

MAYOR OF LONDON

AIR QUALITY IN LONDON 2016-2024

March 2024



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**Greater London Authority
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Executive Summary



Since 2016, London's air quality has improved dramatically, and the number of Londoners living in areas that exceed the UK's legal air pollution limits has decreased significantly. Drawing on data from London's comprehensive monitoring network and the latest modelling from the London Atmospheric Emissions Inventory (LAEI), this report evaluates how air quality in London has improved between 2016 and 2023 and assesses the ambitious policies of the Mayor of London, Sadiq Khan, that have contributed to these changes.

Average concentrations of nitrogen dioxide (NO₂) were much higher in London than the rest of the UK in 2016 – and yet have fallen much more steeply in London compared to the rest of the country. Annual roadside NO₂ concentrations across London dropped by nearly half (49 per cent) between 2016 and 2023, compared to 35 per cent in the rest of England, 39 per cent in Scotland and 31 per cent in Wales over the same period.¹

Preliminary figures also indicate that average annual concentrations of NO₂ in London dropped to the lowest levels ever recorded in 2023, lower even than the first year of COVID-19 lockdowns². 2023 was also the first year since records began when annual mean particulate matter (PM_{2.5}) concentrations did not exceed the latest interim World Health Organization (WHO) air quality target across London's active air quality monitoring sites.³

New data from London's more than 150 reference-grade air quality monitoring sites⁴ also show the capital has made significant progress towards reaching the UK's legal air pollution limits. The number of monitoring sites across London exceeding the UK's annual legal limit for NO₂ has decreased from 56 sites in 2016 to just five in 2023. There has also been a 99 per cent reduction in the number of hours when NO₂ concentrations exceeded the UK's hourly legal limit since 2016 – dropping from 4,130 hours in 2016, to just 22 hours in 2023.

¹ Northern Ireland is not included as no air pollution monitoring sites with sufficient data capture were available.

² Monitoring data for 2023 is yet to be ratified. The standard process of ratifying the data, i.e. undergoing the process of detailed quality assurance and control, can take between six months to a year and varies across monitoring stations in London. Data is not likely to change substantially or affect overall trends.

³ When averaging concentrations across Central, Inner and Outer London. Because this is an average, some individual monitoring sites still recorded exceedances in 2023.

⁴ Reference-grade air quality monitors follow a method that represents the scientific standard for air quality monitors and are used for assessing compliance with legal limits and targets.

The air quality monitoring and modelling presented in this report demonstrate that the clear accelerated reduction in emissions in London since 2016 has been largely driven by the introduction and expansion of key Mayoral and Transport for London (TfL) policies to reduce air pollution and protect public health. These have included:

- Introducing the world's first 24-hour [Ultra Low Emission Zone \(ULEZ\)](#) in 2019 and expanding it London-wide in 2023 to transform the capital into the world's largest clean air zone of its kind, with more than 95 per cent of vehicles seen driving in London now compliant with the ULEZ emissions standards, up from just 39 per cent in 2017.
- Accelerating TfL's transition to a cleaner bus fleet, including upgrading the entire fleet to meet or exceed the ULEZ emissions standards and delivering over 1,300 electric buses to create the [largest zero-emission bus fleet](#) in western Europe.
- Electrifying London's taxi and private hire vehicle fleets by introducing strict new emissions-based licensing requirements, with [more than half](#) (54 per cent) of London's black cabs and over a third (36 per cent) of all private hire vehicles now zero-emission capable.
- Supporting the delivery of London's electric vehicle revolution, with over a third of all UK charging points for electric vehicles (over 18,600) in London. Over 1,000 are rapid or ultra rapid, of which TfL installed over 300. This is enabling Londoners to adopt electric vehicles at a [much faster](#) rate than the rest of the UK.
- Encouraging more people to cycle more often by quadrupling the size of the London-wide cycle network by the end of March 2024, reducing danger at junctions, expanding TfL's Santander Cycle Hire scheme, and delivering high-quality cycle infrastructure, helping to drive substantial increases in journeys made by cycling and reducing emissions compared to travelling by car. These have enabled more Londoners to cycle – [from 1.06 million daily cycle journeys in 2016 to 1.26 million in 2023](#).
- Introducing a pioneering [air quality alerts](#) system to notify Londoners during the worst episodes of air pollution, and expanding these alerts in 2024 to directly notify health professionals. High pollution episodes are now a rare occurrence in London. Between 2018 and 2023, the system issued 19 high pollution alerts and 217

moderate pollution alerts, enabling Londoners to increase their awareness of high pollution episodes and take precautionary action on these days.

- Launching [Breathe London](#), a first-of-its-kind community air quality monitoring network which complements London's reference-grade analysers with over 400 hyper-local air quality sensors, helping community groups to monitor and manage their exposure to air pollution across London. Recognising the scale of air pollution as a global crisis, the Mayor called for the creation of [Breathe Cities](#) at COP26 in 2021, and all participating cities have committed to the combined aim of achieving a reduction of 30 per cent in air pollution by 2030.
- Providing £27 million in funding to support London boroughs' projects to improve air quality through the [Mayor's Air Quality Fund](#) (MAQF), including helping to introduce 25 new clean air routes, supporting 5,300 businesses to reduce their emissions, and creating more than 3,000 square meters of new green space.
- Delivering the world's first [Non-Road Mobile Machinery \(NRMM\) Low Emission Zone \(LEZ\)](#), helping to significantly reduce emissions from construction equipment equivalent to an annual reduction of 42 per cent in particulate matter (PM), 36 per cent in nitrogen oxides (NO_x) and 11 per cent in carbon dioxide (CO₂), with an ambitious roadmap to become zero emission.
- Requiring all new developments in London to not contribute to air pollution and major developers to consider their impact on air quality from the earliest design stages through new, world-leading [Air Quality Neutral](#) and [Air Quality Positive](#) guidelines.

The Mayor has also shown national and international leadership in addressing air pollution, from convening national and international air quality summits to being elected as [chair](#) of the C40 Cities network of climate and air quality leaders in November 2021 and [co-chair](#) in November 2023, and making air pollution a key focus given its link to the climate crisis. Altogether, efforts from the [C40 Clean Air Cities Accelerator](#) have made a significant impact, with an average 5 per cent improvement in air quality between 2018 and 2021, and 94 million more C40 city residents enjoying cleaner air. London has also published a wealth of research, evaluation, and guidance to inform Londoners and support and empower other cities in addressing air pollution.

This report focuses on action to tackle ambient air pollution, particularly in areas where the Mayor has the greatest powers, such as transport and planning. However, the Mayor has also demonstrated leadership on indoor air quality by identifying it as a key issue and taking steps to address it ahead of most other policy makers. Indoor air quality interventions have included a range of initiatives to directly protect school children in classrooms, including funding air quality audits in schools and nurseries and providing funding for a pilot air filtration project for 200 schools. Alongside this, the Mayor has worked with the boroughs and other partners to raise awareness about the impacts of wood burning. And the Mayor has ensured TfL has implemented an ambitious, multi-million-pound programme to improve air quality on the London Underground network.⁵

This report also highlights the challenge London still faces, with parts of the city still exceeding UK legal limits for NO₂ and most of the city still exceeding the WHO air quality guidelines for NO₂, PM₁₀ and PM_{2.5}. These pollutants have well-documented health and economic impacts that fall unequally on those least likely to contribute to the problem. And despite substantial progress, the latest modelling shows that without additional action, all Londoners will still be living in areas exceeding the WHO guidelines for both NO₂ and PM_{2.5} in 2025 and 2030.

Continued action is required to achieve the Mayor's aim, as relatively small increases could bring areas home to hundreds of thousands of Londoners back over the legal limit. An increase of just 1 µg/m³ from 2019 levels of NO₂ would result in an additional 68,200 people living in areas exceeding the legal limit. An increase of 2 µg/m³ would result in a return of a further 156,000 people living in areas exceeding the legal limit.

As such, while the air quality data presented in this report shows that London's air quality has improved substantially over both Mayoral terms, significant work remains to bring London's pollution down to levels where it does not have a harmful impact on public health.

The Mayor has ruled out introducing a new pay-per-mile road charging scheme. He has set ambitious targets in other areas, such as the aim for 80 per cent of all trips in London to be made on foot, by bike or using public transport by 2041, for more electric vehicle charging

⁵ More information on TfL's ongoing work to improve air quality on the London Underground network is available at <https://tfl.gov.uk/corporate/about-tfl/improving-air-quality-on-the-tube>

points across London, as well as for the entire bus fleet of around 9,000 buses to be zero-emission by no later than 2034. He is also committed to pushing for coordinated, ambitious action from the private sector and all levels of government to ensure all Londoners can breathe cleaner air and to build a better, fairer, and greener London for everyone.

