022 and 2023 are included in Appendix 2. The emissions for each year are estimated based upon the average vehicle fleet composition and vehicle kilometres of cars and vans across the London zones.

Reducing emissions of pollution is essential to reduce levels of harmful concentrations of pollution in the air, and ultimately improve the health of all Londoners.

Data sources and methodology

Annual vehicle kilometre estimates on road links in each zone, as represented in the London Atmospheric Emissions Inventory 2019[13], were used for this analysis. Data from available Automatic Traffic Count (ATC) sites across London, as well as Department for Transport (DfT) manual traffic counts[42] providing annual average traffic flows by vehicle type, have been used to calculate the growth in traffic on roads in London which then provide annual vehicle kilometres travelled for cars and vans in 2022 and 2023. Annual average vehicle kilometres for 2023 include the impact of the operation of the London-wide ULEZ from 29 August 2023. The expansion of the London-wide ULEZ was expected to lead to small changes in traffic (changes in the order of +/- one per cent)[38]. In order to estimate emissions for 2023 without the expansion of London-wide ULEZ, vehicle kilometres have been adjusted in that scenario to remove the impact that the ULEZ was expected to have on reducing vehicle kilometres.

The annual average fleet composition for cars (excluding PHVs) and vans for circulating traffic have been derived from camera detections across each zone. This allows changes in proportion of fuel types and Euro Standards to be calculated for traffic. Speed related emissions factors (COPERT) for the pollutants NO_X and $PM_{2.5}$ for each vehicle type are

[42] Road traffic statistics - Download data (dft.gov.uk)

calculated using the fleet information. The average speeds are lowest in central London, and highest in outer London.

Emissions rates in 2023 reflect the changes in the vehicle fleet that have occurred across 2023, including any pre-compliance prior to the London-wide ULEZ expansion on 29 August, and its operation for the rest of the year. Importantly, emissions rates for the 2023 scenario without the London-wide ULEZ reflect that there would have been natural churn in the vehicle fleet, as there is always turnover of vehicles and uptake of newer vehicles, but do not include the additional impacts of the London-wide ULEZ. The difference between the 2023 scenarios (with and without the London-wide ULEZ) represents the impact of the expansion of the London-wide ULEZ.

The emissions in this section are initial annual estimates for 2023 but further work will be carried out as the scheme continues and more detailed data will be provided in future reports.

The quantity of pollutants emitted is estimated by multiplying the vehicle kilometres for each vehicle type by the annual average emission rate.

This section quantifies the estimated impact of the ULEZ on NO_X and $PM_{2.5}$ emissions. The overall trend in emissions between 2022 and 2023, which includes the natural churn of the vehicle fleet and overall changes in vehicle kilometres that are not attributable to the ULEZ, are provided in Appendix 2.

NO_X emissions impacts

Table 13 shows the estimated annual NO_X emissions for cars (excluding PHVs) and vans in 2023 with and without the London-wide ULEZ expansion for each zone. Table 14 shows the change in these emissions.

When looking at London as a whole, it is estimated that NO_X emissions from cars and vans are 11 per cent, and six per cent lower, respectively, than would have been expected without the London-wide ULEZ expansion. This equates to a total NO_X emissions saving of 456 tonnes London-wide.

The biggest impacts on emissions from cars and vans have occurred in the outer London zone as a result of the London-wide expansion of the ULEZ.

> NO_X emissions in outer London are 13 per cent lower for cars, and seven per cent lower for vans than would have been expected without the London-wide ULEZ expansion.

This equates to a saving of 424 tonnes of NO_X in outer London in 2023 and the NO_X emissions savings in outer London represent over 90 per cent of the total emission reductions seen in London as a result of the London-wide expansion.

Table 13: Estimated annual NO_X emissions (tonnes) for cars and vans in 2023 with and without the London-wide ULEZ expansion for each zone

London Zone	Without LWULEZ 2023 - Cars	Without LWULEZ 2023 - Vans	Without LWULEZ 2023 - Cars and Vans	LWULEZ 2023 - Cars	LWULEZ 2023 - Vans	LWULEZ 2023 - Cars and Vans
Central	18	47	66	19	45	64
Inner	558	653	1,211	551	630	1,181
Outer	2,203	1,810	4,013	1,906	1,683	3,590
London-wide	2,780	2,511	5,290	2,476	2,358	4,834

Table 14: Change in car and van NO_X emissions (tonnes and per cent), 2023 with the London-wide ULEZ compared to the 2023 scenario without the London-wide ULEZ

London Zone	Change in Emissions (Tonnes) - Cars	Change in Emissions (Tonnes) - Vans	Change in Emissions (Tonnes) - Cars and Vans	Change in Emissions (%) - Cars	Change in Emissions (%) - Vans	Change in Emissions (%) - Cars and Vans
Central	1	-3	-2	3%	-5%	-3%
Inner	-7	-23	-30	-1%	-4%	-3%
Outer	-297	-127	-424	-13%	-7%	-11%
London-wide	-304	-152	-456	-11%	-6%	-9%

$PM_{2.5}$ emissions impacts

Table 15 shows the estimated $PM_{2.5}$ exhaust emissions from cars (excluding PHVs) and vans. Table 16 shows the change in these emissions.

It is estimated that $PM_{2.5}$ exhaust emissions from cars (excluding PHVs) and vans are 18 per cent and 14 per cent lower across London as a whole than they would have been without the London-wide ULEZ.

> In outer London, car and van exhaust emissions are 20 per cent lower than would have been expected without the London-wide ULEZ.

Overall, $PM_{2.5}$ exhaust emission in London are 17 per cent lower, an estimated saving of six tonnes.

Table 15: Estimated annual $PM_{2.5}$ exhaust emissions (tonnes) for cars and vans in 2023 with and without the London-wide ULEZ expansion for each zone

London Zone	Without LWULEZ 2023 - Cars	Without LWULEZ 2023 - Vans	Without LWULEZ 2023 - Cars and Vans	LWULEZ 2023 - Cars	LWULEZ 2023 - Vans	LWULEZ 2023 - Cars and Vans
Central	0.1	0.2	0.0	0.2	0.2	0.0
Inner	4.2	2.5	7.0	4.2	2.3	7.0
Outer	20.2	7.4	28	15.8	6.2	22
London-wide	24.5	10.1	35	20.2	8.7	29

Table 16: Change in car and van $PM_{2.5}$ exhaust emissions (tonnes and per cent), 2023 with London-wide ULEZ compared to the 2023 scenario without the London-wide ULEZ

London Zone	Change in Emissions (Tonnes) - Cars	Change in Emissions (Tonnes) - Vans	Change in Emissions (Tonnes) - Cars and Vans	Change in Emissions (%) - Cars	Change in Emissions (%) - Vans	Change in Emissions (%) - Cars and Vans
Central	0.0	0.0	0.0	2%	-5%	-2%
Inner	0.0	-0.2	-0.1	1%	-6%	-2%
Outer	-4.4	-1.2	-5.6	-22%	-17%	-20%
London-wide	-4.3	-1.4	-5.7	-18%	-14%	-17%

Emissions continue to reduce in all zones bringing health benefits related to improving air quality to all Londoners.

Air pollution concentrations

By reducing the amount of NO_X emitted by vehicles, the ULEZ helps reduce NO_2 concentrations in the zone. This will reduce the health impacts associated with exposure to NO_2, which is the key aim of expanding the zone.

Air pollution concentrations are affected by a number of factors and follow patterns of seasonal variation. It is therefore preferable to have at least a complete year of data to fully understand the impacts of a scheme on air quality. This section presents a preliminary analysis of air pollution data from London's extensive automatic monitoring network and data from the rest of England, to assess how pollution levels have changed over time. Further analysis will be carried out once a full year of data is available.

For this analysis, air quality monitoring stations are grouped by site type. This analysis focuses on the two most common types of monitoring site: roadside and urban background. Roadside sites give the best estimate of public exposure on busy roads. Background sites are located further away from the main sources of pollution (e.g. traffic) and are representative of air pollution exposure for the wider population.

Trend analysis

Air pollution concentrations are highly sensitive to weather conditions, such as wind speed, wind direction, rainfall, and temperature, as well as the associated long-range transport of pollutants from outside London. Many pollutants also have a seasonal cycle. This seasonal cycle may be caused by seasonally varying emissions, such as heating in the winter or agricultural emissions during the spring. Seasonal cycles can also be caused by other factors, including sunlight, which can induce chemical reactions between air pollutants, and weather conditions hindering dispersal. These seasonal and day-to-day variations can make it difficult to assess short-term trends and the impact of interventions such as the ULEZ. One approach to minimise the impact of these variations is to consider a sufficiently long time period. Another is to use statistics to smooth out short-term variability, which helps to reduce the impact of weather and seasonal factors.

In line with previous reports, statistical smoothing has been used to reduce the impacts of weather and seasonal changes in the long-term trend data. Further detail on the methodology is contained in Appendix 3.

In this section, monthly average concentrations were used to calculate trends in the period from 2010 to the end of February 2024. It should be noted that measurement data from

2024 and some measurement data from late 2023 has not yet been ratified. As a result, these may be subject to change following equipment tests undertaken as part of the routine audit and servicing of air quality monitoring sites[43].

Context

In addition to the ULEZ and the London-wide LEZ (for heavy vehicles), the Mayor has introduced complementary policies, including procuring zero-emission buses, introducing taxi and PHV age limits and licensing requirements, and enabling active travel and use of sustainable public transport, all of which contribute to changes in pollution concentrations. Therefore, the analysis for the ULEZ shows the impacts of not just the ULEZ and its expansions, but all of the Mayor's policies to reduce emissions from transport, including those within the Mayor's Transport Strategy. As such, it is not straightforward to isolate the impact of the ULEZ and its expansions. Therefore the analysis for the ULEZ can be seen to show the impacts of not just the ULEZ and its expansions, but of all the Mayor's policies to reduce emissions from transport.

As previously reported, the impacts of the pandemic on air quality in London have been extreme and variable with much deeper and sustained impacts in central London compared with inner and outer London[44]. The pandemic led to large impacts on traffic volumes in London in 2020 and in 2021, with central London being especially affected. This in turn in reduced pollution levels across the city, particularly in central London. Due to the ULEZ policies and continued efforts to tackle air pollution, it is clear from further air pollution data analysis that concentrations in London are continuing to reduce despite traffic increasing post-pandemic.

For this analysis, long-term monitoring stations which met the minimum data capture requirements were used. Air quality concentration data from 381 NO_2 monitoring stations and 138 $PM_{2.5}$ monitoring stations in London and England have been analysed between 2010 and February 2024. The data has been grouped as follows:

[43] The process of ratifying the data, i.e. undergoing the process of detailed quality assurance and control, can take between six months to a year, varies across monitoring stations, and may depend on network operators. In most cases, ratified monitoring data usually only shows small variations overall from the initial readings. For the purposes of undertaking this analysis, data as available and downloaded at the end of April 2024 has been used.

[44] Further analysis on the initial impact of the pandemic on air quality in London is available here: https://www.london.gov.uk/sites/default/files/london_response_to_aqeg_call_for_evidence_april_2020.pdf

- Roadside and urban background sites.
- Central, inner and outer London as in previous reports and to help describe the impact of the London-wide ULEZ.
- A 0-5 km zone around London recognising this area is close to the boundary of the London-wide ULEZ.
- A 5 – 40 km zone around Greater London which provides a control comparison for outer London.
- Rest of England (sites beyond 40 km from Greater London) representing wider trends in England.

Overview of trends in NO_2 concentrations

Figure 6 shows the trends in NO_2 at roadside and urban background monitoring sites in London zones, the surrounding zones, and the rest of England (beyond 40 km from the Greater London boundary) from January 2014 to February 2024. The graphs show monthly average NO_2 concentrations grouped by zone and site type, statistically smoothed to reduce the impact of weather and seasonality[45].

[45] Data points representing the average monthly concentrations from which the trend lines have been derived are shown for transparency. Circles are roadside and triangles are urban background monthly concentrations averaged across the available sites each month.

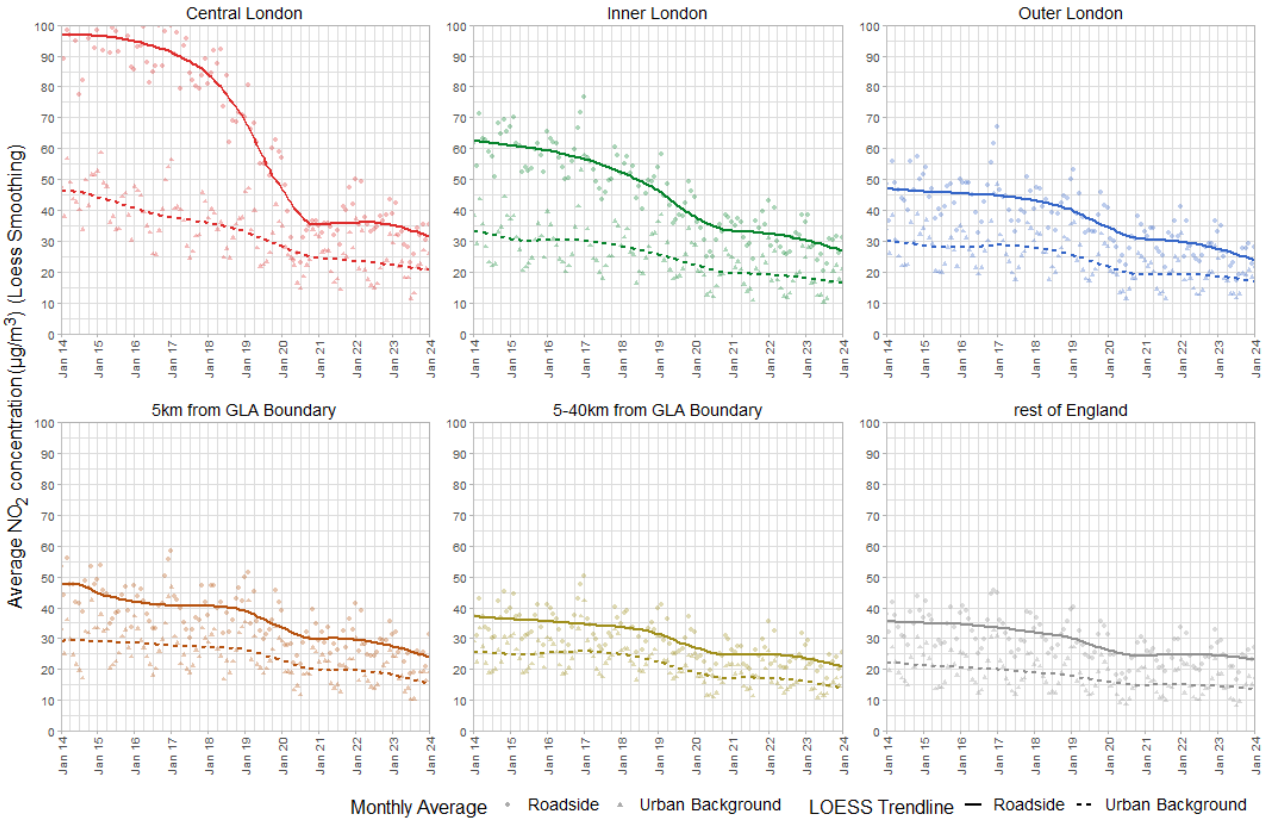

Figure 6: Trends in monthly average NO_2 concentrations in London zones, surrounding zones, and rest of England from January 2014 to February 2024

The data underpinning Figure 6 is displayed in Table 43 in Appendix 4. It can be seen from Figure 6 that:

- Since 2017, when the Mayor introduced the T-Charge and people started preparing for the introduction of the original central ULEZ, the greatest reductions in both roadside and background average concentrations have occurred in central London.
- Average roadside concentrations in outer London are much lower and are now similar to the average for the rest of England (where concentrations have historically been lower). The difference between these areas has reduced more rapidly since 2019.

Average roadside concentrations have reduced in the rest of England to a lesser extent than in outer London, with a generally flat trend over the last four years. Table 43 in Appendix 4 shows that on average, roadside concentrations have reduced by 62 per cent in central London, 47 per cent in inner London, and 41 per cent in outer London between

2017 and 2023. Whereas average roadside concentrations in the rest of England have reduced to a much lesser extent, by 27 per cent. Whilst average concentrations were and continue to be higher in the London zones compared to the rest of England, it is it clear from Figure 6 and Table 43 that due to improvements across London, there is now much less difference. It is noteworthy that average concentrations in all London zones are now below legal limits for NO_2 including in central London, which suggests that we are on track to achieving legal compliance across all of London by 2025[46].

Urban background concentrations have reduced in all zones, with similar levels of percentage reductions for all London zones and the surrounding areas. The average for all of London is 39 per cent lower in 2023 when compared to 2017, whereas the average for the rest of England is 27 per cent lower.

These overall changes in concentrations are important in the context of population exposure. This is particularly important in London as it is clear from the trend analysis that nine million Londoners are breathing cleaner air.

Overview of trends in $PM_{2.5}$ concentrations

Road transport is the largest single source of fine particulate matter in London, accounting for around 30 per cent of emissions[13]. Of this 30 per cent, a growing proportion are non-exhaust emissions[47], which would not be affected by the tightening of tailpipe emissions standards for vehicles driving in the ULEZ.

Unlike NO_2, over half of London's concentrations of $PM_{2.5}$ come from regional, and often transboundary (non-UK) sources outside of London. $PM_{2.5}$ concentrations from these sources are also heavily influenced by meteorological conditions, causing more variation between different years.