Introduction



The World Health Organization (WHO) states that the burden of disease attributable to air pollution is now 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 biggest environmental threat to human health⁶. In London in 2016, two million Londoners, including

⁶ WHO (2021). Global air quality guidelines: particulate matter (PM_{2.5} and PM₁₀), ozone, nitrogen dioxide, sulfur dioxide and carbon monoxide. Available at: <https://www.who.int/publications/i/item/9789240034228>

400,000 children, lived in areas that exceeded legal limits of air pollution⁷, with thousands of Londoners dying prematurely because of exposure to air pollution every year⁸.

In May 2016, Sadiq Khan was elected Mayor of London and identified air pollution as one of the key challenges facing Londoners. He outlined his plans to tackle it in the [London Environment Strategy](#), [Mayor's Transport Strategy](#), [London Health Inequalities Strategy](#), and [London Plan](#). This report has been compiled eight years later, at the end of two mayoral terms, to evaluate the programmes that have been delivered and progress made towards reducing air pollution levels in London. This report provides an update to a previous report, which covered the Mayor's first term from 2016 to 2020⁹.

This report first outlines the key policies that have been enacted over the whole mayoralty, focussing on the achievements in the most recent term (2021 to 2023). The next section evaluates the air quality concentrations, trends, and improvements measured at over 150 reference grade air quality monitoring stations and modelled across London. Looking ahead, this report also outlines the key areas where significant work remains locally and nationally to bring pollution down to levels where it does not have a harmful impact on public health.

Much of London's road transport pollution will be addressed by the policies set out in the London Environment Strategy and Mayor's Transport Strategy. As a result of this bold action, the forecasts from our modelling show that as emissions from transport sources reduce, non-transport sources will increase as a proportion of London's total emissions. The Mayor has much weaker – and often no – powers to tackle these sources. The London Environment Strategy laid out the additional powers required by the Mayor to tackle non-transport sources, but the Mayor has continued to lead the way on these issues, despite the lack of powers. This includes innovative and effective policies such as the Non-Road Mobile Machinery Low Emission Zone. The Mayor has also demonstrated leadership on indoor air quality by identifying the issue and taking steps to address it ahead of most other policy

⁷ GLA and TfL (2023) London Atmospheric Emissions Inventory 2019 (LAEI 2019). Available at: <https://data.london.gov.uk/dataset/london-atmospheric-emissions-inventory--laei--2019>

⁸ Imperial College London (2021) London Health Burden of Current Air Pollution and Future Health Benefits of Mayoral Air Quality Policies. Available at: <https://www.london.gov.uk/programmes-and-strategies/environment-and-climate-change/environment-publications/health-burden-air-pollution-london>

⁹ GLA (2020) Air Quality in London 2016 – 2020. Available at: [Air Quality in London 2016 - 2020 | London City Hall](#)

makers. Indoor air quality interventions have included a range of initiatives to directly protect school children in classrooms, and raising awareness about the impacts of wood burning.

Evidence of the negative health impacts of air pollution, even at levels previously considered to be low, has continued to increase over recent years. One consequence of this has been that since publication of the last report, the WHO updated its health-based air quality guidelines (AQGs) in 2021¹⁰, the first update since 2005. Following passage of the UK Government Environment Act 2021, the Government has also introduced two new legally binding limits for PM_{2.5}.

WHO guidelines and UK legal limits

The new WHO AQGs reflect the best available health evidence and the stricter guidelines respond to the real and global threat of air pollution to public health. The WHO's recommendations continue to be recognised globally as the targets that should be met to protect public health. The recommended annual mean concentrations for NO₂, PM₁₀, and PM_{2.5} have been revised to much stricter thresholds when compared with UK legal limits and are displayed in Table 1, Table 2, and Table 3¹¹.

Recognising that many places throughout the world are not yet close to achieving the latest guidelines, the WHO also introduced a series of additional "interim targets" designed to be used as incremental steps towards meeting the AQGs. The interim targets and guidelines can be met with leadership and continued bold action. In 2019, the Mayor pledged to reduce PM_{2.5} pollution in London in line with the 2005 WHO AQG of 10 µg/m³ by 2030. The Mayor has since been clear that he is committed to meeting the new 2021 WHO AQGs as soon as possible, and that this will require coordinated action from all levels of government. As such, considering that London has been compliant with the UK annual legal limits for PM₁₀ and PM_{2.5} since the beginning of the Mayoralty, the latest WHO interim targets for PM₁₀ and PM_{2.5} have been used as benchmarks within this report, as working to achieve the latest interim targets is a step towards the ultimate achievement of meeting the WHO AQGs.

¹⁰ WHO (2021). Global air quality guidelines: particulate matter (PM_{2.5} and PM₁₀), ozone, nitrogen dioxide, sulfur dioxide and carbon monoxide. Available at: <https://www.who.int/publications/i/item/9789240034228>

¹¹ The WHO has also published revised short-term AQGs and interim targets. For the purpose of this report, short-term AQGs have not been presented, as the annual mean averaging periods represent locations where members of the public are regularly exposed for a longer period.

The Mayor has long made the case for UK air pollution limits for all air pollutants to be aligned with the WHO recommended AQGs, which are based on the best available health evidence. Experts, including the Committee on the Medical Effects of Air Pollutants, have noted that reducing air pollutant concentrations to levels below the WHO AQGs would benefit public health¹². The existing UK legal limits, including those for short-term and annual means, remain in place.

Nitrogen dioxide (NO₂)

Nitrogen dioxide (NO₂) is a toxic gas that is produced during combustion processes, such as in the engine of a car. This is why the highest concentrations of NO₂ in London are recorded at busy roadside locations. NO₂ aggravates respiratory diseases – particularly asthma – and stunts the development of children’s lungs¹³. Road transport is the single biggest source of NO₂ in London¹⁴.

Table 1: UK legal limit and recommended WHO AQGs for annual mean concentrations of NO₂, in 2005 and 2021

Pollutant	Averaging Time	UK Legal Limit (µg/m ³)	2005 AQG (µg/m ³)	2021 Latest Interim Target (µg/m ³)	2021 AQG (µg/m ³)
NO ₂	Annual	40	40	20	10

The UK also set a short-term hourly average limit of 200 µg/m³ not to be exceeded more than 18 times per year.

¹² COMEAP (2022). Advice on health evidence relevant to setting PM2.5 targets – update. Available online at: https://assets.publishing.service.gov.uk/media/623075a3d3bf7f5a89aeecec3/COMEAP_WHO_AQG_-_Defra_PM2.5_targets_advice__2_.pdf

¹³ Imperial College London (2023). Impacts of air pollution across the life course – evidence highlight note. Available at: <https://www.london.gov.uk/sites/default/files/2023-04/Imperial%20College%20London%20Projects%20-%20impacts%20of%20air%20pollution%20across%20the%20life%20course%20%E2%80%93%20evidence%20highlight%20note.pdf>

¹⁴ GLA and TfL (2023). London Atmospheric Emissions Inventory 2019 (LAEI 2019). Available at: <https://data.london.gov.uk/dataset/london-atmospheric-emissions-inventory--laei--2019>

Fine particulate matter (PM_{2.5})

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 400th 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 exhausts. Around a third of the PM_{2.5} emitted in London comes from road transport, with a large proportion also coming from construction, wood burning and commercial cooking, where the Mayor has limited, and in many cases no, powers.¹⁵

Based on current evidence, PM_{2.5} is thought to be the air pollutant that has the greatest impact on human health¹⁶. Both short and long-term exposure to PM_{2.5} increases the risk of mortality from lung and heart diseases as well as increasing hospital admissions. Children growing up exposed to PM_{2.5} are more likely to have reduced lung function and develop asthma. The UK Government's Committee on the Medical Effects of Air Pollution (COMEAP) estimate exposure to PM_{2.5} attributes to 29,000 premature deaths in the UK every year¹⁷.

The WHO acknowledges that current evidence suggests no safe level for PM_{2.5}. However, the WHO set an AQG limit which reflects the level above which increased mortality from exposure to PM_{2.5} is likely.

Following passage of the UK Government Environment Act 2021, the Government has also introduced two new legally binding limits for PM_{2.5}:

- An annual mean concentration target ('concentration target') - a maximum concentration of 10 µg/m³, to be met across England by 2040.
- A population exposure reduction target ('exposure target') - a 35 per cent reduction in population exposure by 2040 (compared to a base year of 2018).

¹⁵ GLA and TfL (2023). London Atmospheric Emissions Inventory 2019 (LAEI 2019). Available at: <https://data.london.gov.uk/dataset/london-atmospheric-emissions-inventory--laei--2019>

¹⁶ WHO (2021). Global air quality guidelines: particulate matter (PM_{2.5} and PM₁₀), ozone, nitrogen dioxide, sulfur dioxide and carbon monoxide. Available at: <https://www.who.int/publications/i/item/9789240034228>

¹⁷ COMEAP (2010). The Mortality Effects of Long-Term Exposure to Particulate Air Pollution in the United Kingdom. Available at: <https://www.gov.uk/government/publications/comeap-mortality-effects-of-long-term-exposure-to-particulate-air-pollution-in-the-uk>

The new legislation does not commit to achieving the WHO PM_{2.5} guidelines that are needed for the protection of human health. Nor does it include the new powers London and other UK cities need to achieve them. In the London Environment Strategy, the Mayor committed to achieving the WHO (2005) annual mean AQG of 10 µg/m³ of PM_{2.5} by 2030, a full decade before the new UK legal limits. Analysis commissioned by City Hall has shown that this is achievable, subject to the provision of additional powers and funding by the UK Government, as well as key national and international action to tackle transboundary sources coming from outside London.¹⁸

Since this commitment, the WHO has tightened its recommendations and 10 µg/m³ now represents the latest interim target for annual mean PM_{2.5}. As there is a clear pathway to achieving this interim target, the analysis in this report is focused on tracking progress to reaching 10 µg/m³. However, the Mayor is committed to achieving the stricter 2021 WHO AQG of 5 µg/m³ as soon as possible and recognises that more needs to be done to do so.

Table 2: UK legal limit and recommended WHO AQGs for annual mean concentrations of PM_{2.5} in 2005 and 2021

Pollutant	Averaging Time	UK Legal Limit (µg/m ³)	2005 AQG (µg/m ³)	2021 Latest Interim Target (µg/m ³)	2021 AQG (µg/m ³)
PM _{2.5}	Annual	20 10 (to be achieved by 2040)	10	10	5

Particulate matter (PM₁₀)

Particulate matter (PM₁₀) refers to a complex mixture of particles or liquid droplets in the air that have a diameter less than 10 micrometres across. Road transport accounts for around a quarter of PM₁₀ in London, with a large proportion also coming from construction, wood burning and commercial cooking¹⁹.

¹⁸ GLA (2019). PM_{2.5} in London: Roadmap to meeting WHO guidelines by 2030. Available at: <https://www.london.gov.uk/programmes-and-strategies/environment-and-climate-change/environment-publications/pm25-london-roadmap-meeting-who-guidelines-2030>

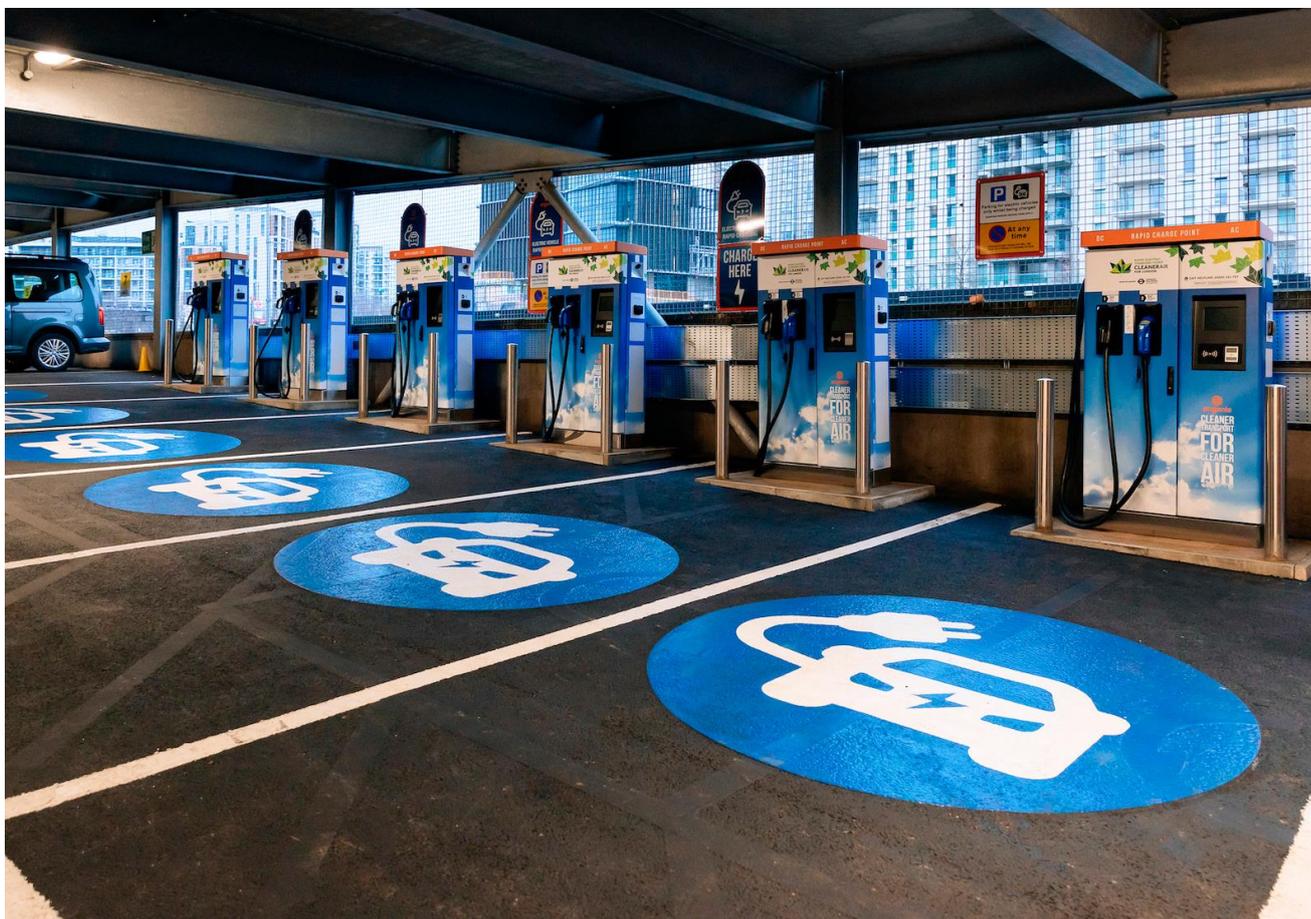
¹⁹ GLA and TfL (2023) London Atmospheric Emissions Inventory 2019 (LAEI 2019). Available at: <https://data.london.gov.uk/dataset/london-atmospheric-emissions-inventory--laei--2019>

Table 3: UK legal limit and recommended WHO AQGs for annual mean concentrations of PM₁₀ in 2005 and 2021

Pollutant	Averaging Time	UK Legal Limit (µg/m ³)	2005 AQG (µg/m ³)	2021 Latest Interim Target (µg/m ³)	2021 AQG (µg/m ³)
PM ₁₀	Annual	40	20	20	15

The UK also set a short-term limit for PM₁₀ as a 50 µg/m³ average over 24 hours, not to be exceeded more than 35 times a year.

Overview of Policies and Action



The Mayor is committed to cleaning up London's air and is delivering an ambitious programme to tackle this problem. He has worked closely with Transport for London (TfL) to introduce and maintain ambitious measures to reduce air pollution and protect public health. These include introducing the world's first 24-hour Ultra Low Emission Zone (ULEZ), cleaning up London's bus and taxi fleets and taking action to reduce exposure to air pollution at some of the city's most polluted schools, nurseries, and hospitals. This chapter provides an overview of the key policies and actions that have been taken in London between 2016 and 2023 to improve air quality. This does not cover the full range of the Mayor's policies and proposals; for this, please see the [London Environment Strategy](#), [Mayor's Transport Strategy](#), [London Health Inequalities Strategy](#), and [London Plan](#) strategy documents.

Ultra Low Emission Zone (ULEZ) and Low Emission Zone (LEZ)

Policy overview

There have been successive emissions-based charging schemes in London, which are aimed at reducing the health impacts associated with high pollution levels.

The Mayor introduced the world's first 24-hour ULEZ in central London on 8 April 2019 and expanded it to inner London on 25 October 2021. On the 29 August 2023, to bring the health benefits of cleaner air to even more people the Mayor further expanded the ULEZ to cover all London boroughs. The ULEZ boundary is now the same as the boundary for the LEZ for heavy vehicles. The London-wide zone measures 1,500 km² and covers nine million people, making it the largest zone of its kind in the world.