[46] This is not official reporting against legal limits as this is an average across all monitoring stations included within this analysis. Therefore, some individual sites still record exceedances. Statutory legal compliance is assessed via annual status reports which are submitted by all London Boroughs on an annual basis.
[47] Non-exhaust emissions include road wear, tyre and brake wear, as well as resuspension of road dust.

For these reasons, the reduction in $PM_{2.5}$ emissions that have occurred due to a cleaner fleet will have a less pronounced impact on concentrations than seen for NO_2, which is dominated by London-based traffic sources.

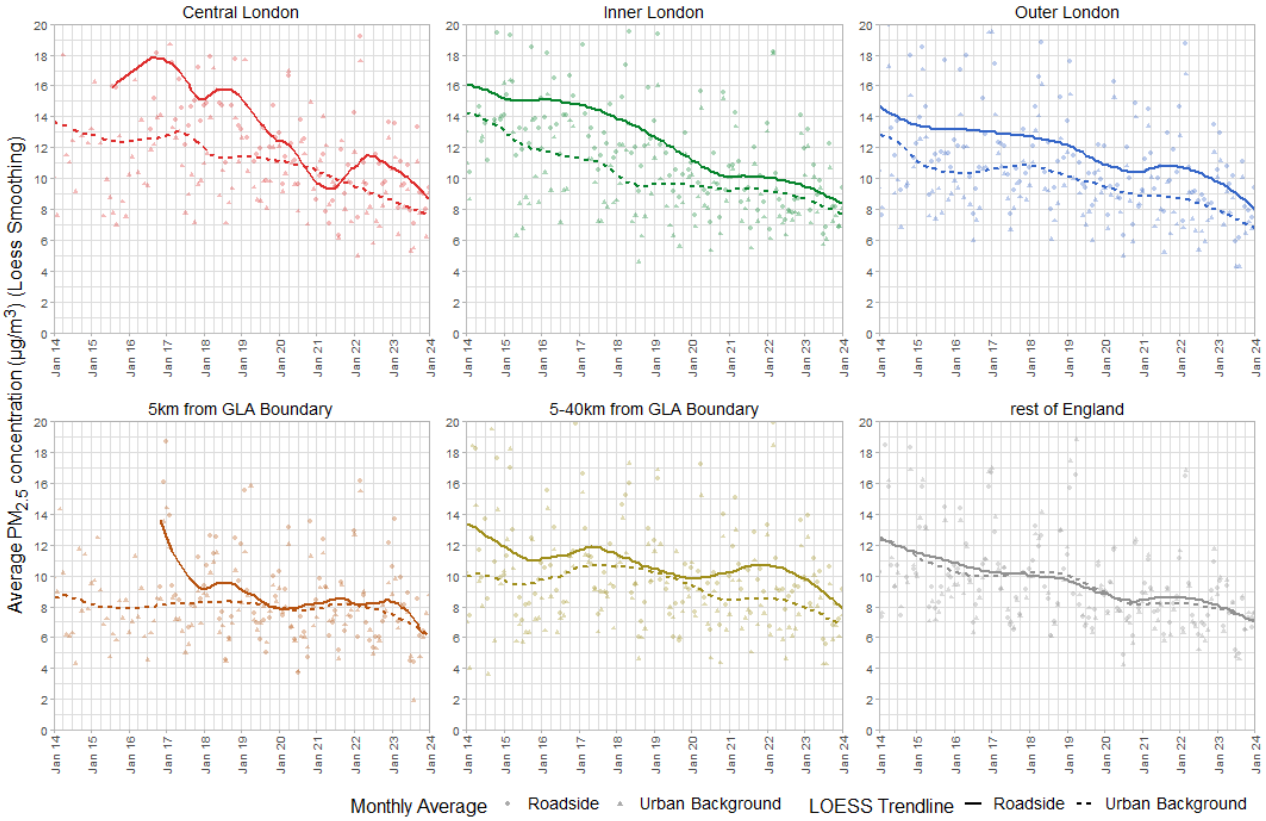

Figure 7: Trends in monthly average $PM_{2.5}$ concentrations in London zones, surrounding zones, and rest of England from 2014 to February 2024

The data underpinning Figure 7 is displayed in Table 44 in Appendix 4. Figure 7 shows the trends in monthly average $PM_{2.5}$ concentrations at roadside and urban background sites in London zones, surrounding zones, and the rest of England (beyond 40 km from Greater London boundary) from January 2014 to February 2024. The graph shows monthly average $PM_{2.5}$ concentrations grouped by zone and site type, statistically smoothed to reduce the impact of weather and seasonality. It can be seen that concentrations at both roadside and background sites are often similar because of the importance of other non-road transport sources, especially regional and transboundary contributions. There are also considerably fewer monitors for $PM_{2.5}$ than NO_2, (138 compared to 381) which means grouping of sites can produce more variable trends.

Average $PM_{2.5}$ concentrations have reduced across all zones, most substanitally in central London, where average roadside concentrations in 2023 were 40 per cent lower than in

2017, equating to a reduction of 7 µg/m^3. Large reductions of 37 per cent and 29 per cent respectively have also been seen in inner and outer London, whilst reductions in the rest of England are approximately 25 per cent. Based on trends analysis, average $PM_{2.5}$ concentrations in the London area are now approaching those for the rest of England (which have historically been lower). Background concentrations have also reduced substantially, by approximately 29 per cent across London.

Figure 7 shows that roadside $PM_{2.5}$ concentrations tended to increase in the short-term from spring 2021 across all areas, which may reflect growing activity and increases in traffic post-pandemic. However it can be seen that roadside concentrations have since started reducing and are tending towards backround concentrations, especially in London where there was historically a bigger difference between background and roadside.

Impacts of the ULEZ on $PM_{2.5}$ concentrations will be assessed in future reports as further monitoring data is required due to the influence of meteorological data on patterns of $PM_{2.5}$ concentrations over time.

ULEZ impact analysis

The previous section highlights the overall NO_2 concentration trends in London and the surrounding area. Additional analysis has been carried out to assess the extent of the impact of the ULEZ and its London-wide expansion. This is important to ensure the recent trends in decreasing NO_2 seen above are not just a product of weather, seasonal factors, the pandemic or due to the natural reduction in emissions that would be expected with the general vehicle fleet turnover.

Method

The method used in this report is based on a similar approach used in the earlier central and inner London ULEZ reports. The use of control sites and an estimated “No ULEZ” scenario is fundamentally required, as observed data will always represent the situation with the ULEZ being in operation. This method also recognises that a general trend of improvement in concentrations would normally be expected even without the ULEZ due to natural fleet churn, whereby older vehicles drop out of the fleet and newer cleaner vehicles come into it over time.

Impacts have been assessed in two ways:

- London-wide ULEZ: The impact of the third phase of the ULEZ expansion in outer London, assessed from December 2022 (after the Mayor announced the decision to go ahead with the expansion). This requires the estimation of a “No London-wide ULEZ” scenario from December 2022 against which impacts are assessed by comparing to observed data.
- All ULEZ policies: The overall impact of the ULEZ package of measures from 2017 (when the policy interventions including the introduction of the T-Charge, the announcement of the intention to bring forward the introduction of the ULEZ in central London and the consultation on tightening the LEZ standards and expanding the ULEZ to inner London were first announced). This requires the estimation of a “No ULEZ” scenario from January 2017 against which impacts are assessed by comparing to observed data.

ULEZ impact analysis in earlier reports used the following principles:

- Monitored data from air quality monitoring stations were used as the basis for all analysis.
- Outer London served as a suitable control area against which to assess the impact of the central and inner London ULEZ.
- The changes in road increment of NO_2 in outer London (that is subtracting outer urban background from total roadside concentrations in outer London to represent the changes in traffic related pollution) represented the trend that would be expected without the ULEZ package of measures.
- Concentrations for a “No ULEZ” scenario were estimated, in order to assess observed changes in concentration trends.

In addition to the above principles, for this analysis a further control zone between 5-40 km of Greater London has been added to assess the impacts of the London-wide ULEZ (the expansion to include outer London). Concentrations for a “No London-wide ULEZ” scenario have also been estimated.

Monitored trends from the area between 5-40 km outside of London is considered suitable to enable an assessment of the impacts in outer London and in the immediate 0-5 km around the boundary. This 5-40 km control zone was chosen because:

- It does not include sites immediately around the boundary of the ULEZ.
- It excludes sites in the south of England that are affected by different local meteorological conditions, especially on the coast.
- Meteorological and regional background influences in this surrounding area are similar to those for London, which is unlikely to be the case for the rest of England.

Full details of the methodology can be found in Appendix 3.

Results

Impacts of the London-wide ULEZ

Figure 8 shows the trends in monthly average roadside NO_2 in outer London, comparing the observed trends (based on measured data and shown by the solid lines), with the estimated trends for the "No London-wide ULEZ" scenario (shown by the dashed lines). The shaded area of each graph represents the impact of the London-wide ULEZ. Whilst the previous phases of the ULEZ and LEZ will have led to changes in emissions in outer London, this estimated impact is looking at specifically the London-wide ULEZ expansion and, therefore, only represents a proportion of the overall impacts on NO_2 concentrations in London.

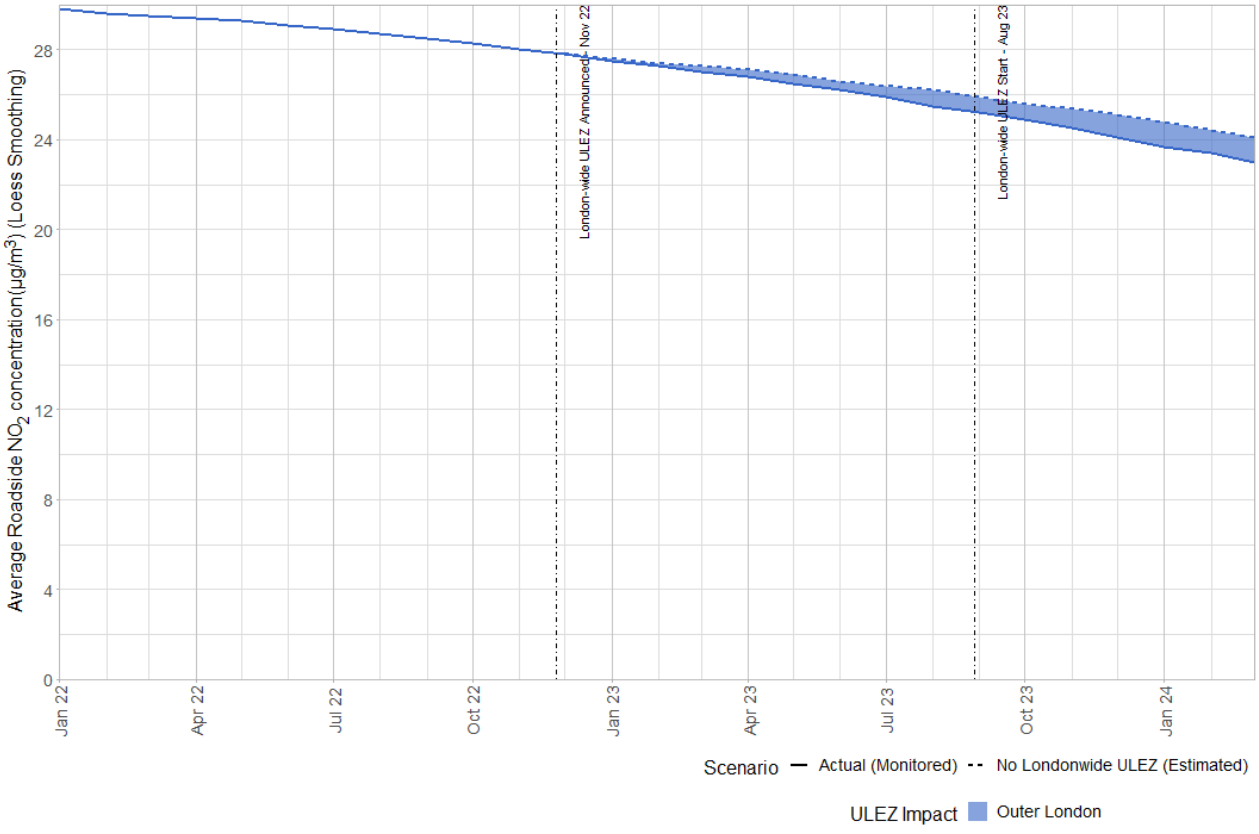

Figure 8: Trends in monthly average roadside NO_2 concentrations in outer London, with and without London-wide ULEZ

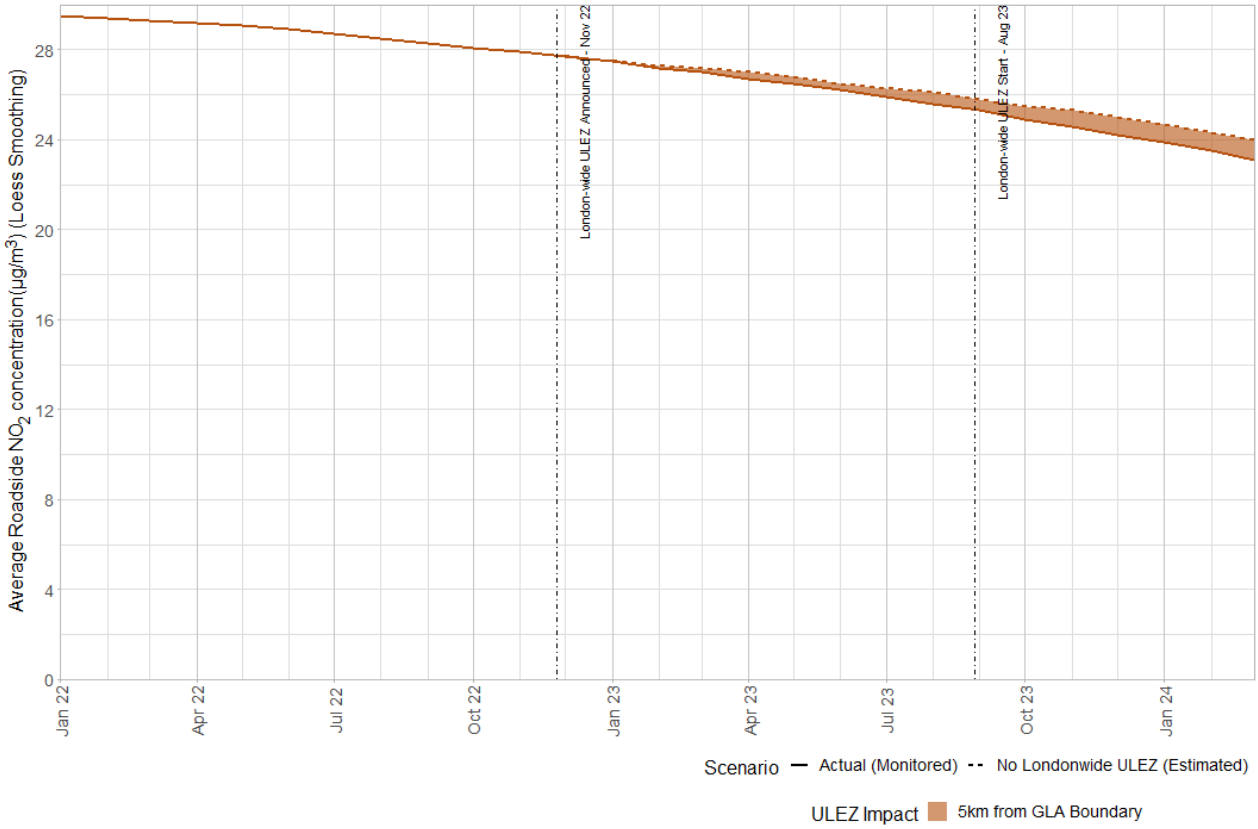

Figure 9: Trends in monthly average roadside NO_2 concentrations in the zone 5 km from the GLA boundary, with and without London-wide ULEZ

The impacts of the London-wide ULEZ are assessed to be largest in outer London, as shown in Figure 8. Impacts are also observed in the areas within 0-5 km of London, where roads also cross the boundary to the new charging area, as shown in Figure 9.

The data that underpins Figure 8 and Figure 9 is in Table 45 in Appendix 4.

> During the first six months of operation of the London-wide ULEZ only (i.e. September 2023 to February 2024), our estimates show that NO_2 concentrations in outer London are between 2.7 – 4.4 per cent lower than would have been expected without the London-wide ULEZ expansion.

The range represents the variation in impacts as estimated on a month-by-month basis, with a maximum monthly impact of 4.4 per cent. This equates to a concentration decrease of between 0.7 – 1.1 µg/m^3.

Analysis of the monthly concentrations in the 0-5 km zone from London suggests that areas outside London are also seeing the impacts of the London-wide ULEZ. The impacts

are approximately 1.9 – 3.3 per cent, which is equivalent to a 0.5 – 0.8 µg/m^3 reduction in average NO_2 concentrations. As noted previously, there are fewer monitoring sites in the 0-5 km zone and not all areas are represented.

The impacts of the London-wide ULEZ for London as a whole are shown in Figure 14 in Appendix 4.

Impacts of all ULEZ policies

Figure 10 shows the trends in monthly average roadside NO_2 concentrations in each zone, comparing the observed trends (based on measured data and shown by the solid lines) with the estimated trends they would have followed based on the “No ULEZ” scenario (shown by the dashed lines). The shaded area on each graph represents the impact of all ULEZ policy measures.

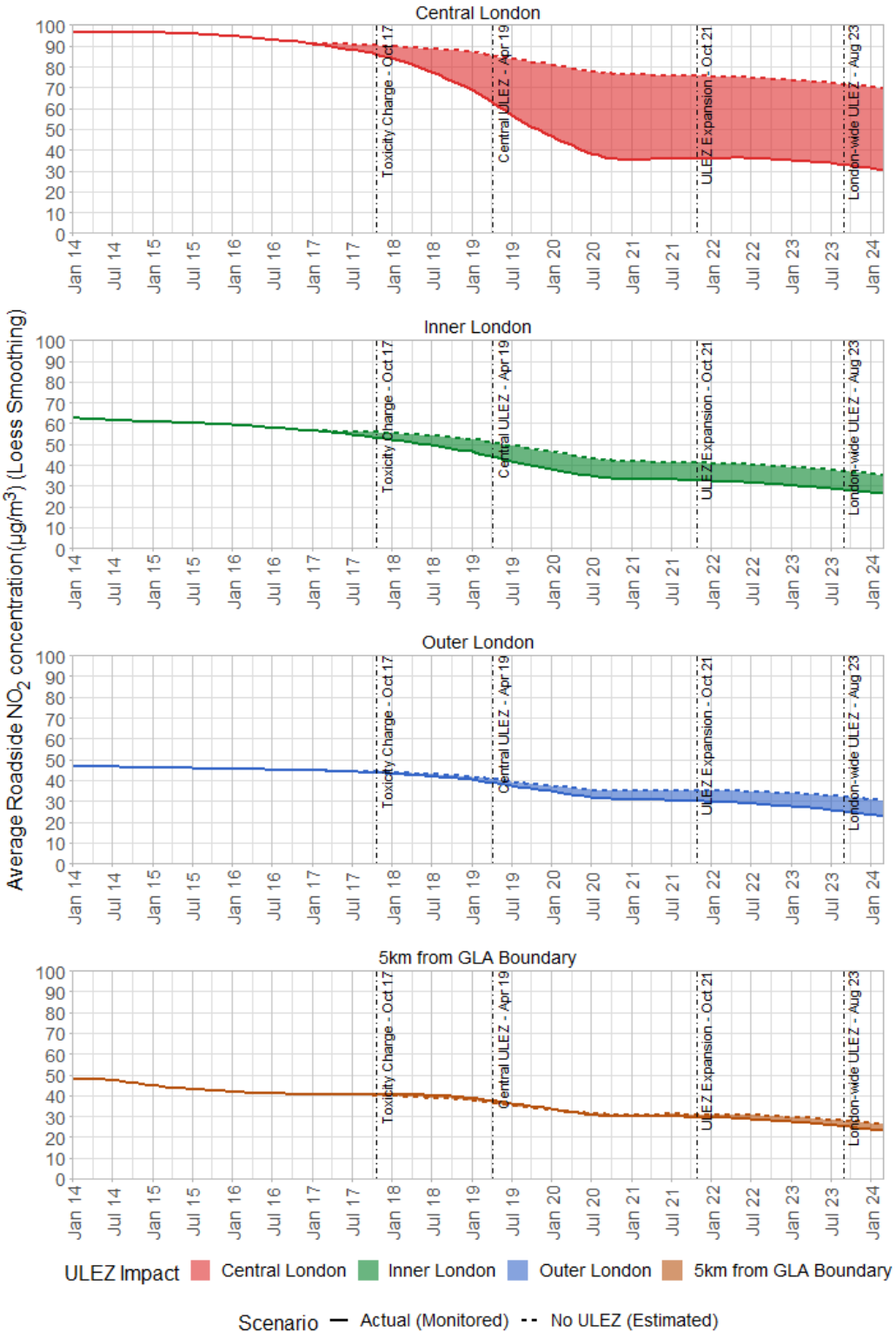

Figure 10: Trends in monthly average NO_2 concentrations in London zones with and without ULEZ

Figure 10 shows that average concentrations for all roadside sites in all London zones have seen accelerated and greater reductions than would be expected without the ULEZ and its expansions. The biggest reductions are in central London, where historically concentrations were much higher and where the earliest phase of the ULEZ was introduced (notably this also included heavy vehicles including London buses). The graphs show how the impacts of the ULEZ can be seen in all London zones, but the magnitude of reductions is greatest in central London, followed by inner London and then outer London. This is a function of the phased introduction of the scheme into different zones of London. The phasing also balanced any potential negative impacts on people and businesses with non-compliant vehicles across progressively larger areas.

The population of Londoners living in outer London is over five million, compared to less than half a million in central London, and under four million in inner London. Therefore, air quality improvements in outer London impact the largest share of London's residents. Table 17 to Table 21 summarise the impacts of all ULEZ policies in each zone by comparing the yearly concentrations for the observed trends against the "No ULEZ" scenario, to provide impacts each year since 2017. This can be understood as the impact of the ULEZ policies in each London zone.

Table 17: Estimated impact of ULEZ policies on roadside NO_2 concentrations in central London based on trends analysis

Year	Actual (Monitored) ($\mu g/m^3$)	No ULEZ (Estimated) ($\mu g/m^3$)	Impact ($\mu g/m^3$)	Impact (per cent)
2016	93	N/A	N/A	N/A
2017	88	91	-3	-3%
2018	78	89	-11	-12%
2019	58	84	-26	-31%
2020	40	78	-38	-49%

Year	Actual (Monitored) (µg/m^3)	No ULEZ (Estimated) (µg/m^3)	Impact (µg/m^3)	Impact (per cent)
2021	36	76	-40	-53%
2022	36	75	-39	-52%
2023	34	72	-39	-53%

Table 18: Estimated impact of ULEZ policies on roadside NO_2 concentrations in inner London based on trends analysis

Year	Actual (Monitored) (µg/m^3)	No ULEZ (Estimated) (µg/m^3)	Impact (µg/m^3)	Impact (per cent)
2016	58	N/A	N/A	N/A
2017	55	56	-2	-3%
2018	50	54	-4	-8%
2019	42	50	-7	-15%
2020	35	44	-8	-19%

Year	Actual (Monitored) ($\mu g/m^3$)	No ULEZ (Estimated) ($\mu g/m^3$)	Impact ($\mu g/m^3$)	Impact (per cent)
2021	33	41	-8	-20%
2022	32	40	-9	-21%
2023	29	38	-9	-24%

Table 19: Estimated impact of ULEZ policies on roadside NO_2 concentrations in outer London based on trends analysis

Year	Actual (Monitored) ($\mu g/m^3$)	No ULEZ (Estimated) ($\mu g/m^3$)	Impact ($\mu g/m^3$)	Impact (per cent)
2016	45	N/A	N/A	N/A
2017	44	44	-0	-1%
2018	42	43	-1	-2%
2019	38	40	-2	-5%
2020	32	36	-3	-9%

Year	Actual (Monitored) (µg/m^3)	No ULEZ (Estimated) (µg/m^3)	Impact (µg/m^3)	Impact (per cent)
2021	30	35	-5	-13%
2022	29	35	-6	-16%
2023	26	33	-7	-21%

Table 20: Estimated impact of ULEZ policies on roadside NO_2 concentrations in the 0-5 km zone outside London based on trends analysis

Year	Actual (Monitored) µg/m^3	No ULEZ (Estimated) µg/m^3	Impact (µg/m^3)	Impact (per cent)
2016	41	N/A	N/A	N/A
2017	41	40	0	-1%
2018	40	39	-1	-3%
2019	37	36	-1	-3%
2020	31	32	0	-1%

Year	Actual (Monitored) µg/m^3	No ULEZ (Estimated) µg/m^3	Impact (µg/m^3)	Impact (per cent)
2021	30	31	-1	-3%
2022	29	30	-2	-6%
2023	26	29	-3	-9%

The difference between the monitored trends and the “No ULEZ” scenario is substantial and demonstrates that the ULEZ and associated policies have had a transformative impact on reducing NO_2 levels.

> In 2023, the average roadside NO_2 concentrations measured in central London were 53 per cent lower than the estimated “No ULEZ” scenario. In inner London, roadside NO_2 concentrations were 24 per cent lower than the estimated “No ULEZ” scenario. In outer London, roadside NO_2 concentrations were 21 per cent lower than the estimated “No ULEZ” scenario.

These impacts on NO_2 concentrations in both inner and outer London are significant given the size of the population in these areas, representing over 95 per cent of people living in London.

The impacts observed in central London have been sustained from previous years. Impacts in 2023 are higher in both inner and outer London compared to 2022 as a result of the phased expansion of the ULEZ. The NO_2 impact of all the ULEZ policies in outer London is five percentage points higher in 2023 than it was in 2022 (21 per cent compared to 16 per cent).

> Areas outside London are also seeing the impacts of the ULEZ, with roadside NO_2 concentrations within 5 km from the Greater London boundary on average nine per cent lower in 2023 than an estimated “No ULEZ” scenario.

Figure 11 and Table 21 show the impacts of all ULEZ policies for London as a whole.

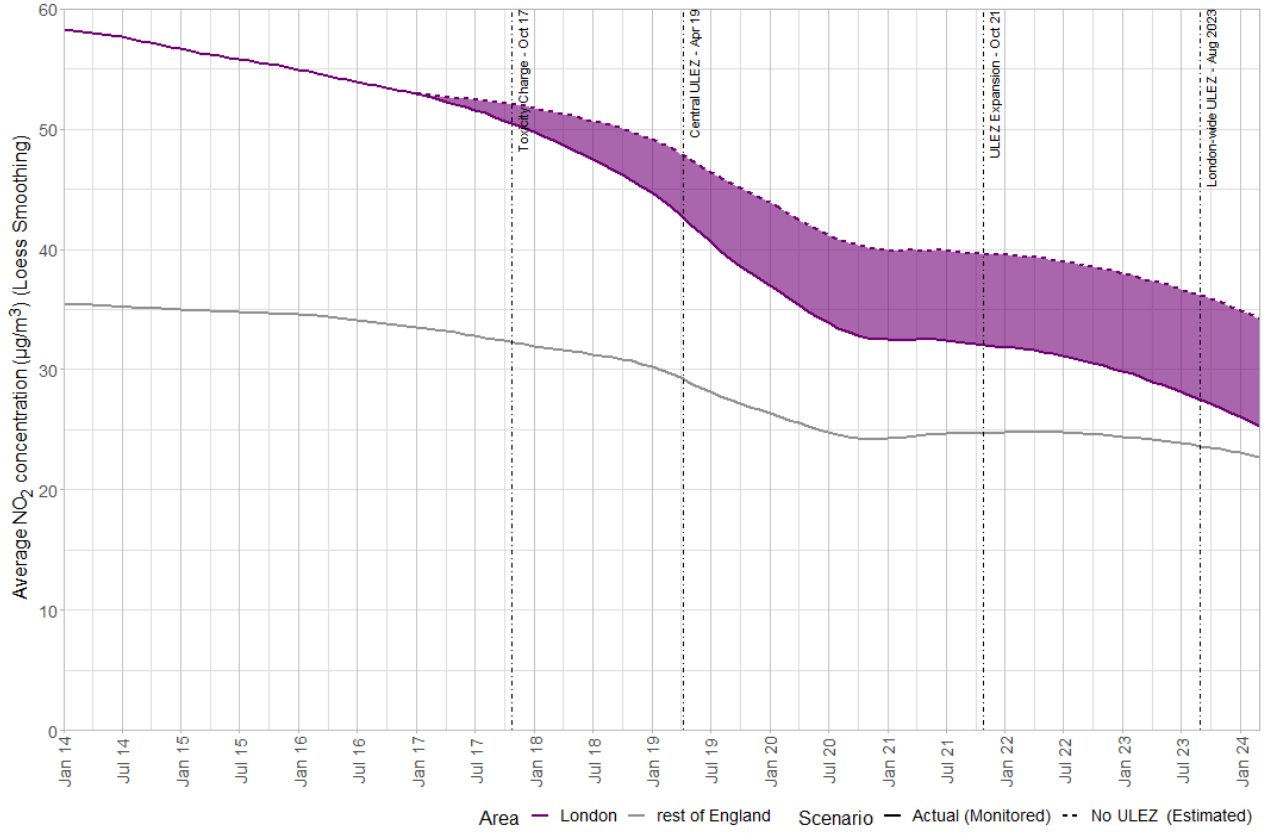

Figure 11: Estimated impact of ULEZ policies on roadside NO_2 concentrations for London based on trends analysis.

Table 21: Estimated impact of ULEZ policies on roadside NO_2 concentrations in London as a whole based on trends analysis

Year	Actual (Monitored) ($\mu g/m^3$)	No ULEZ (Estimated) ($\mu g/m^3$)	Impact ($\mu g/m^3$)	Impact (per cent)
2016	54	N/A	N/A	N/A
2017	51	52	-1	-1%

Year	Actual (Monitored) (µg/m^3)	No ULEZ (Estimated) (µg/m^3)	Impact (µg/m^3)	Impact (per cent)
2018	48	50	-3	-6%
2019	41	46	-5	-12%
2020	34	41	-7	-17%
2021	32	40	-7	-18%
2022	31	39	-8	-20%
2023	28	36	-8	-23%

The analysis of trends of average London concentrations (the whole of London) indicates that the ULEZ has reduced roadside NO_2 concentrations by 23 per cent (equivalent to 8 µg/m^3) compared to what they would have been without the ULEZ.

When compared to trends of monitored data for the rest of England, roadside concentrations in London are declining at a faster rate and therefore are closing the gap between London and the rest of England (see grey and purple solid lines in Figure 11). The rest of England average has always been lower than London due to the inclusion of non-urban areas which are less built-up and have lower population density, therefore demonstrating the success of achieving similar concentrations in a large city of nine million people. In 2014, the gap between London and rest of England was 20 µg/m^3, this reduced to 12 µg/m^3 in 2019 and in 2023 was less than 5 µg/m^3.

Crucially, this means improving air quality directly for the nine million people living in London and those who come into the area for work, study or leisure.

Traffic

The ULEZ was not designed as a congestion management tool, but the way it operates means it does influence travel behaviour and traffic, as has been shown in previous ULEZ monitoring reports. TfL uses ATC data that provides traffic volumes at representative sites, often on key roads across London to monitor changes in traffic flows. These sites provide total traffic flows for all vehicles for each hour of the day.

People who own non-compliant vehicles may choose to pay the daily charge, change their vehicle (the Mayor's scrappage scheme offers all Londoners with an eligible non-compliant car or motorcycle up to £2,000), drive it less, avoid driving in the zone, or choose an alternative mode of transport for some or all of their journeys. These individual choices may influence overall traffic volumes and patterns over time.

ATC data does not provide traffic flows by vehicle type but does provide monthly data which enables comparison to months in previous years and assessment of short-term changes in traffic since ULEZ was expanded. It is important to note that overall changes in traffic flows do not necessarily reflect the changes to individual vehicle types.

Traffic in London by area

Method

Data from ATC sites within London have been analysed[48]. This includes data from over 200 sites that have been assigned to three areas across London: central London (the original ULEZ area), an inner ring representing the expanded inner London ULEZ area (excluding both central London and the North and South Circular Roads), and the expanded outer London area that is now part of the London-wide ULEZ.

The data has been used to index the average daily flow per month for the ATCs in each zone to January 2019. An index of 1.01 means average flows are one per cent higher than January 2019, and an index of 0.99 means flows are one per cent lower than January 2019. The monthly index for each area is shown in Appendix 5.

Indexed traffic flows can be affected by non-scheme factors such as seasonality or road network variability. Influences on indexed traffic flow may include diversions, roadworks,

[48]Traffic flow data available to end of February 2024 has been used for this analysis.

lane closures or other factors. In areas with fewer sites or lower average traffic, these influences can have a greater effect on indexed traffic flow variability.

Traffic flow data represents circulating vehicles travelling on roads across London and is not the same as unique vehicles detected by the camera network, which only need to be seen once by any camera during the day. This means that changes in the average number of unique vehicles detected do not necessarily equate to the same changes in traffic flows.

Findings

Preliminary analysis of the indexed traffic flows indicates there are no notable changes in overall traffic in the three areas, or around the London-wide ULEZ boundary, with data showing flow quantify and seasonal patterns have stayed broadly the same compared to before the London-wide ULEZ expansion.

The data remains within the range of normal observed variations of traffic that can occur in any month. As expected, traffic is higher London-wide in September than August, once school holidays have finished. In addition, traffic is lower in December 2023 and January 2023 as an impact of the Christmas holidays, this is in line with seasonal effects observed in previous years.

The trends over the last six months since the scheme was launched mirrors those observed in other comparable years with indexed traffic flows being the same or fractionally higher than the year before.

Traffic around the London-wide ULEZ boundary

Analysis of detected vehicles shows that there is a higher proportion of newer, cleaner vehicles in the zone, particularly after the scheme launched, analysis of traffic count data is required to understand any impacts on traffic flows. For this report, analysis of data obtained from 48 ATCs around the boundary of the GLA area has been undertaken up to the end of February 2024. The monthly index for each area is shown in Appendix 5.

The initial analysis of the traffic flows near the boundary indicates that no unusual changes due to the implementation of the scheme have occurred. As expected from patterns in previous years, flows in September 2023 are higher than in August 2023 (school holidays) but comparatively remain below levels in June 2023. For the rest of 2023 and 2024, traffic flows remain broadly the same as previous comparable years. As seen in seasonal patterns from previous years, a dip in traffic can be observed between December 2023 and January 2024 as a function of the Christmas holidays.