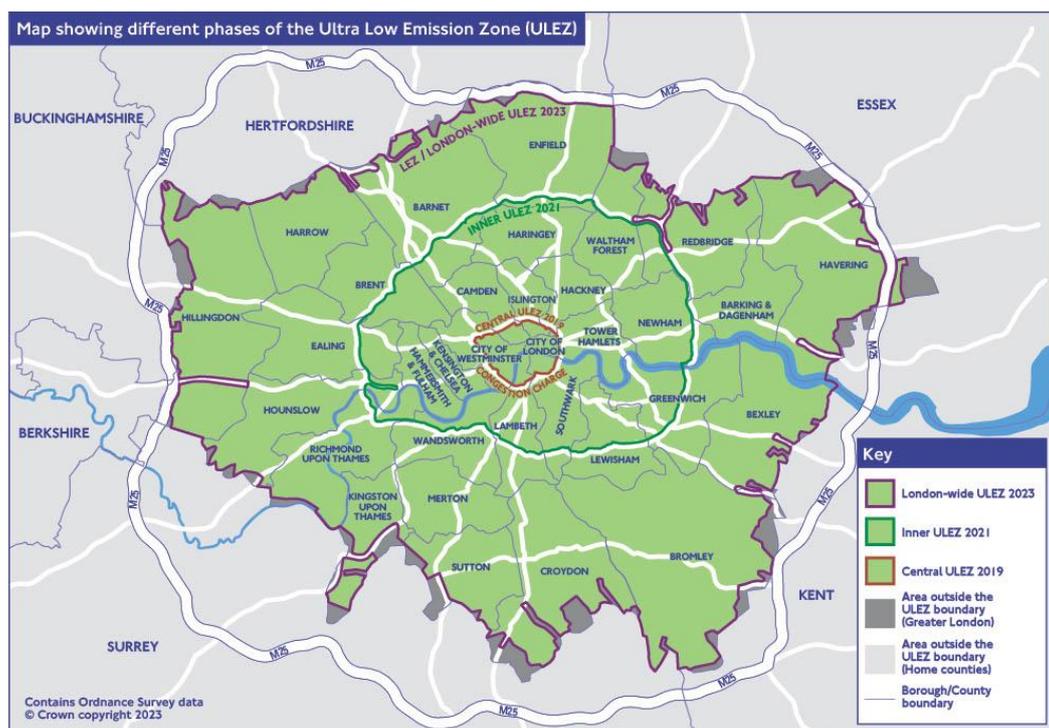


Figure 1: Map showing different phases of the ULEZ

The ULEZ operates in conjunction with the London-wide LEZ, which was originally launched in 2008 and applies to large and heavy vehicles, such as coaches, buses, and lorries. In March 2021, enforcement of tougher emission standards for the LEZ began. Prior to this, the standards had not changed since 2012. The LEZ standards are now the same as the ULEZ standards for most large and heavy vehicles.

Vehicles that do not meet certain emissions standards, and are not otherwise subject to a grace period, discount, or exemption, must pay a charge to travel within the city. 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. The vehicle types and relevant ULEZ/LEZ standards are set out in Table 4.

Table 4: Vehicle types and relevant ULEZ/LEZ standards

Vehicle type	Emissions limits	Relevant scheme
Cars	Euro 4 (Petrol) Euro 6 (Diesel)	ULEZ
Motorbikes	Euro 3	ULEZ
Smaller vans	Euro 4 (Petrol) Euro 6 (Diesel)	ULEZ
Larger vans and minibuses (vans up to and including 3.5 t, minibuses up to and including 5 t)	Euro 4 (Petrol) Euro 6 (Diesel)	ULEZ (and LEZ for some diesel vehicles) ²⁰
Heavy diesel vehicles (incl. buses and coaches over 5 t and HGVs and other heavy vehicles over 3.5 t)	Euro VI	LEZ

Support for Londoners

A range of measures were introduced to support Londoners, businesses and charities with non-compliant vehicles to prepare for all phases of the ULEZ and the introduction of tighter LEZ standards. This support has included time-limited exemptions or “grace periods” for disabled people (to 2027) and charities (to 2025), a reimbursement scheme for certain NHS patients, funding to retrofit or scrap vehicles, and third party offers on sustainable transport alternatives. Scrappage and retrofit schemes have been a key element of the support available to Londoners. Under these schemes, successful applicants are provided

²⁰ Diesel vans between 1.2T and 3.5T and minibuses under 5T 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).

with financial grants (or in some cases, financial grants plus bus and tram passes) to scrap or retrofit their non-compliant vehicles.

Original scrappage schemes

Two schemes were launched to support the central and inner London phases of the ULEZ (one for vans and minibuses, and one for cars and motorcycles), and a third scheme supported the introduction of tighter LEZ standards. All schemes were operated by TfL and the total budget allocated was more than £61 million. The scrappage schemes were open to small businesses, Londoners receiving certain low income and disability benefits, and charities operating minibuses, prioritising the limited funding to target those most in need of support.

Over 15,200 vehicles were scrapped or retrofitted under these schemes, including over 9,700 cars, over 5,200 vans and minibuses, and over 120 HGVs. A survey administered by TfL to recipients of the car and motorcycle scrappage scheme grants found that the scheme was also effective in reducing vehicle ownership and changing travel behaviour, with a third of survey respondents reporting that they did not purchase a replacement car or motorcycle with the scrappage grant²¹.

London-wide ULEZ scrappage scheme

To support the London-wide expansion of the ULEZ, a new scrappage scheme launched on 30 January 2023. Ahead of the London-wide expansion, TfL made a number of changes to the eligibility criteria and grant levels of the scrappage scheme, including expanding the eligibility criteria to include small businesses with fewer than 50 employees and Londoners in receipt of Child Benefit in July 2023, and then further expanding the criteria in August 2023 to allow any Londoner with an eligible non-compliant car or motorcycle to apply for scrappage funding. To date, the Mayor has provided £210 million in funding for this scheme²². TfL will publish an evaluation report following the scheme's closure.

²¹ TfL (2022). ULEZ scrappage schemes evaluation. Available at: <https://tfl.gov.uk/cdn/static/cms/documents/ulez-scrappage-schemes-evaluation-report.docx>

²² TfL regularly publishes factsheets about the uptake of the scrappage scheme on its website at: <https://tfl.gov.uk/corporate/publications-and-reports/ultra-low-emission-zone>

ULEZ and LEZ impacts

The GLA has published a series of monitoring reports for the ULEZ and the LEZ. The Inner London ULEZ One Year Report²³ analysed the impact of the central and inner London phases of the ULEZ and the introduction of tighter emissions standards for the LEZ on compliance rates and air pollution levels. The analysis showed that between 2019 and 2022, emissions of NO_x, PM_{2.5}, and CO₂ had reduced. Specifically, the ULEZ policies were estimated to have reduced nitrogen oxides (NO_x) emissions from road traffic by 13,500 tonnes in London between 2019 and 2022. Separate analysis has shown that this is roughly equivalent to the annual emissions produced by all aviation, industrial and commercial heat and power generation, and domestic sources of air pollution in the capital combined²⁴. These reductions in emissions led to reductions in concentrations, with roadside NO₂ concentrations 46 per cent lower in central London and 21 per cent lower in inner London than they would have been without the ULEZ and its 2021 expansion to inner London (see Figure 2).

²³ GLA (2022). Inner London Ultra Low Emission Zone Expansion One Year Report. Available at: <https://www.london.gov.uk/programmes-strategies/environment-and-climate-change/environment-and-climate-change-publications/inner-london-ultra-low-emission-zone-expansion-one-year-report>

²⁴ Air Quality Consultants (2023). Air Quality Fact Sheet: Emissions Savings from ULEZ Policies. Available at: <https://data.london.gov.uk/air-quality/#factsheets>

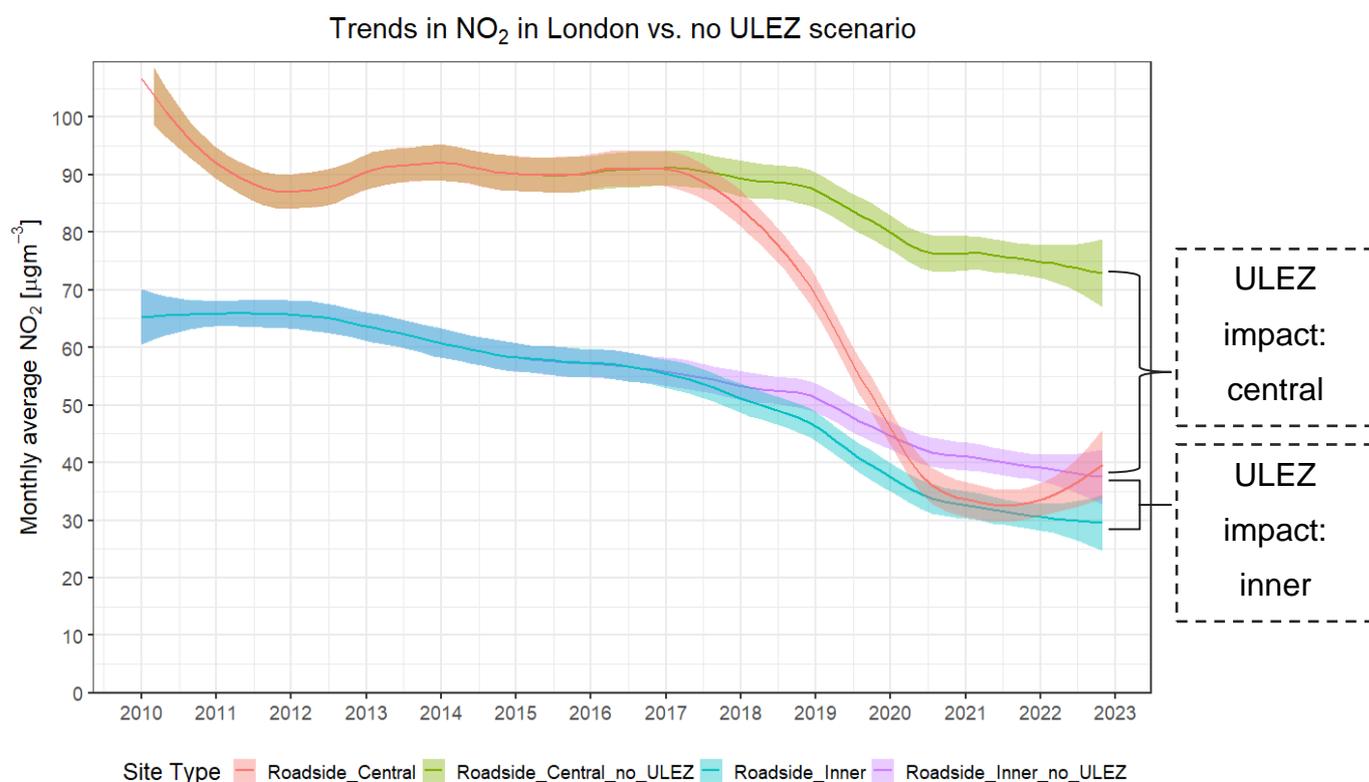


Figure 2: Trends in NO₂ in London compared with a "no-ULEZ" scenario

Carbon emissions from vehicles have also reduced. Cumulatively since 2019 it is estimated the ULEZ has led to a reduction of around 800,000 tonnes of CO₂ emissions from vehicles across London over the four-year period compared to without the ULEZ. Within the ULEZ area this is a saving of 290,000 tonnes.