Traffic data will continue to be observed and assessed in the One Year Report to examine what consistent trends further emerge.

Conclusions

There is a strong body of research evidencing the negative health impacts associated with exposure to air pollution, and road transport is currently estimated to be the largest single source of NO_2 in London, one of the main pollutants of concern. The expansion of the ULEZ London-wide in August 2023 is the latest world-leading policy delivered in London under this Mayoralty aimed at tackling harmful air pollution emissions from road transport, specifically NO_2 and PM. The ULEZ disincentivises the use of older, more polluting vehicles within the city through applying a daily charge to vehicles that do not meet certain emissions criteria.

This report is the latest in a series of reports evaluating the impact of the ULEZ and covers the first six months of operation since the London-wide expansion. This report provides updated statistics on the compliance of vehicles driving in the ULEZ area, as well as preliminary analysis of air pollutant emissions and concentrations.

This report shows that a larger proportion of vehicles in London are cleaner, and compliance with the ULEZ emissions standards has increased for all vehicles subject to ULEZ standards. Now, 96.2 per cent of vehicles seen driving in the London-wide ULEZ meet the standards.

A cleaner fleet has translated to lower emissions from cars and vans. NO_X emissions from cars and vans in outer London are 13 and seven per cent lower, respectively, than would have been expected without the London-wide ULEZ, equating to savings of 424 tonnes. $PM_{2.5}$ exhaust emissions from cars and vans are 20 per cent lower in outer London.

This means that people in London are breathing cleaner air. Even in the short six-month timeframe covered by the report, roadside NO_2 concentrations in outer London are on average up to 4.4 per cent lower than what would have been expected without the London-wide expansion of the ULEZ.

The combined impact of all phases of the ULEZ has contributed to greater overall air quality improvements in London. Harmful NO_2 concentrations alongside roads across all of London are estimated to be 23 per cent lower on average than they would have been without the ULEZ and its expansions.

Areas outside London are also seeing the benefits of ULEZ policies, as roadside NO_2 concentrations within 5 km of the Greater London boundary were on average nine per cent lower in 2023 than an estimated “No ULEZ” scenario.

Fuller analysis of both emissions and concentrations will be reported in the One Year Report, however this initial analysis indicates that the London-wide ULEZ expansion has had a positive impact on air quality in London.

Appendix 1– Monthly average compliance rates

This section provides the monthly average compliance rates and vehicles detected in the central ULEZ area, the inner London ULEZ area and the expanded outer London ULEZ area.

Central London ULEZ area

Table 22: **Daily average number and proportion of ULEZ compliant vehicles detected in the central ULEZ area per month (rounded to the nearest 1000 vehicles)**

Date	Unique vehicles detected in Central ULEZ zone[49]	Number of non-compliant vehicles	Number of compliant vehicles	Proportion of non-compliant vehicles	Proportion of compliant vehicles
May-22	141,000	11,000	130,000	8.0%	92.0%
Nov-22	143,000	9,000	134,000	6.5%	93.5%
May-23	143,000	8,000	136,000	5.3%	94.7%
Jun-23	153,000	8,000	145,000	5.1%	94.9%
Jul-23	152,000	8,000	145,000	5.1%	94.9%

[49] November 2022 and May 2022 are based on the camera network in place before additional new cameras were installed for the London-wide ULEZ. Detected volumes for these months cannot be compared to London-wide ULEZ volumes for the new camera network. Data for May 2023 included the first data available from some cameras installed as part of the network changes, as well as bank holidays (including the coronation).

Date	Unique vehicles detected in Central ULEZ zone[49]	Number of non-compliant vehicles	Number of compliant vehicles	Proportion of non-compliant vehicles	Proportion of compliant vehicles
Aug-23	144,000	7,000	137,000	5.0%	95.0%
Sep-23	158,000	7,000	151,000	4.5%	95.5%
Oct-23	158,000	7,000	152,000	4.3%	95.7%
Nov-23	158,000	6,000	152,000	4.0%	96.0%
Dec-23	151,000	6,000	146,000	3.9%	96.1%
Jan-24	141,000	5000	136,000	3.6%	96.4%
Feb-24	145,000	5000	140,000	3.6%	96.4%
Change between June 2023 and February 2024	-8,000	-3,000	-5,000	-1.6 ppt	+ 1.6 ppt

Date	Unique vehicles detected in Central ULEZ zone[49]	Number of non-compliant vehicles	Number of compliant vehicles	Proportion of non-compliant vehicles	Proportion of compliant vehicles
% Change in vehicles between June 2023 and February 2024	-5%	-34%	-4%	N/A	N/A

Table 23: **Daily average number and proportion of ULEZ compliant cars (M1 and PHV, excl. taxis) detected in the central ULEZ area per month (rounded to nearest 1000 vehicles)**

Date	Unique vehicles detected in central ULEZ zone[49]	Number of non-compliant vehicles	Number of compliant vehicles	Proportion of non-compliant vehicles	Proportion of compliant vehicles
May-22	105,000	7,000	99,000	6.4%	93.6%
Nov-22	105,000	6,000	100,000	5.2%	94.8%
May-23	106,000	4,000	102,000	4.2%	95.8%
Jun-23	112,000	5,000	108,000	4.1%	95.9%

Date	Unique vehicles detected in central ULEZ zone[49]	Number of non-compliant vehicles	Number of compliant vehicles	Proportion of non-compliant vehicles	Proportion of compliant vehicles
Jul-23	114,000	5,000	109,000	4.2%	95.8%
Aug-23	107,000	4,000	102,000	4.1%	95.9%
Sep-23	117,000	4,000	113,000	3.5%	96.5%
Oct-23	117,000	4,000	113,000	3.4%	96.6%
Nov-23	117,000	4,000	113,000	3.2%	96.8%
Dec-23	120,000	4,000	116,000	3.3%	96.7%
Jan-24	105,000	3,000	102,000	2.9%	97.1%
Feb-24	107,000	3,000	104,000	2.9%	97.1%
Change between June 2023 and February 2024	-6,000	-2,000	-4,000	-1.3 ppt	+1.3 ppt

Date	Unique vehicles detected in central ULEZ zone[49]	Number of non-compliant vehicles	Number of compliant vehicles	Proportion of non-compliant vehicles	Proportion of compliant vehicles
% Change in vehicles between June 2023 and February 2024	-5%	-34%	-4%	N/A	N/A

Table 24: Daily average number and proportion of ULEZ compliant vans (N1) detected in the central ULEZ area per month (rounded to nearest 100 vehicles)

Date	Unique vehicles detected in central ULEZ zone[49]	Number of non-compliant vehicles	Number of compliant vehicles	Proportion of non-compliant vehicles	Proportion of compliant vehicles
May-22	28,700	4,200	24,500	14.7%	85.3%
Nov-22	31,600	3,700	28,000	11.6%	88.4%
May-23	29,100	2,800	26,300	9.7%	90.3%
Jun-23	32,000	3,000	29,000	9.3%	90.7%

Date	Unique vehicles detected in central ULEZ zone[49]	Number of non-compliant vehicles	Number of compliant vehicles	Proportion of non-compliant vehicles	Proportion of compliant vehicles
Jul-23	30,600	2,800	27,800	9.3%	90.7%
Aug-23	29,900	2,600	27,200	8.9%	91.1%
Sep-23	32,200	2,700	29,500	8.4%	91.6%
Oct-23	32,100	2,600	29,500	8.1%	91.9%
Nov-23	32,800	2,500	30,300	7.6%	92.4%
Dec-23	25,100	1,800	23,200	7.4%	92.6%
Jan-24	28,900	1900	27,000	6.5%	93.5%
Feb-24	29,900	1900	28,000	6.5%	93.5%
Change between June 2023 and February 2024	-2,000	-1,000	-1,000	-2.9 ppt	+ 2.9 ppt

Date	Unique vehicles detected in central ULEZ zone[49]	Number of non-compliant vehicles	Number of compliant vehicles	Proportion of non-compliant vehicles	Proportion of compliant vehicles
% Change in vehicles between June 2023 and February 2024	-6%	-35%	-3%	N/A	N/A

Table 25: Daily average number and proportion of ULEZ compliant minibuses detected in the central London ULEZ area per month (rounded to nearest 10 vehicles)

Date	Unique vehicles detected in central ULEZ zone[49]	Number of non-compliant vehicles	Number of compliant vehicles	Proportion of non-compliant vehicles	Proportion of compliant vehicles
May-22	310	70	250	20.9%	79.1%
Nov-22	320	60	250	20.2%	79.8%
May-23	320	60	260	19.4%	80.6%

Date	Unique vehicles detected in central ULEZ zone[49]	Number of non-compliant vehicles	Number of compliant vehicles	Proportion of non-compliant vehicles	Proportion of compliant vehicles
Jun-23	360	70	290	19.3%	80.7%
Jul-23	320	70	250	22.7%	77.3%
Aug-23	240	50	180	22.8%	77.2%
Sep-23	310	60	250	19.1%	80.9%
Oct-23	300	60	240	20.0%	80.0%
Nov-23	320	60	260	17.8%	82.2%
Dec-23	260	50	210	19.7%	80.3%
Jan-24	250	40	210	16.7%	83.3%
Feb-24	270	40	220	16.9%	83.1%

Date	Unique vehicles detected in central ULEZ zone[49]	Number of non-compliant vehicles	Number of compliant vehicles	Proportion of non-compliant vehicles	Proportion of compliant vehicles
Change between June 2023 and February 2024	-90	-20	-70	-2.4 ppt	+2.4 ppt
% Change in vehicles between June 2023 and February 2024	-26%	-35%	-23%	N/A	N/A

Table 26: **Daily average number and proportion of ULEZ compliant motorcycles (L) detected in the central London ULEZ area per month (rounded to nearest 10 vehicles)**

Date	Unique vehicles detected in central ULEZ zone[49]	Number of non-compliant vehicles	Number of compliant vehicles	Proportion of non-compliant vehicles	Proportion of compliant vehicles
May-22	6,490	180	6,320	2.8%	97.2%

Date	Unique vehicles detected in central ULEZ zone[49]	Number of non-compliant vehicles	Number of compliant vehicles	Proportion of non-compliant vehicles	Proportion of compliant vehicles
Nov-22	6,130	110	6,020	1.8%	98.2%
May-23	7,530	140	7,390	1.9%	98.1%
Jun-23	8,320	160	8,150	1.9%	98.1%
Jul-23	7,680	150	7,540	1.9%	98.1%
Aug-23	7,250	140	7,120	1.9%	98.1%
Sep-23	8,330	170	8,170	2.0%	98.0%
Oct-23	8,720	160	8,560	1.8%	98.2%
Nov-23	8,560	150	8,410	1.8%	98.2%
Dec-23	6,400	110	6,300	1.7%	98.3%
Jan-24	7,010	110	6,900	1.5%	98.5%
Feb-24	8,030	130	7,900	1.6%	98.4%

Date	Unique vehicles detected in central ULEZ zone[49]	Number of non-compliant vehicles	Number of compliant vehicles	Proportion of non-compliant vehicles	Proportion of compliant vehicles
Change between June 2023 and February 2024	-280	-30	-250	-0.3 ppt	+ 0.3 ppt
% Change in vehicles between June 2023 and February 2024	-3%	-19%	-3%	N/A	N/A

Inner London ULEZ area

Table 27: **Daily average number and proportion of ULEZ compliant vehicles detected in the inner London ULEZ area per month (rounded to the nearest 1000 vehicles)**

Date	Unique vehicles detected in 2021 ULEZ zone[49]	Number of non-compliant vehicles	Number of compliant vehicles	Proportion of non-compliant vehicles	Proportion of compliant vehicles
May-22	929,000	57,000	871,000	6.2%	93.8%
Nov-22	912,000	49,000	863,000	5.4%	94.6%
May-23	911,000	41,000	870,000	4.5%	95.5%
Jun-23	935,000	42,000	893,000	4.5%	95.5%
Jul-23	903,000	40,000	863,000	4.4%	95.6%
Aug-23	840,000	36,000	803,000	4.3%	95.7%
Sep-23	911,000	37,000	874,000	4.1%	95.9%
Oct-23	903,000	36,000	867,000	4.0%	96.0%
Nov-23	926,000	36,000	890,000	3.9%	96.1%
Dec-23	888,000	33,000	855,000	3.8%	96.2%

Date	Unique vehicles detected in 2021 ULEZ zone[49]	Number of non-compliant vehicles	Number of compliant vehicles	Proportion of non-compliant vehicles	Proportion of compliant vehicles
Jan-24	881,000	30,000	851,000	3.4%	96.6%
Feb-24	905,000	32,000	873,000	3.5%	96.5%
Change between June 2023 and February 2024	-30,000	-10,000	-20,000	-1 ppt	+1 ppt
% Change in vehicles between June 2023 and February 2024	-3%	-25%	-2%	N/A	N/A

Table 28: Daily average number and proportion of ULEZ compliant cars (M1 and PHV, excl. taxis) detected in the inner ULEZ area per month (rounded to nearest 1000 vehicles)

Date	Unique vehicles detected in 2021 ULEZ zone[49]	Number of non-compliant vehicles	Number of compliant vehicles	Proportion of non-compliant vehicles	Proportion of compliant vehicles
May-22	778,000	35,000	742,000	4.6%	95.4%
Nov-22	757,000	30,000	727,000	4.0%	96.0%
May-23	764,000	26,000	738,000	3.4%	96.6%
Jun-23	779,000	26,000	753,000	3.3%	96.7%
Jul-23	755,000	25,000	730,000	3.3%	96.7%
Aug-23	698,000	23,000	675,000	3.3%	96.7%
Sep-23	758,000	23,000	735,000	3.1%	96.9%
Oct-23	750,000	23,000	727,000	3.0%	97.0%
Nov-23	768,000	22,000	746,000	2.9%	97.1%
Dec-23	760,000	23,000	737,000	3.0%	97.0%

Date	Unique vehicles detected in 2021 ULEZ zone[49]	Number of non-compliant vehicles	Number of compliant vehicles	Proportion of non-compliant vehicles	Proportion of compliant vehicles
Jan-24	738,000	19,000	718,000	2.6%	97.4%
Feb-24	754,000	20,000	733,000	2.7%	97.3%
Change between June 2023 and February 2024	-26,000	-6,000	-20,000	-0.7 ppt	+0.7 ppt
% Change in vehicles between June 2023 and February 2024	-3%	-23%	-3%	N/A	N/A

Table 29: Daily average number and proportion of ULEZ compliant vans (N1) detected in the inner ULEZ area per month (rounded to nearest 100 vehicles)

Date	Unique vehicles detected in 2021 ULEZ zone[49]	Number of non-compliant vehicles	Number of compliant vehicles	Proportion of non-compliant vehicles	Proportion of compliant vehicles
May-22	118,600	20,600	98,000	17.4%	82.6%
Nov-22	125,100	18,000	107,100	14.4%	85.6%
May-23	115,500	14,300	101,100	12.4%	87.6%
Jun-23	122,900	14,600	108,300	11.9%	88.1%
Jul-23	116,600	13,500	103,100	11.6%	88.4%
Aug-23	112,200	12,500	99,700	11.1%	88.9%
Sep-23	120,300	12,800	107,500	10.6%	89.4%
Oct-23	120,900	12,400	108,400	10.3%	89.7%
Nov-23	126,400	12,500	113,900	9.9%	90.1%
Dec-23	102,300	9,900	92,400	9.6%	90.4%
Jan-24	114,900	10,000	104,900	8.7%	91.3%

Date	Unique vehicles detected in 2021 ULEZ zone[49]	Number of non-compliant vehicles	Number of compliant vehicles	Proportion of non-compliant vehicles	Proportion of compliant vehicles
Feb-24	120,900	10,600	110,300	8.7%	91.3%
Change between June 2023 and February 2024	-2,000	-4,100	2,100	-3.2 ppt	+3.2 ppt
% Change in vehicles between June 2023 and February 2024	-2%	-28%	2%	N/A	N/A

Table 30: **Daily average number and proportion of ULEZ compliant minibuses detected in the inner London ULEZ area per month (rounded to nearest 10 vehicles)**

Date	Unique vehicles detected in 2021 ULEZ zone[48]	Number of non-compliant vehicles	Number of compliant vehicles	Proportion of non-compliant vehicles	Proportion of compliant vehicles
May-22	1,660	350	1,310	21.1%	78.9%
Nov-22	1,740	340	1,400	19.4%	80.6%
May-23	1,590	310	1,280	19.4%	80.6%
Jun-23	1,750	340	1,410	19.5%	80.5%
Jul-23	1,440	310	1,130	21.5%	78.5%
Aug-23	990	220	770	22.1%	77.9%
Sep-23	1,540	280	1,260	18.3%	81.7%
Oct-23	1,470	280	1,200	18.7%	81.3%
Nov-23	1,740	300	1,430	17.6%	82.4%
Dec-23	1,300	240	1,060	18.5%	81.5%
Jan-24	1,460	240	1,220	16.5%	83.5%
Feb-24	1,500	250	1,250	16.7%	83.3%

Date	Unique vehicles detected in 2021 ULEZ zone[48]	Number of non-compliant vehicles	Number of compliant vehicles	Proportion of non-compliant vehicles	Proportion of compliant vehicles
Change between June 2023 and February 2024	-240	-90	-160	-2.7 ppt	+2.7 ppt
% Change in vehicles between June 2023 and February 2024	-14%	-26%	-11%	N/A	N/A

Table 31: Daily average number and proportion of ULEZ compliant motorcycles (L) detected in the inner London ULEZ area per month (rounded to near 10 vehicles)

Date	Unique vehicles detected in 2021 ULEZ zone[49]	Number of non-compliant vehicles	Number of compliant vehicles	Proportion of non-compliant vehicles	Proportion of compliant vehicles
May-22	30,540	1,010	29,530	3.3%	96.7%
Nov-22	28,640	770	27,870	2.7%	97.3%

Date	Unique vehicles detected in 2021 ULEZ zone[49]	Number of non-compliant vehicles	Number of compliant vehicles	Proportion of non-compliant vehicles	Proportion of compliant vehicles
May-23	29,880	820	29,060	2.7%	97.3%
Jun-23	31,610	890	30,720	2.8%	97.2%
Jul-23	29,500	810	28,690	2.7%	97.3%
Aug-23	28,480	770	27,710	2.7%	97.3%
Sep-23	30,890	850	30,040	2.8%	97.2%
Oct-23	30,720	790	29,930	2.6%	97.4%
Nov-23	30,130	740	29,390	2.5%	97.5%
Dec-23	25,190	590	24,600	2.3%	97.7%
Jan-24	26,520	600	25,920	2.3%	97.7%
Feb-24	29,080	670	28,410	2.3%	97.7%

Date	Unique vehicles detected in 2021 ULEZ zone[49]	Number of non-compliant vehicles	Number of compliant vehicles	Proportion of non-compliant vehicles	Proportion of compliant vehicles
Change between June 2023 and February 2024	-2,530	-220	-2,310	-0.5 ppt	+ 0.5 ppt
% Change in vehicles between June 2023 and February 2024	-8%	-25%	-8%	N/A	N/A

Expanded outer London ULEZ area

Table 32: Daily average number and proportion of ULEZ compliant vehicles detected in the expanded outer London area per month (rounded to the nearest 1000 vehicles)

Date	Unique vehicles detected in 2023 expanded ULEZ zone[49]	Number of non-compliant vehicles	Number of compliant vehicles	Proportion of non-compliant vehicles	Proportion of compliant vehicles
May-22	862,000	129,000	733,000	14.9%	85.1%
Nov-22	926,000	110,000	816,000	11.9%	88.1%
May-23	1,580,000	150,000	1,430,000	9.5%	90.5%
Jun-23	1,714,000	156,000	1,558,000	9.1%	90.9%
Jul-23	1,697,000	147,000	1,550,000	8.6%	91.4%
Aug-23	1,636,000	128,000	1,508,000	7.8%	92.2%
Sep-23	1,679,000	80,000	1,599,000	4.8%	95.2%
Oct-23	1,683,000	76,000	1,606,000	4.5%	95.5%
Nov-23	1,761,000	75,000	1,685,000	4.3%	95.7%

Date	Unique vehicles detected in 2023 expanded ULEZ zone[49]	Number of non-compliant vehicles	Number of compliant vehicles	Proportion of non-compliant vehicles	Proportion of compliant vehicles
Dec-23	1,717,000	71,000	1,647,000	4.1%	95.9%
Jan-24	1,735,000	65,000	1,669,000	3.8%	96.2%
Feb-24	1,819,000	69,000	1,750,000	3.8%	96.2%
Change between June 2023 and February 2024	105,000	-87,000	192,000	-5.3 ppt	+ 5.3 ppt
% Change in vehicles between June 2023 and February 2024	6%	-56%	12%	N/A	N/A

ppt - Percentage point

Table 33: Daily average number and proportion of ULEZ compliant cars (M1 and PHV, excl. Taxis) detected in the expanded outer London area per month (rounded to nearest 1000)

Date	Unique vehicles detected in 2023 expanded ULEZ zone[49]	Number of non-compliant vehicles	Number of compliant vehicles	Proportion of non-compliant vehicles	Proportion of compliant vehicles
May-22	745,000	93,000	652,000	12.5%	87.5%
Nov-22	780,000	78,000	702,000	10.0%	90.0%
May-23	1,371,000	110,000	1,261,000	8.0%	92.0%
Jun-23	1,483,000	113,000	1,369,000	7.6%	92.4%
Jul-23	1,473,000	107,000	1,367,000	7.2%	92.8%
Aug-23	1,416,000	91,000	1,325,000	6.4%	93.6%
Sep-23	1,457,000	52,000	1,405,000	3.6%	96.4%
Oct-23	1,459,000	49,000	1,409,000	3.4%	96.6%
Nov-23	1,526,000	48,000	1,478,000	3.2%	96.8%
Dec-23	1,521,000	49,000	1,472,000	3.2%	96.8%

Date	Unique vehicles detected in 2023 expanded ULEZ zone[49]	Number of non-compliant vehicles	Number of compliant vehicles	Proportion of non-compliant vehicles	Proportion of compliant vehicles
Jan-24	1,516,000	43,000	1,473,000	2.8%	97.2%
Feb-24	1,584,000	45,000	1,539,000	2.9%	97.1%
Change between June 2023 and February 2024	101,000	-68,000	169,000	-4.8 ppt	+ 4.8 ppt
% Change in vehicles between June 2023 and February 2024	7%	-60%	12%	N/A	N/A

ppt - Percentage points (ppt)

Table 34: Daily average number and proportion of ULEZ compliant diesel cars (M1 excl. PHVs and taxis) detected in the expanded outer London area per month (rounded to nearest 100)

Date	Unique vehicles detected in 2023 expanded ULEZ zone[49]	Number of non-compliant vehicles	Number of compliant vehicles	Proportion of non-compliant vehicles	Proportion of compliant vehicles
May-22	214,000	85,800	128,200	40.1%	59.9%
Nov-22	206,700	72,500	134,200	35.1%	64.9%
May-23	312,900	100,300	212,600	32.1%	67.9%
Jun-23	332,200	103,100	229,100	31.0%	69.0%
Jul-23	324,400	97,000	227,400	29.9%	70.1%
Aug-23	298,800	82,400	216,400	27.6%	72.4%
Sep-23	282,800	47,600	235,200	16.8%	83.2%
Oct-23	280,400	45,100	235,200	16.1%	83.9%
Nov-23	286,700	44,000	242,700	15.4%	84.6%
Dec-23	285,400	44,900	240,600	15.7%	84.3%

Date	Unique vehicles detected in 2023 expanded ULEZ zone[49]	Number of non-compliant vehicles	Number of compliant vehicles	Proportion of non-compliant vehicles	Proportion of compliant vehicles
Jan-24	277,900	39,200	238,700	14.1%	85.9%
Feb-24	290,200	41,200	249,100	14.2%	85.8%
Change between June 2023 and February 2024	-42,000	-62,000	20,000	-16.9 ppt	+16.9 ppt
% Change in vehicles between June 2023 and February 2024	-13%	-60%	9%	N/A	N/A

ppt - Percentage points

Table 35: Daily average number and proportion of ULEZ compliant vans (N1) detected in the expanded outer London area per month (rounded to nearest 100)

Date	Unique vehicles detected in 2023 expanded ULEZ zone[49]	Number of non-compliant vehicles	Number of compliant vehicles	Proportion of non-compliant vehicles	Proportion of compliant vehicles
May-22	113,300	35,000	78,300	30.9%	69.1%
Nov-22	141,400	31,400	110,000	22.2%	77.8%
May-23	183,800	39,000	144,700	21.2%	78.8%
Jun-23	201,100	41,200	160,000	20.5%	79.5%
Jul-23	194,000	38,300	155,600	19.8%	80.2%
Aug-23	190,600	35,200	155,500	18.5%	81.5%
Sep-23	191,300	26,400	164,900	13.8%	86.2%
Oct-23	193,500	25,400	168,100	13.1%	86.9%
Nov-23	203,800	25,500	178,300	12.5%	87.5%
Dec-23	169,500	20,500	149,100	12.1%	87.9%

Date	Unique vehicles detected in 2023 expanded ULEZ zone[49]	Number of non-compliant vehicles	Number of compliant vehicles	Proportion of non-compliant vehicles	Proportion of compliant vehicles
Jan-24	189,900	20,800	169,100	11.0%	89.0%
Feb-24	204,000	22,400	181,600	11.0%	89.0%
Change between June 2023 and February 2024	2,900	-18,800	21,600	-9.5 ppt	+ 9.5 ppt
% Change in vehicles between June 2023 and February 2024	1%	-46%	14%	N/A	N/A

ppt - Percentage points

Table 36: Daily average number and proportion of ULEZ compliant minibuses detected in the expanded outer London area per month (rounded to nearest 10)

Date	Unique vehicles detected in 2023 expanded ULEZ zone[49]	Number of non-compliant vehicles	Number of compliant vehicles	Proportion of non-compliant vehicles	Proportion of compliant vehicles
May-22	1,350	420	940	30.8%	69.2%
Nov-22	1,540	400	1,140	26.0%	74.0%
May-23	2,190	540	1,660	24.5%	75.5%
Jun-23	2,530	620	1,910	24.6%	75.4%
Jul-23	2,100	550	1,550	26.2%	73.8%
Aug-23	1,450	400	1,060	27.2%	72.8%
Sep-23	2,230	480	1,750	21.3%	78.7%
Oct-23	2,140	460	1,680	21.5%	78.5%
Nov-23	2,560	520	2,040	20.2%	79.8%
Dec-23	1,840	390	1,450	21.3%	78.7%

Date	Unique vehicles detected in 2023 expanded ULEZ zone[49]	Number of non-compliant vehicles	Number of compliant vehicles	Proportion of non-compliant vehicles	Proportion of compliant vehicles
Jan-24	2,190	430	1,760	19.7%	80.3%
Feb-24	2,260	440	1,810	19.6%	80.4%
Change between June 2023 and February 2024	-270	-180	-100	-4.9 ppt	+ 4.9 ppt
% Change in vehicles between June 2023 and February 2024	-11%	-29%	-5%	N/A	N/A

Table 37: Daily average number and proportion of ULEZ compliant motorcycles (L) detected in the expanded outer London area per month (rounded to nearest 10)

Date	Unique vehicles detected in 2023 expanded ULEZ zone[49]	Number of non-compliant vehicles	Number of compliant vehicles	Proportion of non-compliant vehicles	Proportion of compliant vehicles
May-23[50]	23,590	1,000	22,580	4.2%	95.8%
Jun-23	28,060	1,220	26,840	4.4%	95.6%
Jul-23	27,420	1,150	26,270	4.2%	95.8%
Aug-23	27,650	1,110	26,540	4.0%	96.0%
Sep-23	28,330	960	27,370	3.4%	96.6%
Oct-23	28,020	890	27,130	3.2%	96.8%
Nov-23	28,110	880	27,240	3.1%	96.9%
Dec-23	24,760	760	24,000	3.1%	96.9%

[50] Data on motorcycles available from May 2023 following enhancements to the camera network in preparation for London-wide ULEZ scheme. Data for May 2023 included the first data available from some cameras installed as part of the network changes, as well as bank holidays (including the coronation).

Date	Unique vehicles detected in 2023 expanded ULEZ zone[49]	Number of non-compliant vehicles	Number of compliant vehicles	Proportion of non-compliant vehicles	Proportion of compliant vehicles
Jan-24	25,970	770	25,190	3.0%	97.0%
Feb-24	28,870	860	28,010	3.0%	97.0%
Change between June 2023 and February 2024	810	-360	1,170	-1.4 ppt	+ 1.4 ppt
% Change in vehicles between June 2023 and February 2024	3%	-29%	4%	N/A	N/A

ppt - Percentage points (ppt)

Appendix 2 – Air quality emissions results

Emissions Trends

The emission section in the main body of the report isolated the impacts of the London-wide ULEZ expansion on NO_X and $PM_{2.5}$ emissions, using a comparison with a scenario where there was "No London-wide expansion" of the ULEZ in 2023. This section provides annual trend data from 2022 and 2023. It is worth noting that this comparison includes natural vehicle fleet turnover and therefore changes in emissions between 2022 and 2023 are not the impact of the London-wide ULEZ expansion. Emissions rates in 2022 reflect the observed data and include the operation of the previous expansion of the ULEZ to inner London (which operated to up to the North and South Circulars).

Table 38 provides the emissions for NO_X from cars (excluding PHVs) and vans in 2022 and 2023 (with the London-wide ULEZ expansion), and Table 39 provides the changes in NO_X emissions. Table 40 provides the $PM_{2.5}$ exhaust emissions from cars (excluding PHVs) and vans in 2022 and 2023 (with the London-wide ULEZ expansion), and Table 41 provides the changes in $PM_{2.5}$ exhaust emissions.

Table 38: NO_X emissions (tonnes) from cars (excluding PHVs) and vans in 2022 and 2023 (with the London-wide ULEZ expansion)

London Zone	2022 - Cars	2022 - Vans	2022 - Cars and Vans	LWULEZ 2023 - Cars	LWULEZ 2023 - Vans	LWULEZ 2023 - Cars and Vans
Central	23	55	78	19	45	64
Inner	595	718	1,313	551	630	1,181
Outer	2,529	2,146	4,675	1,906	1,683	3,590
London-wide	3,147	2,919	6,066	2,476	2,358	4,834

Table 39: Change in NO_X emissions (tonnes and percentage) between 2022 and 2023 (with the London-wide ULEZ expansion)

London Zone	Change in Emissions (Tonnes) - Cars	Change in Emissions (Tonnes) - Vans	Change in Emissions (Tonnes) - Cars and Vans	Change in Emissions (%) - Cars	Change in Emissions (%) - Vans	Change in Emissions (%) - Cars and Vans
Central	-4	-10	-14	-16%	-19%	-18%
Inner	-45	-88	-132	-7%	-12%	-10%
Outer	-623	-462	-1,086	-25%	-22%	-23%

London Zone	Change in Emissions (Tonnes) - Cars	Change in Emissions (Tonnes) - Vans	Change in Emissions (Tonnes) - Cars and Vans	Change in Emissions (%) - Cars	Change in Emissions (%) - Vans	Change in Emissions (%) - Cars and Vans
London-wide	-671	-561	-1,232	-21%	-19%	-20%

Table 40: $PM_{2.5}$ exhaust emissions (tonnes) from cars (excluding PHVs) and vans in 2022 and 2023 (with the London-wide ULEZ expansion)

London Zone	2022 - Cars	2022 - Vans	2022 - Cars and Vans	LWULEZ 2023 - Cars	LWULEZ 2023 - Vans	LWULEZ 2023 - Cars and Vans
Central	0.2	0.2	0.4	0.2	0.2	0.3
Inner	4.6	2.9	7.6	4.2	2.3	6.5
Outer	24.1	9.8	33.9	15.8	6.2	22.0
London-wide	28.9	12.9	41.9	20.2	8.7	28.8

Table 41: Change in $PM_{2.5}$ exhaust emissions (tonnes and percentage) between 2022 and 2023 (with the London-wide ULEZ expansion)

London Zone	2022 - Cars	2022 - Vans	2022 - Cars and Vans	LWULEZ 2023 - Cars	LWULEZ 2023 - Vans	LWULEZ 2023 - Cars and Vans
Central	-0.0	-0.0	-0.1	-18%	-18%	-18%
Inner	-0.4	-0.6	-1.0	-10%	-20%	-14%
Outer	-8.3	-3.6	-11.9	-34%	-37%	-35%
London-wide	-8.8	-4.3	-13.0	-30%	-33%	-31%

Emissions for 2023 are much lower than in 2022 with a reduction of 20 per cent in car and van NO_X emissions across all of London. Emissions of $PM_{2.5}$ from exhausts of cars and vans in London are also estimated to have reduced by 31 per cent London-wide as a result of improvements in the vehicle fleet and use of cleaner vehicles.

Appendix 3 – Air quality concentrations methodology

Air pollution monitoring concentrations

All air quality data analysis was performed using the open-source statistical software R[51]. Air pollutant monitoring data from approximately 800 real time monitoring analysers across England were initially considered from national and local air quality monitoring networks[52]. The full list of monitoring sites considered is provided in the Supplementary Data Sheet published alongside this Six Month Report.

Hourly concentrations from these sites, if available, were obtained using the R package openair[53], which provides convenient functions to query the key air quality monitoring networks in operation across the UK and download data in bulk, including historical data.

From this extensive dataset of hourly monitoring concentrations, average monthly concentrations have been calculated for each site over the period 2010 to 2024. This report focuses on the results between 2014 and 2024 representing a 10-year period. Monitoring sites have then been grouped by site type to calculate average “Roadside” and “Urban Background” concentrations. For this analysis “Suburban” or “Urban Centre” sites have been treated as “Urban Background”. “Kerbside”, “Industrial”, “Airport” or “Rural” sites have been excluded from the analysis, as they are fewer in number and not typical of population exposure.

Roadside sites are typically within one to five metres of a busy road and usually located close to adult breathing height. Roadside sites enable us to track and understand changes in air pollution concentrations from traffic. These sites give the best estimate of public exposure on busy roads. Roadside sites are useful for identifying air quality hotspots caused by traffic that may have potential health impacts, especially those areas frequented by large numbers of people travelling on the road or pavement or where homes are close to the kerb.

Urban background sites are located further away from the main sources of emissions and are not influenced by one single nearby pollution source. In London, and most of the rest of England, traffic is the main source for background sites to avoid being influenced by and

[51] https://www.r-project.org/
[52] Air quality monitoring stations are run and managed by a variety of different organisations including national and locally-funded sites. There are many reasons why air quality monitoring stations open and close over time, including changing the location to prioritise local hotspots, changes to funding, or meeting legal compliance meaning monitoring is no longer required.
[53] https://cran.r-project.org/web/packages/openair/index.html

there are guidelines about how close background sites can be to roads[54]. The benefit of urban background sites is that they are usually representative of air pollution exposure for the wider population.