At the time of publication, the latest reporting on the ULEZ is the London-wide ULEZ First Month Report²⁵. This report evaluated the impact of the newly expanded scheme in its first month. The initial data showed that the London-wide expansion was highly effective at reducing both the proportion and number of older, more polluting vehicles on London's roads in its first month of operation. The compliance rate for vehicles subject to the ULEZ is now 95.8 per cent, with 96.7 per cent of cars, 87.8 per cent of vans, and 96.9 per cent of

²⁵ GLA (2023). London-wide Ultra Low Emission Zone First Month Report. Available at: <https://www.london.gov.uk/programmes-strategies/environment-and-climate-change/environment-and-climate-change-publications/london-wide-ultra-low-emission-zone-first-month-report>

motorcycles operating in London meeting the ULEZ standards²⁶. Figure 3 shows the growth in ULEZ compliance across London over time. The compliance rate for vehicles subject to the LEZ is now 97.2 per cent²⁷.

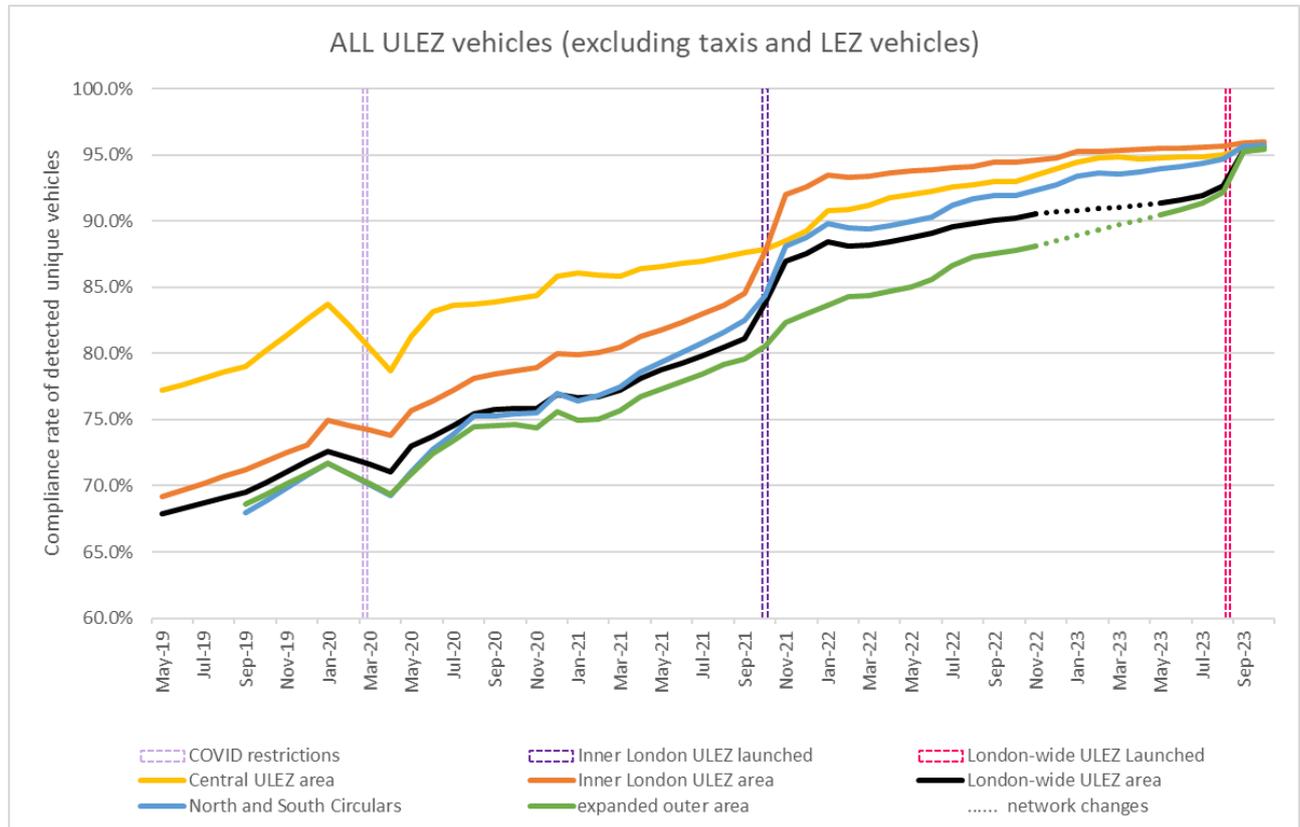


Figure 3: Compliance rates over time for vehicles subject to the ULEZ

A longer period of time is required to assess the impact of the London-wide ULEZ on air pollutant emissions and concentrations. Preliminary analysis of the air quality impacts will be reported in a London-wide ULEZ Six Month Report later in 2024, with a fuller analysis in a London-wide ULEZ One Year Report in 2025.

²⁶ TfL regularly reports on vehicle compliance rates for the ULEZ. Quarterly factsheets are available under the “Finance, operations & performance” section of the TfL website at: <https://tfl.gov.uk/corporate/publications-and-reports/ultra-low-emission-zone>

²⁷ TfL regularly reports on vehicle compliance rates for the LEZ. Quarterly factsheets are available under the “Finance, operations & performance” section of the TfL website at: <https://tfl.gov.uk/corporate/publications-and-reports/congestion-charge>

Improvements to the TfL bus fleet

The Mayor and TfL have continued to enhance and expand London's bus network. Buses are London's most affordable form of public transport (with a single fare of £1.75, the Mayor's Hopper Fare allows unlimited interchange within one hour) and cheaper than the Government's £2 bus fare cap, which limits bus fares nationally. Buses are also London's most available and accessible mode of transport, with 96 per cent of Londoners living within 400 metres of the network and 95 per cent of stops providing level access.

In 2022, TfL published a [Bus Action Plan](#), setting out its long-term plan for the bus network: for quicker journeys, enhanced connection, an improved customer experience and the decarbonising of the network. Buses are the most used form of public transport in the capital and the Action Plan aims to make the network an even more attractive alternative to car use.

Big strides in emissions reductions have been achieved since January 2021, when TfL upgraded the entire bus fleet to meet the ULEZ standards (alongside delivering 12 Low Emission Bus Zones between 2017 and 2019). This was achieved by replacing old buses with new ones and retrofitting mid-life buses to meet the Euro VI emissions standards, helping to reduce NO_x and PM across the capital.

TfL has continued to decarbonise the bus network, hitting the milestone of over 1,300 zero-emission buses in January 2024. London has the largest zero-emission²⁸ bus fleet in western Europe with more than one in seven now zero-emission at the tailpipe²⁹. Since 2016, the number of fully zero-emission bus routes has increased from five to more than 60, with a further 15 routes using a mixture of zero-emission and low emission buses. TfL plans to convert the entire bus fleet of around 9,000 buses to be zero-emission no later than 2034, but could accelerate this target to 2030 with additional Government funding.

Alongside decarbonising the fleet, TfL introduced innovative charging technology in 2023 to allow zero-emission buses to charge in 10 minutes and return to service quicker than via

²⁸ When classifying as "zero-emission" this refers to zero-emission at the tailpipe.

²⁹ C40 Cities (2023). London powers ahead with zero-emission buses. Available at: <https://www.c40.org/case-studies/london-powers-ahead-with-zero-emission-buses/>

conventional charging. This type of technology will help support operations on some of the longest bus routes in London.

London's investment in zero-emission buses is not only making the city greener but also boosting the national green economy. TfL's investment in zero-emission buses supports around 3,000 green jobs across the UK³⁰. By fostering a growing market for zero-emission vehicles, this investment is paving the way for green economic growth and lowering costs for other local authorities through economies of scale.

TfL always reviews the bus network to ensure it provides the connections that Londoners need and has continued to extend and grow the network, especially in outer London. In March 2023, the Mayor announced plans for the Superloop, a transformative network of express bus services in outer London to strengthen and improve public transport options to maximise the benefits of the London-wide ULEZ expansion. The Superloop will be fully operational by Spring 2024 (with the exception of the SL4 which will use the Silvertown tunnel once opened), allowing Londoners to travel between outer London's town centres, hospitals and transport hubs more quickly. The Superloop complements wider plans to enhance the network.

³⁰ C40 Cities (2023). London powers ahead with zero-emission buses. Available at: <https://www.c40.org/case-studies/london-powers-ahead-with-zero-emission-buses/>

Electric vehicle charging infrastructure

The Mayor has overseen a dramatic increase in the provision of public charging infrastructure to help Londoners switch to zero-emission vehicles. In 2018, the Mayor established the world's first Electric Vehicle Infrastructure Taskforce, bringing together representatives from business, energy and infrastructure sectors, Government and the London boroughs to unlock barriers to expanding charging infrastructure and accelerating the switch to electric vehicles. In 2019, the taskforce published a [Delivery Plan](#) with recommendations to increase London's electric vehicle infrastructure up until 2025.

In December 2021, following further engagement with the public and private sectors and updated infrastructure forecasts to 2030, [London's Electric Vehicle Infrastructure Strategy](#) was published by TfL, setting out how the public sector could support the delivery of infrastructure and remove barriers for private sector delivery. Current forecasts show that London will need between 40,000 and 60,000 public charge points by 2030, of which up to 4,000 will need to be rapid charge points³¹. The key commitment in the strategy is to unlock GLA land for electric vehicle charging.

As of January 2024, London had over 18,600 public charge points, over one third of the UK's total³². This is a threefold increase from October 2019, the earliest point at which reliable public numbers are available. With further delivery over the next few years by boroughs using London's almost £39 million Local Electric Vehicle Infrastructure fund allocation, and rapid charge point delivery by TfL and the private sector, London is on track to meet the 2030 demand forecasts.

As set out in the Mayor's Electric Vehicle Infrastructure Strategy, the Mayor and TfL are focussing on the delivery of rapid and ultra rapid charge points to support high mileage,

³¹ TfL is currently in the process of reassessing and updating the forecasts set out in London's Electric Vehicle Infrastructure Strategy to reflect the changes in the EV market and infrastructure landscape seen in recent years.

³² ZapMap (2023). EV charging statistics 2023. Available at: <https://www.zap-map.com/ev-stats/how-many-charging-points>

essential road users, such as those who require their vehicle for work. This includes taxis, private hire vehicles, delivery drivers and emergency services.

To date, TfL has delivered over 300 rapid charge points, including supporting delivery of three rapid charging hubs in Stratford, Woolwich and the City of London. With private sector installations, the number of rapid and ultra-rapid charge points has now more than tripled, to around 1,050, with this number steadily increasing month-by-month³³.

In 2023, TfL awarded contracts to deliver a further 100 rapid EV charging bays on its road network, with installation of these charge points starting in early 2024. Separately, Places for London, TfL's commercial property arm, is tendering for a joint venture partner to deliver ultra-rapid charging hubs on TfL land. An initial five sites have been selected for delivery, with up to 50 sites in total potentially being delivered over the course of the project. Work continues to identify further sites suitable for electric vehicle charging on public sector land.

The Mayor has supported the London boroughs to access government funding to deliver on-street residential charge points. The boroughs have delivered the vast majority of London's almost 17,500 slow-to fast (up to 22 kW) charge points, with the remainder delivered by the private sector.

Londoners are responding to these policies and investment. London electric vehicle registrations continue to increase rapidly, outstripping the UK. Electric cars comprised 23.2 per cent of new car registrations in 2022, up from just 1.3 per cent in 2018, an average growth rate of 5.5 per cent per year. Growth was even more impressive in inner London, skyrocketing from two per cent in 2018 to 35.5 per cent in 2022, an average rate of 8.4 per cent per year. This is compared to 0.6 to 15.8 per cent in the rest of the UK over the same period, an average rate of just 3.8 per cent per year³⁴. Meanwhile, the number of diesel car registrations in London has rapidly declined.

³³Gov UK (2023). Department for Transport, Electric vehicle charging device statistics: October 2023. Available at: <https://www.gov.uk/government/statistics/electric-vehicle-charging-device-statistics-october-2023>

³⁴Air Quality Consultants (2023), Air Quality Fact Sheet: Electric Vehicle Uptake in the UK and London. Available at: <https://data.london.gov.uk/air-quality/#factsheets>

Improvements to the taxi and private hire vehicle fleets

As of December 2023, over half (54 per cent) of the almost 15,000 black taxis on London's roads were zero-emission capable (ZEC). The progress made to decarbonise the taxi fleet is significant given that 2019 figures showed taxis were responsible for 29 per cent of the NO_x emissions from central London road transport³⁵. The Mayor has been determined to establish London's taxi fleet as the greenest in the world and to phase out diesel, which is why TfL introduced strict licensing requirements that have helped to bring about this step change. London's iconic and historic taxi trade is now leading the way in the early adoption of ZEC technology.

New licensing requirements were introduced in January 2018, and since then all taxis presented for licensing for the first time have needed to be ZEC. Alongside this, to phase out the most polluting vehicles from the fleet, the maximum age for the most polluting taxis was reduced from 15 to 12 years, between 2020 and 2022. To help drivers make the switch, a plug-in taxi grant is available, which gives London's taxi owners £7,500 off the price of a new ZEC. Following City Hall and TfL lobbying, the Government recently announced that the plug-in taxi grant will be extended until April 2025. As set out in the previous section, TfL continues to invest in rapid and ultra rapid charging to continue to support taxi drivers, and other high mileage, essential road users.

The Mayor and TfL have taken the same approach with private hire vehicles (PHVs), introducing emissions-based licensing requirements in 2018. The latest requirement was introduced in January 2023, with all PHVs licensed for the first time needing to be ZEC and meet the Euro 6 emissions standards. As of December 2023, over a third (35.8 per cent) of the PHV fleet were ZEC, while less than a third were solely fuelled by petrol or diesel.

³⁵ GLA and TfL (2023). London Atmospheric Emissions Inventory 2019 (LAEI 2019). Available at: <https://data.london.gov.uk/dataset/london-atmospheric-emissions-inventory--laei--2019>

Active travel

The overarching goal of the Mayor's Transport Strategy is that by 2041, 80 per cent of journeys will be made by walking, cycling and public transport. Achieving this aim will improve Londoners' health and their quality of life, clean up the city's air, reduce carbon emissions, and enhance London's environment. Initial estimates suggest that the mode share for these active, efficient and sustainable modes in 2023 could be around 64 per cent.

TfL's annual [Travel in London](#) report shows that there have been continued increases in the levels of walking and cycling in London. Enabling more people to walk and cycle, including as part of journeys that also involve public transport, is vital to a sustainable transport network and reducing air pollution in the capital.

Cycling

Significant progress has been made in cycling in London since 2016, enabling more Londoners to make greener and more active transport choices, and reducing air pollutant emissions compared to travelling by car. TfL, working closely with London's boroughs, has continued to deliver high-quality cycle routes, quadrupling the size of London's Cycleway network from 90 kilometres in 2016 to more than 360 kilometres by the end of March 2024. The cycle network now reaches over 70 town centres and high streets. By the end of March 2024, TfL expects that one in four Londoners will live within 400 metres of the cycle network.

Alongside expanding the cycle network, TfL has continued to work to remove the barriers that stop some people from cycling, reducing danger at 44 junctions as part of its Safer Junctions programme. 100,470 children have been trained to Level 2 Bikeability between 2018 and 2023 and cycle training has reached over 60,000 adults across London between 2018 and 2022.³⁶ The delivery of high-quality cycle infrastructure enables more Londoners to cycle. Since 2019, TfL has funded 17,000 cycle parking spaces and has quadrupled the number of cycle hangars in the capital from 1,200 in 2017 to 4,800 by the end of 2024.³⁷

³⁶ TfL (2023). Cycling Action Plan 2. Available at: <https://content.tfl.gov.uk/cycling-action-plan.pdf>

³⁷ Data provided in answer to MQ2023/4468: <https://www.london.gov.uk/who-we-are/what-london-assembly-does/questions-mayor/find-an-answer/cycle-hangars-0>

There has been a steady increase in the number of Londoners cycling over time, with a significant increase during the pandemic years. TfL's Travel in London report showed that the number of daily cycle journeys increased to 1.26 million in 2023, up 6.3 per cent since 2022, with 24 per cent of Londoners reporting having cycled in the last year, up from 21 per cent in 2019-20. This represents a level of growth not seen in the years leading up to the pandemic. While central London has seen a smaller level of growth (1.7 per cent) reflecting hybrid working and less commuter cycling, both inner and outer London have seen strong increases of 8.2 per cent and 5.5 per cent respectively compared to 2022 levels. Separate data from the report shows that in the financial year 2022-23, the percentage of all journeys made by cycling reached 4.5 per cent, a significant increase compared to the pre-pandemic level of 3.6 per cent in 2019-20.