Additionally, monitoring sites have been grouped by geographical areas to calculate average concentrations for key locations, as follows:

- Central, inner and outer London.
- A 0–5 km zone around Greater London, recognising this area is close to the boundary of the London-wide ULEZ.
- A 5–40 km zone around Greater London which provides a control comparison for outer London.
- Rest of England (sites beyond 40 km from Greater London) representing wider trends in England.

Air pollution concentrations are highly sensitive to the prevailing meteorology, such as wind speed, wind direction, precipitation, and temperature, as well as the associated long-range transport of pollutants from outside London. Many pollutants also have a seasonal cycle. This seasonal cycle may be caused by seasonally varying emissions, such as heating in the winter or agricultural emissions during the spring. Seasonal cycles can also be caused by other factors, including sunlight, that can induce chemical reactions between air pollutants, and meteorological conditions hindering dispersal. These seasonal and day-to-day variations can make it difficult to assess short-term trends and the impact of interventions such as the ULEZ. One approach to minimise the impact of these variations is to consider a sufficiently long time period. Another is to use statistical methods to smooth out short-term variability, which helps to reduce the impact of weather and seasonal factors.

In line with previous reports, statistical smoothing of the monthly means was carried out using the LOESS (Locally Estimated Scatterplot Smoothing) curve fitting methodology, a type of local polynomial regression, to reduce the impacts of weather and seasonal

[54] London Local Air Quality Management (LLAQM) Technical Guidance 2019. Available at: llaqm_technical_guidance_2019.pdf (london.gov.uk)

changes in the long-term trend data. The smoothing was applied to the average monthly concentrations, using a span parameter[55] of 0.375, in line with previous ULEZ reports.

Over the period covered by the analysis, a number of monitoring stations have opened, moved, or closed, whilst others may have experienced issues that led to missing data, such as power outages.

In order to remove potential outliers and reduce noise in the averaging and smoothing of the data, a number or rules have been applied to the dataset, as follows:

- A data capture threshold of 75 per cent was applied to the dataset when calculating monthly averages from hourly mean concentrations. This means that, for any given month, if there was less than 75 per cent valid hourly concentrations within that month at a site (i.e. more than 25 per cent data was missing or not reported for any reason), the monthly average was not calculated for that site.
- To avoid / reduce the effect of closed / new sites in operation on the zonal averages, any site with less than three years' worth of data in the period covered by the analysis was removed from the analysis.

As a key aspect of the analysis was to determine the preliminary impacts of the London-wide ULEZ, any NO_2 monitoring site that started operation or was closed after March 2023 was removed from the analysis, to avoid skewing the impact analysis.

[55] The span parameter of the LOESS methodology controls the number of datapoints used to smooth the data, and therefore the degree of smoothing. If the span is too small, it can result in insufficient data to determine an accurate fit, resulting in a large variance. If the span is too large, the regression will be over-smoothed, resulting in a loss of information.

Figure 12 provides a map of the London zones and the location of both roadside and urban background monitoring sites that have been used in the analysis.

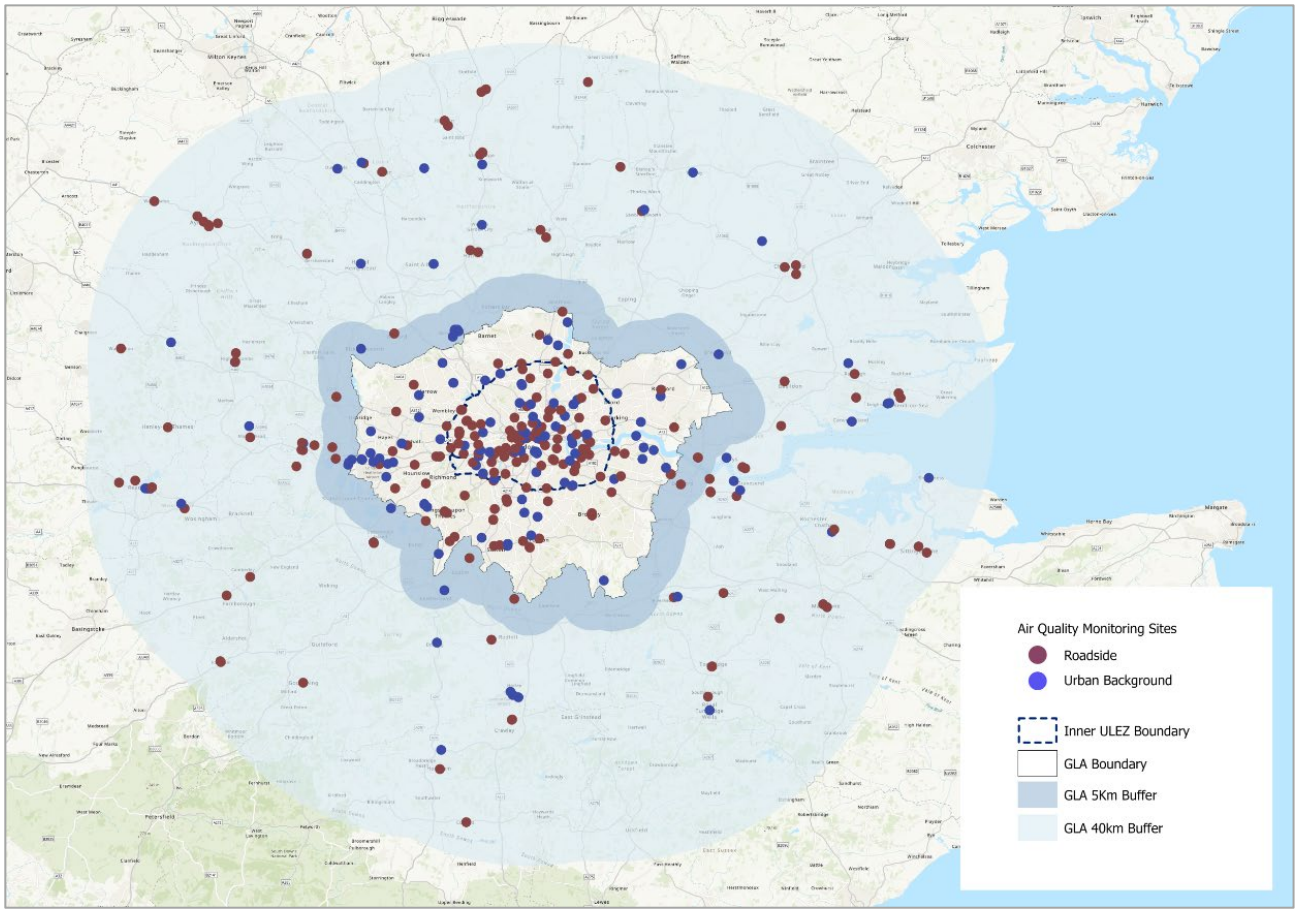

Figure 12: Map of London showing the location of roadside and urban background monitoring sites that were used in the analysis.

Table 42 shows the final number of sites used in the analysis, by pollutant, site type, and area, based on the rules described above. The total number of sites used in the analysis (roadside and urban background) is 381 for NO_2 and 138 for $PM_{2.5}$.

Table 42: Summary of the roadside and urban background monitoring sites used in the analysis

Area	Roadside NO_2	Roadside $PM_{2.5}$	Urban Background NO_2	Urban Background $PM_{2.5}$
Central London	4	2	4	5
Inner London	38	16	12	6
Outer London	27	8	23	13
5 km from GLA Boundary	6	1	6	7
5-40 km from GLA Boundary	41	9	15	2
Beyond 40 km from GLA	143	32	62	37
Total used in analysis	**259**	**68**	**122**	**70**

Methodology to estimate the "No ULEZ" scenario

The method used in this report to estimate the trend in concentrations across London if the ULEZ had not been implemented is based on a similar approach used in the earlier central and inner London ULEZ monitoring reports. The use of control sites, and an estimated "No ULEZ" scenario, are fundamentally required, as observed data will always represent the situation with the ULEZ being in operation. This method also recognises that a general trend of improvement in concentrations would normally be expected even without the ULEZ because there is natural fleet churn, whereby older vehicles drop out of the fleet and newer cleaner vehicles come into it over time.

It notably uses the notion of “road increment” concentration at roadside sites (described in more detail further below). The road increment is defined as the total concentration observed at roadside sites, minus the background concentration. Removing the background component from roadside concentration allows for the isolation of the traffic related component, or signal, within observed concentrations.

The average changes in road increment in areas unlikely to be affected by the ULEZ have been applied to the London zones (central, inner, outer) to estimate the likely trend in concentration, assuming the ULEZ was not in place.

The previous ULEZ reports used the following principles:

- Monitored data from air quality monitoring stations have been used as the basis for all analysis.
- Outer London serves as a suitable control area against which to assess the impact of the central and inner London ULEZ.
- The changes in road increment of NO_2 in outer London (subtracting outer urban background concentrations from total roadside concentrations in outer London) represented the trend that would be expected without the ULEZ package of measures.
- Concentrations for a “No ULEZ” scenario are estimated against which to assess observed changes in concentration trends.

In addition to the above principles, in order to assess the impact of the third phase of the ULEZ (the expansion to include outer London), for this analysis, a further control zone between 5-40 km of London has been added.

Monitoring trends from the area between 5-40 km from London have been considered suitable to enable an assessment of the impacts in outer London and in the immediate 0-5 km around the boundary. The 5-40 km control zone was chosen because:

- It does not include sites immediately around the boundary of the ULEZ.
- It excludes sites in the south of England that are affected by different local meteorological conditions especially on the coast.
- Meteorological and regional background influences in this surrounding area are similar to those for London, which is unlikely to be the case for the rest of England.

NO_2 road increment calculations

A technique often used to isolate the proportion of pollution related to traffic sources is to subtract the background concentration from the roadside concentration. The resulting concentration is referred to as the "roadside increment"[56]. This roadside increment isolates the changes in concentration at the roadside from changes in background concentrations, using the equation below:

$$R_{inc} = roadside\ concentration - urban\ background\ concentration$$

This removes the impact of changes over time due to processes at the regional scale (such as meteorological conditions, boundary layer dynamics, policies outside the city, etc.) as described in more detail by Lenschow et al[57] and Font and Fuller[56] in a London context.

The average NO_2 road increment was calculated separately for each area considered in the analysis, based on statistical smoothing of the roadside and urban background monthly means, as follows:

- **Central / inner London:** The average urban background concentration in outer London was subtracted from the average roadside concentrations in these zones.
- **Outer London / 0-5 km zone from London / 5-40 km zone from London:** The average urban background concentration in the 5-40 km zone from Greater London was subtracted from the average roadside concentrations in these zones.
- **Rest of England:** The average urban background concentration in the area beyond 40 km from Greater London (all monitoring sites in England except those within 40 km from London) was subtracted from the average roadside concentration in that zone.

Figure 13 shows that road increment has reduced across all areas, but especially in London zones. Trends in the road increment around the boundary of Greater London (and the ULEZ area) are more variable but overall show reductions with little difference from inner and outer London across 2023. However, the 5 km boundary analysis is based on fewer sites, meaning conclusions must be treated with caution. The road increment in the

[56] Font, A. & Fuller, G. (2016) Did policies to abate atmospheric emissions from traffic have a positive effect in London? Environmental Pollution, Volume 218, November 2016, Pages 463-474
[57] Lenschow et al, Some ideas about the sources of PM_{10}, 2001

rest of England (beyond 40 km from London) is generally slightly higher than areas within 40 km of London, which may be due to the higher number of monitoring sites from large urban areas in the rest of England. The average road increment for the rest of England zone is historically lower than London, but the data suggests there has been little improvement with a very flat trend over the last 10 years. Data also suggests that the average road increment in London is now very similar to the average for the rest of England as substantial reductions have occurred across all zones in London.

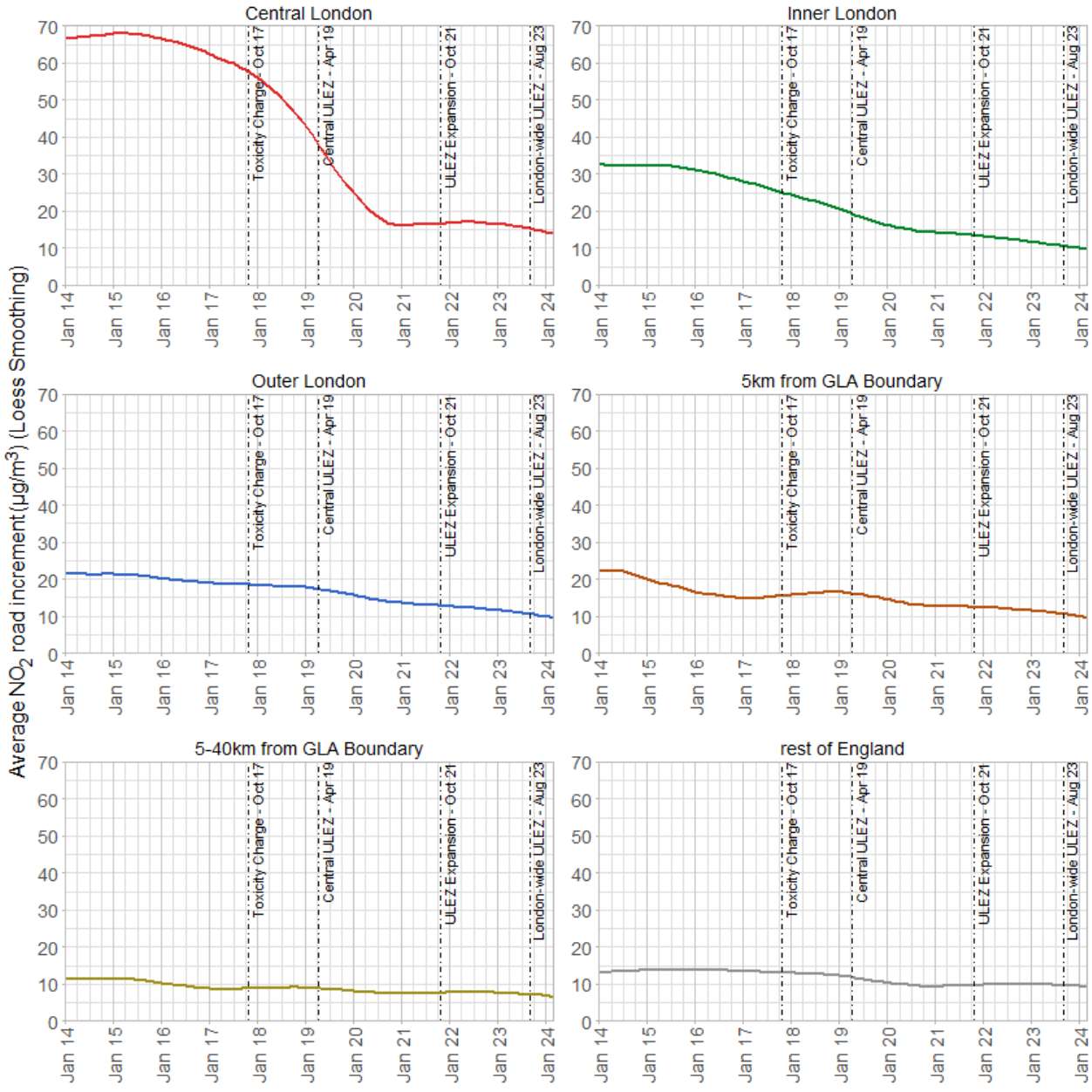

Figure 13: LOESS trend of average NO_2 road increment (traffic component) concentrations

Estimated road increment for the "No ULEZ" and "No London-wide ULEZ" scenarios

Following the calculation of the road increment in each zone as described above, the road increment for the "No ULEZ" and "No London-wide ULEZ" scenarios were estimated for each zone as follows:

- **Central / inner London:** Remaining consistent with previous reporting, changes in the average road increment in outer London have been used to represent the changes that would have occurred to the road increment in a "No ULEZ" scenario for central and inner London. This is a limitation of this approach, as it means that additional impacts in central and inner zones due to the London-wide expansion of the ULEZ may be missed, since any improvements would be included in the changes in roadside increment for outer London. Additionally, and as in previous reports, policies including the LEZ and other transport schemes have also been implemented in outer London. Therefore, changes in air quality in outer London are not solely due to natural turnover over the fleet. It is more likely that impacts are underestimated rather than overestimated and, therefore, the results represent a conservative approach to the assessment of the impacts of the ULEZ.

- **Outer London:** Changes in the average road increment concentrations in the 5-40 km zone from London have been used to represent the change that would have happened in a "No ULEZ" scenario for sites in outer London and for the zone within 5 km of London, which represents boundary sites outside the London-wide ULEZ. The 5-40 km zone is largely away from the influence of the earlier central and inner London ULEZ phases, although there may be some influence due to the recently expanded London-wide ULEZ. It also includes improvements that would have been expected as part of natural turnover. A potential limitation of using the 5-40 km zone is that the LEZ and London-wide ULEZ, as well as other transport schemes such as local interventions, may have had some impact on the road traffic component in these areas and this could be included in the analysis. However, compared to the rest of England, this zone is generally affected by similar meteorological and regional background influences as outer London. Therefore, the 5-40 km zone, rather than the rest of England, is considered to be a suitable control group to assess the impacts of the ULEZ in outer London.