TfL's [Cycling Action Plan 2](#) sets out its vision for making cycling more representative of London's diverse communities, including ambitious evidence-led measures to support underrepresented groups.

TfL's Santander Cycle Hire scheme has also gone from strength to strength, with two successive record years for hires in 2021 and 2022 and a record year for member hires in 2023³⁸. Since 2016, 83 new docking stations have opened, and 600 new e-bikes were introduced in 2022. The e-bikes have proven incredibly popular and TfL plans to almost triple the number of e-bikes in the scheme in 2024, taking the number to 2,000.

School Streets

TfL has provided funding and support to the London boroughs to increase the total number of school streets in the capital to over 500 (from less than 90 in 2019), making it safer, cleaner and easier for children to get to school on foot, by bike or by scooter. Analysis has shown average decreases of 34 per cent in nitrogen monoxide (NO) concentrations and 23 per cent in NO₂ concentrations during School Streets closure periods³⁹. The TfL School Streets evaluation found School Streets are well supported and have had an impact on

³⁸ TfL (2023). Available at: <https://tfl.gov.uk/info-for/media/press-releases/2023/january/london-s-iconic-santander-cycles-hire-scheme-sees-yet-another-record-breaking-year-in-2022>

³⁹ Air Quality Consultants (2021). Air Quality Monitoring Study: London School Streets. Available at: https://www.london.gov.uk/sites/default/files/school_streets_monitoring_study_march21.pdf

reducing car travel with parents of children at School Streets schools driving less (down by 18 per cent), and reporting to be more satisfied with the ease of active travel and air quality.

Walking & Cycling Grants London (WCGL)

WCGL aims to encourage more people to walk and cycle, helping to break down the barriers that prevent people from getting active and helping to make London a more sustainable, inclusive, and healthy city. Last year TfL and the London Marathon Foundation awarded more than £575,000 to 78 new projects and 69 continuing projects run by community groups. Between 2016 and 2023 TfL has awarded over £2.9m in grants with 78,000 participants benefitting.

Pedestrian crossings

Since 2016, TfL has introduced 75 new standalone signalised pedestrian crossings on its road network to make it safer and easier for people walking to cross the road. Green Person Authority traffic signals have been installed at 21 sites on the TfL road network, giving pedestrians priority over traffic. TfL has also worked with boroughs and funded 104 pedestrian crossings in 2022-23 through its Local Implementation Plan funding.

Air quality alerts

In August 2016, the Mayor announced the introduction of the Mayor's Air Quality Alert System. Previously there was no information for Londoners to manage their exposure to toxic air pollution episodes. The system provides air quality alerts at bus stops, tube stations, and road-side signs across London to notify Londoners during the worst episodes of air pollution. Schools are also directly notified of moderate, high, and very high pollution episodes. During and on the day before high and very high air pollution days, air quality alerts are displayed at:

- 2,500 bus countdown signs and river pier signs across London.
- 140 road-side dot matrix message signs on the busiest main roads into London, with instructions to switch engines off when stationary to reduce emissions.
- Electronic update signs in the entrances of all 272 London Underground stations.
- Social and print media channels are utilised to raise awareness. Social media channels are also used for moderate air quality incidents.

High pollution episodes are now a rare occurrence in London. Between 2018 and 2023, the system has issued 19 high pollution and 217 moderate pollution alerts, enabling Londoners to increase their awareness of high pollution episodes and take precautionary action on these days.

At the Clean Air and Health Summit in February 2022, the GLA committed to review the air quality alert messaging and information for London to make it more effective. Following the review, the Mayor of London and [London Air Quality and Health Programme Office](#) developed new Healthcare Air Quality Alerts, which were introduced in February 2024. With support from the NHS, the new alerts will go directly to healthcare professionals in General Practices and Emergency Departments to increase awareness about the health impacts of air quality and enable them to better support patients with conditions that are impacted by air pollution. The NHS has supported this work with new guidance for recipients on what to do when they receive an alert. In addition, the messaging for schools was also updated to include clear actions schools can take to reduce exposure to air pollution.

Air quality at schools and nurseries

Through the [Mayor's School and Nursery Air Quality Audits Programme](#), audits were undertaken at 50 primary schools and 20 nurseries in some of the city's most polluted areas. The audits made recommendations to reduce emissions and exposure. Examples include moving school entrances and play areas away from busy roads, 'no engine idling' schemes, and adding green infrastructure like 'barrier bushes' to help filter fumes.

In February 2024, The Mayor announced the allocation of £2.7m to install PM_{2.5} filters in every classroom of 200 schools. The funding will be supplemented by school engagement, educational resources, and monitoring and maintenance of the filters to help ensure children are breathing cleaner air in schools. If successful, this project could lead to the further rollout of filters across all schools in London. This project builds on the audits undertaken at schools and links with other work, including TfL's ongoing support for school streets, which help improve air quality and awareness of it at schools.

The Mayor introduced the [London Schools Pollution Helpdesk](#) in 2021. When first introduced, it was part funded by Impact on Urban Health. It provides free support, advice, and practical guidance to help improve air quality at schools, particularly those schools which are in the most polluted areas of the city. Since its introduction, the helpdesk has provided tailored support to over 100 schools and nurseries, across 26 boroughs. This includes providing schools with the tools needed to develop Clean Air Day⁴⁰ action plans and completing the [Clean Air for Schools' framework](#).

⁴⁰ Global Action Plan Clean Air Day resources for schools. Available at: <https://www.actionforcleanair.org.uk/campaigns/clean-air-day/school-resources>

Breathe London

Originally launched as a pilot by the Mayor in January 2019, with funding from the Children's Investment Fund Foundation, the Breathe London Network is a first-of-its-kind community air quality network that combines reference-grade analysers with citizen and community-led monitoring.

The Breathe London Network helps make air quality data more accessible and enables wider coverage, providing hyper-local, accurate and reliable data to Londoners. The programme empowers communities to monitor air pollution in their neighbourhoods and use the data to lobby for change.

After a successful first pilot phase, the Mayor committed to funding the programme for four years from January 2021 and launched a new delivery partnership with Imperial College London and Bloomberg Philanthropies, with an increased focus on providing data to community groups. The Breathe London Network started with 136 sensors deployed across London at priority locations such as schools, hospitals, residential communities and reference monitor co-location sites, wholly funded by the Mayor of London. Now in its fourth year, the programme comprises over 400 Breathe London monitoring sites across London.

All the data from the Breathe London Network is publicly available in near real time on the [Breathe London website](#). Additionally, the GLA published a report⁴¹ that summarises the data for the first two years (2021 and 2022) of operation of Breathe London. The report reveals that the annual average concentration of both NO₂ and PM_{2.5} exceeded the WHO AQGs at all sites with sufficient data capture in both years, underlining the importance of ongoing efforts to address air pollution in London.

The Breathe London network has been so successful that London has been the model for cities worldwide. In June 2023, Michael R. Bloomberg and the Mayor announced the launch of the \$30 million [Breathe Cities](#) Initiative, with all participating C40 cities now committed to the combined aim of achieving a reduction of 30 per cent in air pollution by 2030.

⁴¹ GLA (2024). Breathe London Network Air Quality Monitoring Report 2024. Available at: <https://www.breathelondon.org/network-reports>

Mayor's Air Quality Fund

The Mayor's Air Quality Fund (MAQF) supports projects by London boroughs to improve air quality. To date, the Mayor has committed £27 million to the fund, which has been matched by the boroughs and their partners. The MAQF is designed to help the boroughs trial local measures to cut pollution and exposure to pollution. They also share learnings and outcomes with each other, including via workshops and events.

Round 2 of the Fund helped boroughs cut pollution by introducing 25 new clean air routes in some of London's busiest and most polluted neighbourhoods—helping pedestrians reduce their exposure to pollution by up to 60 per cent between 2016-2019.

With the Mayor and TfL's support, boroughs in rounds 1-3 have⁴²:

- installed and upgraded over 400 electric vehicle chargers
- supported 5,300 businesses to reduce their emissions
- created over 3,000 square meters of new green spaces
- planted more than 250 trees
- installed over 1,300 cycle parking spaces
- repaired more than 750 bikes
- provided 17,000 school pupils with resources and materials around improving air quality

Round 4 of the MAQF will start in April 2024. This fourth round of funding aims to help boroughs take action to reduce harmful PM_{2.5} emissions, including by delivering projects to protect the most vulnerable Londoners from pollution exposure in locations such as schools and hospitals, and improve indoor air quality.

⁴² More information about the outcomes of the MAQF can be found online at: <https://www.london.gov.uk/programmes-and-strategies/environment-and-climate-change/pollution-and-air-quality/mayors-air-quality-fund>

Air Quality Neutral and Air Quality Positive Planning Guidance

The Mayor's [London Plan](#) sets out a framework for how London will develop over the next 20-25 years and his vision for Good Growth. Borough's Local Plans must be in 'general conformity' with the London Plan, ensuring that the planning system in London reflects the overall strategy for how London can develop sustainably.