The above change in road increment is calculated from January 2017 onward for the "No ULEZ" scenario, and from December 2022 onward for the "No London-wide ULEZ" scenario. December 2022 chosen as this is after the London-wide ULEZ was confirmed

and allows for pre-compliance where vehicle owners may start to prepare for the upcoming scheme.

For each London zone, the estimated road increment for any subsequent month *i* beyond the relevant started point was calculated as follows:

- For the “No ULEZ” scenario:

$$R_{inc}^{central/inner\ no\ ulez}{}_{i} = R_{inc}^{central/inner}{}_{Jan2017} - \left(R_{inc}^{outer}{}_{Jan2017} - R_{inc}^{outer}{}_{i} \right)$$

$$R_{inc}^{outer\ no\ ulez}{}_{i} = R_{inc}^{outer}{}_{Jan2017} - \left(R_{inc}^{5-40km\ from\ London}{}_{Jan2017} - R_{inc}^{5-40km\ from\ London}{}_{i} \right)$$

- For the “No-London-wide ULEZ” scenario:

$$R_{inc}^{outer\ no\ londonwide\ ulez}{}_{i} = R_{inc}^{outer}{}_{Dec2022} - \left(R_{inc}^{5-40km\ from\ London}{}_{Dec2022} - R_{inc}^{5-40km\ from\ London}{}_{i} \right)$$

Finally, the total roadside concentrations for the “No ULEZ” and “No London-wide ULEZ” scenarios are calculated by adding back the relevant average urban background concentration discussed above to the estimated road increment concentrations.

Now that the ULEZ operates London-wide, impacts have also been assessed for London as a whole. This has been undertaken by estimating the changes in road increment at each monitoring site and then taking an average of them all to obtain the London average.

Assessment of impacts

Comparison of the trends based on observed measurements to the estimated “No ULEZ” or “No London-wide ULEZ” trend in each zone reveals the additional impacts of all ULEZ policies and the London-wide ULEZ expansion specifically.

Limitations

The ULEZ is one of many policies to reduce air pollution from road transport and other sources in London. Other local policies include the London-wide LEZ (for heavy vehicles); investment in cleaner buses and taxis; the Low Emission Zone for non-road mobile machinery and planning policies; and supporting local traffic reduction and air quality projects, alongside wider policies such as the progressively tighter European exhaust

controls for new vehicles. As a result, it is not straightforward to isolate the impact of the ULEZ and its expansion.

Air quality monitoring is affected by seasonality due to variation in activity from pollution sources and meteorological conditions which affects the dispersion of pollutants. Statistical smoothing of variations over short-term periods is used to reduce fluctuations and noise in the data in order to focus on long term trends.

Key amongst the strengths is the ease of analysis, allowing data to be analysed as it becomes available (once a suitable amount of time has passed), along with the large number of measurement sites involved, especially in London. Despite the rules applied to the monitoring data (75 per cent data capture minimum, dismiss sites with less than 3 years of data), the change in the number of roadside and urban background monitoring sites available for each month across each zone may have an influence on the trendlines but the overall number of sites reduces this impact. Monthly average concentrations were used to calculate trends in the period from 2010 to the end of February 2024. It should be noted that measurement data from 2024 and some measurement data from late 2023 has not yet been ratified which may affect specific sites but due to large number of sites used this impact should be minimised.

Grouping of monitoring sites is used to obtain average trendlines and impacts for each zone, but there will be variation at individual sites depending on local conditions. This could be if a site was affected by major roadworks which would not be reflected in the zonal average.

Using control zones as a means for detecting the difference in trends has both strengths and weaknesses. The key weakness stems from differences in the vehicle fleets in the ULEZ compared with outside London. Traffic in London has a greater proportion of certain vehicle types, such as taxis, PHVs and buses, and proportionally fewer private cars compared to outside London - although this tends to be more of the case for central and inner London than outer London. The method used here recognises these issues and, therefore, a control zone outside of London has been used for outer London. A further weakness of the method is that there are no major urban areas within the 5–40 km from London zone. However, the need to consider prevailing meteorological conditions has been the determining consideration and the use of data which is geographically close to London also acts, to some extent, as a control for the weather and seasonal factors that can confound this type of analysis.

Appendix 4 – Air quality concentrations results

Air quality trends

Table 43 summarises the annual average NO_2 concentrations at roadside and urban background sites, this data is visualised in Figure 6 within the main body of the report.

Table 43: Annual average NO_2 concentrations at roadside and urban background sites by zone based on the statistically smoothed trends analysis in Figure 6

Location and site type	Average NO_2 in 2017 ($\mu g/m^3$)	Average NO_2 in 2023 ($\mu g/m^3$)	Change between 2017 and 2023 ($\mu g/m^3$)	Change between 2017 and 2023 (per cent)
Central Roadside	88	34	-55	-62%
Inner Roadside	55	29	-26	-47%
Outer Roadside	44	26	-18	-41%
All London Roadside	53	28	-24	-46%
5 km from GLA boundary Roadside	41	26	-15	-36%
5-40 km from GLA boundary Roadside	34	22	-12	-34%

Location and site type	Average NO_2 in 2017 ($\mu g/m^3$)	Average NO_2 in 2023 ($\mu g/m^3$)	Change between 2017 and 2023 ($\mu g/m^3$)	Change between 2017 and 2023 (per cent)
Rest of England Roadside	33	24	-9	-27%
Central Background	37	22	-15	-42%
Inner Background	29	17	-12	-41%
Outer Background	29	18	-11	-37%
All London Background	30	18	-12	-39%
5 km from GLA boundary Background	27	17	-10	-38%
5-40 km from GLA boundary Background	25	15	-10	-41%
Rest of England Background	20	14	-5	-27%

Table 44 summarises the annual average $PM_{2.5}$ concentrations at roadside and urban background sites, this data is visualised in Figure 7 within the main body of the report.

Table 44: Annual average $PM_{2.5}$ at roadside sites by zone and site type, based on statistically smoothed trends analysis in Figure 7

Location and site type	Annual average $PM_{2.5}$ in 2017 ($\mu g/m^3$)	Average $PM_{2.5}$ in 2023 ($\mu g/m^3$)	Change between 2017 and 2023 ($\mu g/m^3$)	Change between 2017 and 2023 (per cent)
Central Roadside	16	10	-7	-40%
Inner Roadside	14	9	-5	-37%
Outer Roadside	13	9	-4	-29%
All London Roadside	14	9	-5	-35%
5 km from GLA boundary Roadside	11	8	-3	-30%
5-40 km from GLA boundary Roadside	12	9	-3	-23%
Rest of England Roadside	10	8	-3	-25%
Central Background	13	8	-5	-36%

Location and site type	Annual average $PM_{2.5}$ in 2017 ($\mu g/m^3$)	Average $PM_{2.5}$ in 2023 ($\mu g/m^3$)	Change between 2017 and 2023 ($\mu g/m^3$)	Change between 2017 and 2023 (per cent)
Inner Background	11	8	-3	-25%
Outer Background	11	7	-3	-31%
All London Background	11	8	-3	-29%
5 km from GLA boundary Background	8	7	-1	-16%
5-40 km from GLA boundary Background	11	7	-3	-30%
Rest of England Background	10	8	-3	-25%

Air quality impact analysis

Table 45 summarises the early impacts of the London-wide ULEZ, this data is visualised in Figure 8 within the main body of the report. The monthly concentrations for the observed trends are compared against the “No London-wide ULEZ” scenario for the first six months of the scheme to provide indicative impacts so far. Further analysis will be undertaken once more air pollution data is available and this will be presented in the One Year Report.

Table 45: Estimated impact of the expansion of London-wide ULEZ on roadside NO_2 concentrations in outer London based on trends analysis

Date	Actual (Monitored) (µg/m^3)	No LWULEZ (Estimated) (µg/m^3)	Impact (µg/m^3)	Impact (per cent)
Dec-22	27.8	27.8	0.0	0.0%
Jan-23	27.5	27.6	-0.1	-0.4%
Feb-23	27.3	27.4	-0.1	-0.4%
Mar-23	27.0	27.3	-0.3	-1.1%
Apr-23	26.8	27.1	-0.3	-1.1%
May-23	26.5	26.9	-0.4	-1.5%
Jun-23	26.2	26.6	-0.4	-1.5%
Jul-23	25.9	26.4	-0.5	-1.9%
Aug-23	25.5	26.2	-0.7	-2.7%
Sep-23	25.2	25.9	-0.7	-2.7%
Oct-23	24.9	25.6	-0.7	-2.7%
Nov-23	24.5	25.4	-0.9	-3.5%

Date	Actual (Monitored) (µg/m^3)	No LWULEZ (Estimated) (µg/m^3)	Impact (µg/m^3)	Impact (per cent)
Dec-23	24.1	25.1	-1.0	-4.0%
Jan-24	23.7	24.8	-1.1	-4.4%
Feb-24	23.4	24.4	-1.0	-4.1%

Table 46: Estimated impact of the expansion of London-wide ULEZ on roadside NO_2 concentrations in the zone 0-5 km from London based on trends analysis

Date	Actual (Monitored) (µg/m^3)	No LWULEZ (Estimated) (µg/m^3)	Impact (µg/m^3)	Impact (per cent)
Dec-22	27.7	27.7	-0.0	-0.0%
Jan-23	27.5	27.5	-0.0	-0.0%
Feb-23	27.2	27.3	-0.1	-0.4%
Mar-23	27.0	27.2	-0.2	-0.7%
Apr-23	26.7	27.0	-0.3	-1.1%
May-23	26.5	26.8	-0.3	-1.1%

Date	Actual (Monitored) (µg/m^3)	No LWULEZ (Estimated) (µg/m^3)	Impact (µg/m^3)	Impact (per cent)
Jun-23	26.2	26.5	-0.3	-1.1%
Jul-23	25.9	26.3	-0.4	-1.5%
Aug-23	25.6	26.1	-0.5	-1.9%
Sep-23	25.3	25.8	-0.5	-1.9%
Oct-23	24.9	25.5	-0.6	-2.4%
Nov-23	24.6	25.3	-0.7	-2.8%
Dec-23	24.2	25.0	-0.8	-3.2%
Jan-24	23.9	24.7	-0.8	-3.2%
Feb-24	23.5	24.3	-0.8	-3.3%

Table 47 summarises the monthly impacts in outer London estimated for all phases of the ULEZ, compared to those for the London-wide ULEZ on its own during the months of operation of the London-wide ULEZ. Dividing the change attributed to just the London-wide ULEZ by the overall impact in each month gives the relative contribution of the London-wide ULEZ to reductions in NO_2 concentrations in outer London. This shows that the London-wide ULEZ represents 10 to 15 per cent of the overall NO_2 impacts in outer London in first six months of operation.

Table 47: Proportion of impacts on NO_2 concentrations in outer London attributed to London-wide ULEZ.

Date	Overall Impact due to ULEZ (µg/m^3)	Impact due to LWULEZ (µg/m^3)	Proportion of overall impact attributed to LWULEZ
Sep-23	-6.9	-0.7	10%
Oct-23	-6.9	-0.7	10%
Nov-23	-7.1	-0.9	13%
Dec-23	-7.2	-1.0	14%
Jan-24	-7.3	-1.1	15%
Feb-24	-7.2	-1.0	14%

Figure 14 shows the impacts of the London-wide ULEZ for London as a whole.

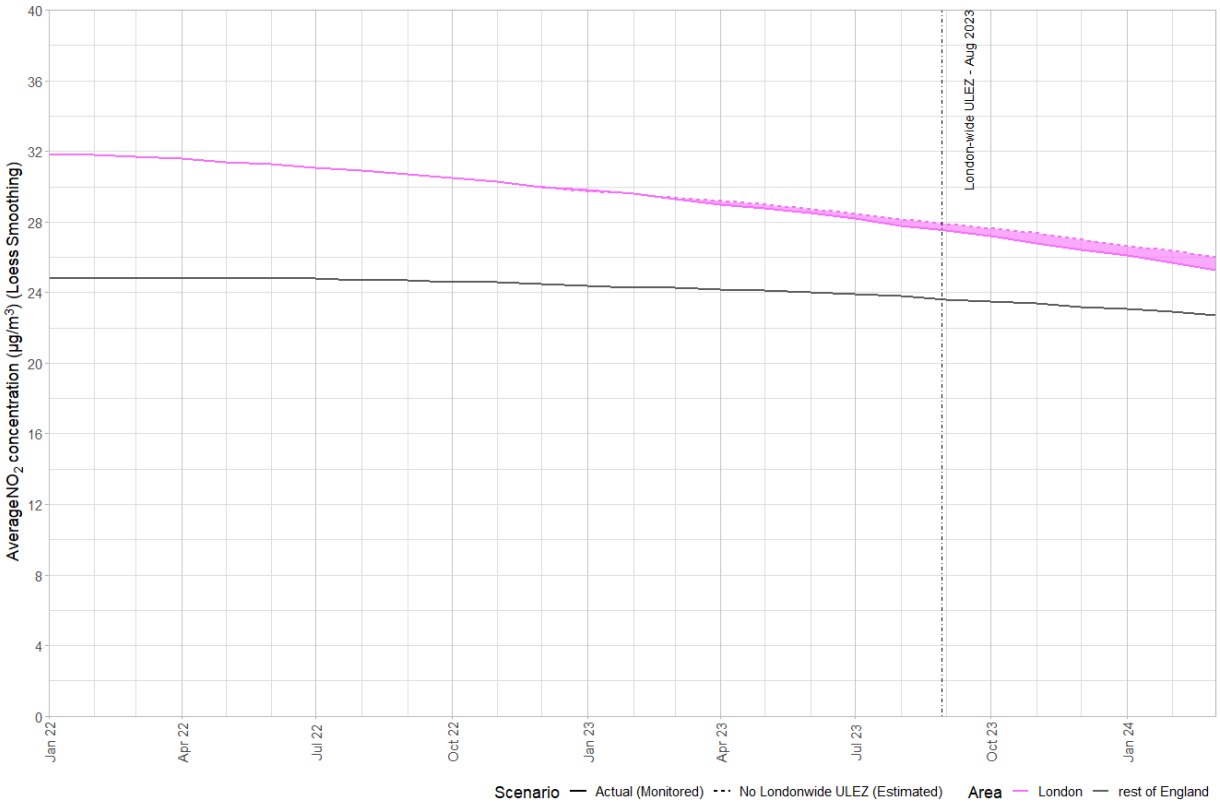

Figure 14: Trends in monthly average roadside NO_2 concentrations London-wide (with and without LWULEZ) compared to outside London

The data that underpins Figure 14 is in Table 48. The analysis of trends of average roadside concentrations for the whole of London indicates that the London-wide ULEZ has reduced roadside NO_2 concentrations by 1.5 – 2.5 per cent. This is equivalent to a reduction of 0.4 - 0.6 µg/m^3. Improvements in NO_2 concentrations are highest in outer London, ranging between 0.7 – 1.1 µg/m^3 in the first six months of the scheme operating.

The difference between the monitored trend and the “No ULEZ” scenario for London as a whole demonstrates that the London-wide ULEZ and associated policies have had a transformative impact on reducing NO_2 levels across the Greater London area.

Table 48: Estimated impact of London-wide ULEZ on roadside NO_2 concentrations in London as a whole based on trends analysis

Month	Actual (Monitored) ($\mu g/m^3$)	No LWULEZ (Estimated) ($\mu g/m^3$)	Impact ($\mu g/m^3$)	Impact (per cent)
Sep-23	27.5	27.9	-0.4	-1.5%
Oct-23	27.2	27.6	-0.4	-1.5%
Nov-23	26.8	27.3	-0.5	-2.0%
Dec-23	26.4	27.0	-0.6	-2.2%
Jan-24	26.1	26.6	-0.5	-1.9%
Feb-24	25.7	26.3	-0.6	-2.5%

Appendix 5 – Indexed traffic flows

Figure 15 shows the indexed traffic flows for central, expanded inner, expanded outer and London-wide ULEZ areas. This data is also summarised in Table 49 to Table 52.

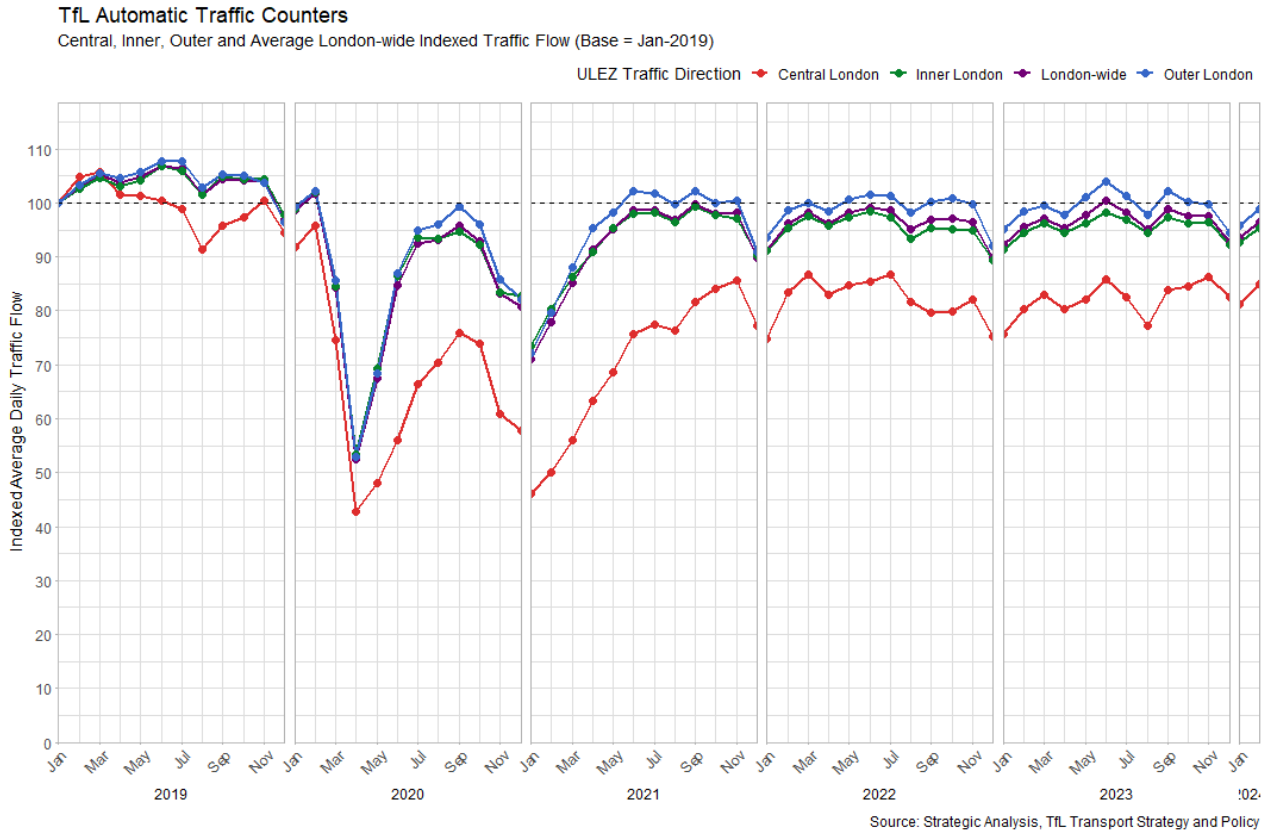

Figure 15: Indexed traffic flows for central, expanded inner, expanded outer and London-wide ULEZ areas

Table 49: Indexed monthly traffic in central ULEZ area (Indexed to January 2019)[58]

Central ULEZ	2019	2020	2021	2022	2023	2024
Jan	1.00	0.92	0.46	0.75	0.76	0.81
Feb	1.05	0.96	0.50	0.83	0.80	0.85
Mar	1.06	0.74	0.56	0.87	0.83	ND
Apr	1.02	0.43	0.63	0.83	0.80	ND
May	1.01	0.48	0.69	0.85	0.82	ND
Jun	1.01	0.56	0.76	0.85	0.86	ND
Jul	0.99	0.66	0.77	0.87	0.83	ND

[58] ND means No Data

Central ULEZ	2019	2020	2021	2022	2023	2024
Aug	0.91	0.7	0.76	0.82	0.77	ND
Sep	0.96	0.76	0.82	0.80	0.84	ND
Oct	0.97	0.74	0.84	0.80	0.85	ND
Nov	1.00	0.61	0.86	0.82	0.86	ND
Dec	0.95	0.58	0.77	0.75	0.82	ND

Table 50: Indexed monthly traffic in expanded inner ULEZ area (Indexed to January 2019)[58]

Expanded Inner	2019	2020	2021	2022	2023	2024
Jan	1.00	0.99	0.73	0.91	0.91	0.93
Feb	1.03	1.02	0.8	0.95	0.94	0.95
Mar	1.05	0.85	0.86	0.98	0.96	ND
Apr	1.03	0.53	0.91	0.96	0.94	ND
May	1.04	0.69	0.95	0.97	0.96	ND
Jun	1.07	0.87	0.98	0.98	0.98	ND
Jul	1.06	0.94	0.98	0.97	0.97	ND
Aug	1.02	0.93	0.97	0.93	0.94	ND
Sep	1.05	0.95	0.99	0.95	0.97	ND
Oct	1.04	0.92	0.98	0.95	0.96	ND
Nov	1.04	0.83	0.97	0.95	0.96	ND
Dec	0.98	0.83	0.9	0.89	0.92	ND

Table 51: Indexed monthly traffic in expanded outer ULEZ area (Indexed to January 2019)[58]

Expanded Outer	2019	2020	2021	2022	2023	2024
Jan	1.00	0.99	0.72	0.93	0.95	0.96
Feb	1.03	1.02	0.8	0.99	0.98	0.99
Mar	1.06	0.86	0.88	1.00	1.00	ND
Apr	1.05	0.53	0.95	0.98	0.98	ND
May	1.06	0.68	0.98	1.01	1.01	ND
Jun	1.08	0.87	1.02	1.01	1.04	ND
Jul	1.08	0.95	1.02	1.01	1.01	ND
Aug	1.03	0.96	1.00	0.98	0.98	ND
Sep	1.05	0.99	1.02	1.00	1.02	ND
Oct	1.05	0.96	1.00	1.01	1.00	ND

Expanded Outer	2019	2020	2021	2022	2023	2024
Nov	1.04	0.86	1.01	1.00	1.00	ND
Dec	0.97	0.82	0.91	0.92	0.94	ND

Table 52: Indexed monthly traffic in London-wide ULEZ area (Indexed to January 2019)[58]

London-wide	2019	2020	2021	2022	2023	2024
Jan	1.00	0.99	0.71	0.91	0.92	0.94
Feb	1.03	1.02	0.78	0.96	0.96	0.97
Mar	1.05	0.84	0.85	0.98	0.97	ND
Apr	1.04	0.53	0.91	0.96	0.95	ND
May	1.05	0.67	0.95	0.98	0.98	ND
Jun	1.07	0.85	0.99	0.99	1.00	ND
Jul	1.06	0.92	0.99	0.99	0.98	ND
Aug	1.02	0.93	0.97	0.95	0.95	ND
Sep	1.04	0.96	1.00	0.97	0.99	ND
Oct	1.04	0.93	0.98	0.97	0.98	ND
Nov	1.04	0.83	0.98	0.97	0.97	ND
Dec	0.97	0.81	0.9	0.9	0.93	ND

Traffic around the North and South Circular Roads and ULEZ boundary

Traffic data collected at 24 sites on the North and South Circular Roads (the boundary for the inner London ULEZ) has been analysed and indexed to January 2019. Analysis of the data for the North and South Circular Roads index flows separately does not indicate any notable changes in flows in September 2023. The monthly index for each area is shown in to Table 53 to Table 55.

Indexed flows on the North Circular remain broadly the same to 2022 and early 2023 in terms of the indexed value and pattern of change from September 2023 through to February 2024. A slightly higher indexed traffic flow can be observed in September, but there is a return to similar levels of flow in the following months. The pattern in indexed flows also remains the same for the North Circular, with a decline in flows from November towards December and a recovery to similar indexed flows in the early months of 2024.

The indexed flows for 2023 are similar on the South Circular Road apart from a large spike in indexed flows in the summer prior to the scheme launch. This particularly effects May and June 2023. A reduced number of available sites makes the data in these areas more

susceptible to the effects of network related permutation such as diversions, especially when utilising indexed flows. However, following the scheme's introduction the pattern of a decreasing flow from September 2023 through to December is demonstrated much like with 2022, even though the overall indexed traffic flow is marginally higher than 2022. The pattern of decline and recovery at the end of 2023 and 2024 reflects the same seen in 2022 and 2023 however the indexed flows are higher.

Furthermore, as shown in Table 53 and Table 54, compliance rates on the North and South Circular Roads have continued to increase since the London-wide ULEZ was launched and was at 96.4 per cent in February 2024. This shows that while there have been no notable changes in traffic flows on the North Circular and marginally higher flows on the South Circular, the vehicles using these roads are cleaner.

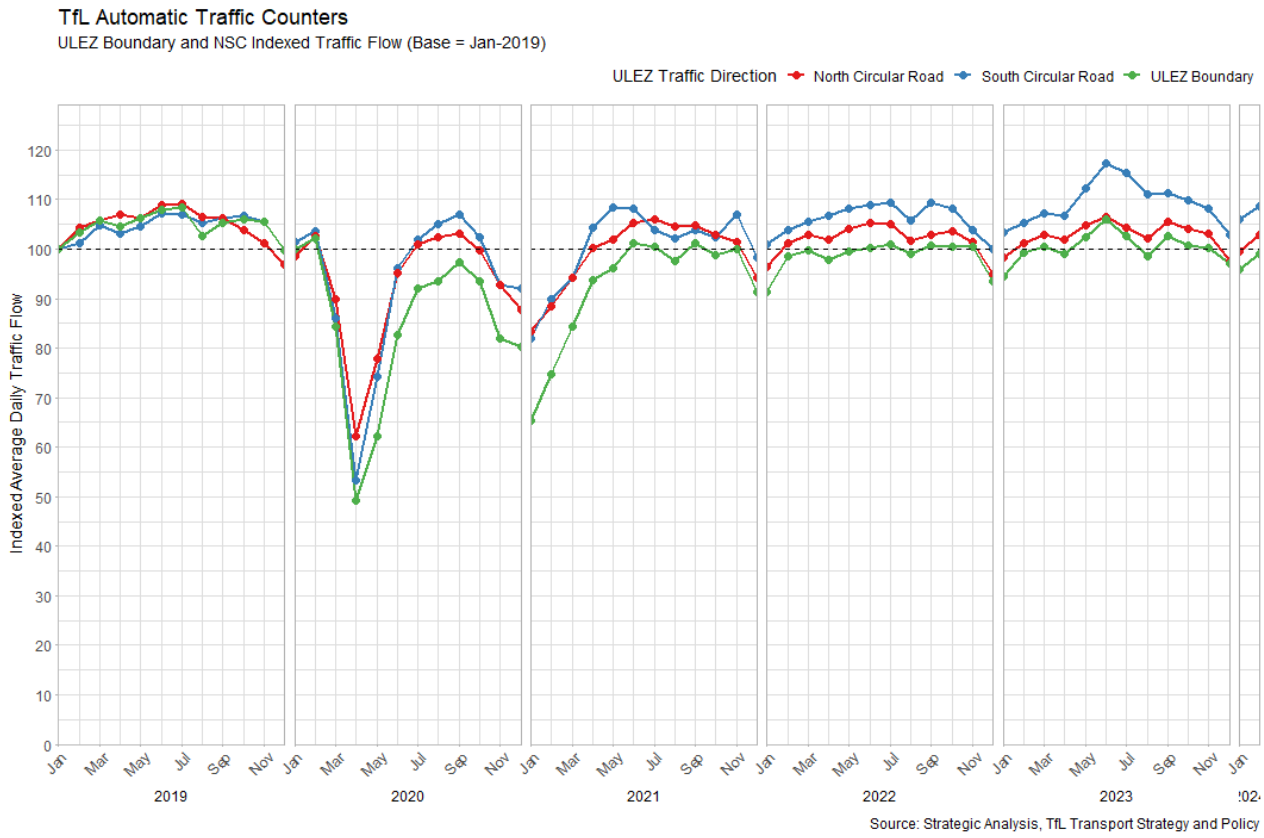

Figure 16: Indexed traffic flows for North Circular Road, South Circular Road and London-wide ULEZ Boundary

Table 53: Indexed monthly traffic for North Circular Road (Indexed to January 2019)[58]

North Circular Road	2019	2020	2021	2022	2023	2024
Jan	1.00	0.99	0.83	0.96	0.98	0.99
Feb	1.04	1.03	0.88	1.01	1.01	1.03
Mar	1.06	0.9	0.94	1.03	1.03	ND
Apr	1.07	0.62	1.00	1.02	1.02	ND
May	1.06	0.78	1.02	1.04	1.05	ND
Jun	1.09	0.95	1.05	1.05	1.06	ND
Jul	1.09	1.01	1.06	1.05	1.04	ND
Aug	1.07	1.02	1.04	1.02	1.02	ND
Sep	1.06	1.03	1.05	1.03	1.05	ND
Oct	1.04	1.00	1.03	1.04	1.04	ND
Nov	1.01	0.93	1.01	1.02	1.03	ND
Dec	0.97	0.88	0.94	0.95	0.98	ND

Table 54: Indexed monthly traffic for South Circular Road (Indexed to January 2019)[58]

South Circular Road	2019	2020	2021	2022	2023	2024
Jan	1.00	1.01	0.82	1.01	1.03	1.06
Feb	1.01	1.04	0.9	1.04	1.05	1.09
Mar	1.05	0.86	0.94	1.05	1.07	ND
Apr	1.03	0.53	1.04	1.07	1.07	ND
May	1.05	0.74	1.08	1.08	1.12	ND
Jun	1.07	0.96	1.08	1.09	1.17	ND
Jul	1.07	1.02	1.04	1.09	1.15	ND
Aug	1.05	1.05	1.02	1.06	1.11	ND
Sep	1.06	1.07	1.04	1.09	1.11	ND
Oct	1.07	1.02	1.02	1.08	1.10	ND
Nov	1.05	0.93	1.07	1.04	1.08	ND
Dec	1.00	0.92	0.98	1.00	1.03	ND

Table 55: Indexed monthly traffic for GLA boundary (Indexed to January 2019)[58]

GLA Boundary	2019	2020	2021	2022	2023	2024
Jan	1.00	1.00	0.65	0.91	0.94	0.96
Feb	1.03	1.02	0.75	0.99	0.99	0.99
Mar	1.06	0.84	0.84	1.00	1.01	ND
Apr	1.05	0.49	0.94	0.98	0.99	ND
May	1.06	0.62	0.96	0.99	1.02	ND
Jun	1.08	0.83	1.01	1.00	1.06	ND
Jul	1.08	0.92	1.01	1.01	1.03	ND
Aug	1.03	0.94	0.98	0.99	0.99	ND
Sep	1.05	0.97	1.01	1.01	1.03	ND
Oct	1.06	0.94	0.99	1.01	1.01	ND
Nov	1.05	0.82	1.00	1.01	1.00	ND
Dec	1.00	0.80	0.91	0.94	0.97	ND

Appendix 6 – LEZ compliance

Compliance for the LEZ is reported separately to the ULEZ as the scheme applies to different vehicles. More detailed information on the progression of emissions standards under the LEZ is available in the previous London Low Emission Zone Six Month Report and the Inner London Ultra Low Emission Zone – One Year Report.

The emissions standards for the LEZ were tightened to match the ULEZ standards on 1 March 2021. Data up to February 2021 is prior to the change in emissions standards, but all the data shown is the compliance with the tighter standards to show changes over time. Data from September 2023 includes information based on the newly installed cameras in outer London.

Table 56 shows the average monthly compliance rates for large and heavy vehicles travelling in the LEZ. It shows that the LEZ compliance rate remains above 97 per cent. This highlights the success of the scheme in reducing the number of older, more polluting heavy vehicles on London's roads. This is based on the number of unique vehicles detected in the zone each day.

Table 56: London-wide LEZ compliance rate per month

Month	LEZ Compliance Rate (new emissions standards)
Feb – 2017 baseline§	48.0%
May-19*	71.0%
Sep-19*	73.7%
Jan-20*	78.5%
May-20†	83.2%
Jun-20†	83.4%

Month	LEZ Compliance Rate (new emissions standards)
Jul-20†	83.8%
Aug-20†	85.0%
Sep-20†	85.0%
Oct-20†	85.8%
Nov-20†	87.9%
Dec-20†	88.7%
Jan-21†	89.9%
Feb-21†	90.4%
Mar-21	93.5%
Apr-21	94.3%
May-21	94.5%
Jun-21	94.9%
Jul-21	95.3%

Month	LEZ Compliance Rate (new emissions standards)
Aug-21	95.5%
Sep-21	95.4%
Oct-21	95.7%
Dec-21	95.9%
Jan-22	96.1%
Feb-22	96.2%
Mar-22	96.1%
Apr-22	96.2%
May-22	96.2%
Jun-22	96.3%
Jul-22	96.7%
Aug-22	97.0%
Sep-22	97.0%

Month	LEZ Compliance Rate (new emissions standards)
Oct-22	97.1%
Nov-22	97.1%
Dec-22	97.1%
Jan-23	97.2%
Feb-23	97.4%
Mar-23	97.4%
Apr-23	97.4%
May-23	97.4%
Jun-23	97.4%
Jul-23	97.5%
Aug-23	97.7%
Sep-23	97.3%
Oct-23	97.3%

Month	LEZ Compliance Rate (new emissions standards)
Nov-23	97.3%
Dec-23	97.2%
Jan-24	97.4%
Feb-24	97.5%
Overall change in compliance February 2017 to present	Increase of 49.5 percentage points
Change in compliance since February 2021 (before the tighter standards)	Increase of 7.1 percentage points

§ February 2017 based on data from the London Atmospheric Emissions Inventory

** Analysis based on sampled days with these months, using historical data*

† Compliance rates estimated using information from ANPR camera data and associated vehicle information such as age and type of vehicle

Appendix 7 − Privacy and data minimisation

The ULEZ uses a network of ANPR cameras to identify non-compliant vehicles and enforce the scheme. The cameras along the boundary and within the zone operate as a single network for the whole expanded zone. This means that when a non-compliant vehicle is identified, even if it is observed on multiple cameras, only a single evidential record is retained for enforcement purposes to minimise the data collected. An evidential record will include a number of colour and black and white images to identify the vehicle and place it in the context of its surroundings.

When traffic is diverted into the zone because of road closures on or near the boundary, TfL does not use data from cameras along the diversion route to avoid unfairly penalising drivers of non-compliant vehicles who would not have otherwise entered the zone. Vehicles travelling off the diversion route and further into the zone will be picked up by the in-zone cameras.

A full Data Protection Impact Assessment for the scheme has been published on TfL's website.

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