The latest London Plan introduces significant new protections for local and regional air quality. The Plan puts a focus on PM_{2.5} as one of the key pollutants of concern in the city. Construction is one of the key sources of this pollutant in London, contributing to 7.7% of PM_{2.5} emissions in 2019⁴³. In February 2023, new world-leading Air Quality Neutral and Air Quality Positive guidelines were published as part of the new London Plan.

The Air Quality Neutral guidance expects all new developments in London to not contribute to air pollution beyond specified limits (or 'benchmarks'). As well as driving down emissions across the board, the benchmarks also make it much harder to use the most polluting fuels, meaning that, as of 2023, new and refurbished properties in London will be unable to use wood or other solid fuels for heating.

The new Air Quality Positive guidance is a ground-breaking approach that requires developers of large-scale developments to consider their impact on air quality from the earliest design stages. Instead of designing the development and then assessing and mitigating any increases to local air pollution, developers and their architects, planners and air quality experts are expected to consider air quality at every design stage, in addition to demonstrating what measures or design features will be put in place to reduce exposure to pollution.

The new London Plan also makes it clear that borough development plans and other area-based policies will no longer be allowed to use improvements in air quality delivered by the Mayor as "headroom" to allow polluting developments to go ahead.

⁴³ GLA and TfL (2023) London Atmospheric Emissions Inventory 2019 (LAEI 2019). Available at: <https://data.london.gov.uk/dataset/london-atmospheric-emissions-inventory--laei--2019>

London Local Air Quality Management (LLAQM)

The Mayor's [London Local Air Quality Management \(LLAQM\) framework](#) is the statutory process used by the London boroughs to review and improve air quality within their areas. This bespoke system was designed to encourage close working with the London boroughs to help drive the vital local interventions needed to improve London's air quality. It recognises the specific challenges in London and is the process for which these policies measures are introduced and monitored.

Under the LLAQM, boroughs are required to maintain their existing monitoring networks, provide published annual reports on their pollution monitoring and air quality work, and have an up-to-date Air Quality Action Plan detailing the action they will take to tackle local pollution. The framework also provides resources, templates, and support for boroughs on their air quality work.

The LLAQM has enabled the Mayor to ensure the boroughs are taking ambitious action that is properly co-ordinated at the regional level, and that supports Mayoral objectives including those set out in the London Environment Strategy. The LLAQM has helped to deliver a range of improvements in local action, including more targeted and up-to-date Air Quality Action Plans, innovative local and pan-London projects funded through the Mayor's Air Quality Fund, more consistent annual updates from boroughs on their air quality monitoring and progress, an increase in local monitoring undertaken by boroughs, and the provision of a mechanism to ensure that London boroughs continue to work towards achievement of the WHO AQGs even when legal limits are met. The Mayor has also provided additional support including bespoke borough-by-borough modelled pollution maps and data packages, delivering workshops, and providing summaries and platforms for borough monitoring data.

Non-Road Mobile Machinery Low Emission Zone

Non-Road Mobile Machinery (NRMM) is a broad category that includes mobile machines and transportable industrial equipment or vehicles that are fitted with an internal combustion engine and not intended for transporting goods or passengers.

NRMM used in the construction and infrastructure building sectors is a significant contributor to air pollution. As emissions from road transport continue to fall due in large part to the Mayor's bold policies, these sectors are expected to grow as a proportion of London's total emissions⁴⁴. Furthermore, in addition to contributing to overall levels of pollution in London, they can contribute to significant localised pollution issues in proximity to sites where NRMM is used.

London is the only city in the world to have an [NRMM Low Emission Zone \(LEZ\)](#). In the absence of clearly defined enforcement powers at the national level, the NRMM LEZ uses the Mayor's and London boroughs' planning powers to control emissions from NRMM used on construction sites. The NRMM LEZ requires all engines with a power rating between 37 kw and 560 kw to meet emission standards based on the engine emission "Stage".

The NRMM LEZ standards are set to become progressively tighter in line with the NRMM road map which was agreed following consultation with stakeholders. The standards set out ensure we can accelerate the transition to zero emissions for NRMM on construction sites in London, promoting the research, development and uptake of zero-emission technology.

Enforcement of the NRMM LEZ is delivered by a team from the London Borough of Merton, funded by the GLA with match funding from London boroughs. According to the latest figures, the NRMM LEZ audit programme has delivered a significant reduction in emissions from construction site equipment, equivalent to an annual reduction of 42 per cent PM, 36 per cent NO_x and 11 per cent CO₂⁴⁵.

⁴⁴ GLA and TfL (2023) London Atmospheric Emissions Inventory 2019 (LAEI 2019). Available at: <https://data.london.gov.uk/dataset/london-atmospheric-emissions-inventory--laei--2019>

⁴⁵ GLA (2024). Mayor's Air Quality Fund Round 3 Report. Available at: <https://www.london.gov.uk/programmes-and-strategies/environment-and-climate-change/pollution-and-air-quality/mayors-air-quality-fund>

National and international leadership

Over the latest Mayoral term (2021 to 2024), London has continued to show national and international leadership in the field of air quality. Notable air quality achievements and events are listed below:

- In September 2021, the Mayor hosted the Zero-Emission Bus Summit, in partnership with Campaign for Better Transport and TfL to drive forward the uptake of zero-emission buses across the UK. At this summit, the Mayor [announced](#) that all new buses ordered by TfL would be zero-emission.
- In November 2021, the Mayor became Chair of C40 Cities, a global network of almost 100 megacities committed to addressing climate change, and he set out his aims to tackle the twin dangers of air pollution and the climate emergency. London has been an active participant in the C40 Air Quality Network. Altogether, efforts from C40 Clean Air Cities Accelerator have made a [significant impact](#), with an average 5 per cent improvement in air quality between 2018 and 2021, and 94 million more C40 city residents enjoying cleaner air.
- In February 2022, the Mayor convened government, health and Non-Governmental Organisations leaders for the [London Clean Air and Health Summit](#). Attendees at the summit agreed several actions to take forward in partnership to raise awareness of the health impacts of air pollution.
- In July 2022, the Mayor convened global cities in London to accelerate city-led action to address the triple threat of congestion, air pollution and the climate emergency.
- In October 2022, the Mayor attended the [C40 World Mayors Summit](#) in Buenos Aires alongside global mayors, business leaders, philanthropists, campaigners, youth leaders, scientists, and residents. Participants showcased city-led solutions to tackle air pollution, climate change, and inequalities and create cleaner, healthier cities.
- In December 2022, London's policies, including the ULEZ, were featured as a city case study in the [Chief Medical Officer's 2022 Annual Report](#).

Research, evaluation and guidance

The previous Air Quality in London report outlined the wealth of research the GLA published between 2016 and 2020. Since the publication of the previous report, the GLA has continued to publish a large amount of research, guidance, and tools to inform Londoners about the impact of air pollution in London, and what action they can take to minimise their own impact and exposure. Notable examples are outlined in this section.

Research

- The GLA commissioned Imperial College London to assess [the impact on health of the mayoral air quality policies, and air pollution in London](#). The report shows that the Mayor's air quality policies and wider improvements in air pollution will increase the average life expectancy of a child born in London in 2013 by six months.
- The GLA commissioned a report that found [a link between a person's exposure to air pollution and the severity with which they will experience the impacts of Covid-19](#).
- Building upon previous analysis, the GLA commissioned a report analysing the [relationship between exposure to air pollution, deprivation and ethnicity in London in 2019](#). The report shows the impact of Mayor's policies in reducing the exposure gap between most and least deprived areas of London.
- The GLA commissioned a report on the [Health Impact Assessment of Air Pollution on Asthma in London, which](#) shows that improvements in London's air quality helped reduce hospital admissions for asthma attributable to air pollution in London by 30 per cent in children.
- The GLA commissioned a report [evaluating electric vehicle uptake in the UK and London](#), which found that electric car registrations in London are outpacing the rest of the UK, with registrations of diesel cars decreasing significantly since 2016.
- The GLA commissioned [a report to determine the top five most polluted major roads within each London borough and across all of London](#) – the A4202, A501, A301, A1203, and A3211.
- In 2024, the GLA commissioned a report to evaluate the [Pollutant Trends in the UK and London](#), using monitored data across the UK, showing that the largest percentage reductions in NO₂ concentrations was in London between 2016 and 2023.

Evaluation of key policies

- In March 2021, tougher standards for the heavy vehicles operating with the LEZ were introduced. This [LEZ Six Month Report](#) showed that six months on from their introduction, these changes were already delivering results.
- A [Central London ULEZ Report](#) evaluated the impacts of the central London ULEZ during 2020.
- A [School Streets Air Quality Study](#) evaluated the air quality benefits of School Streets. The study found that closing the roads around schools to traffic at pick-up and drop-off times has reduced polluting NO₂ levels by up to 23 per cent.
- An [Expanded Ultra Low Emission Zone – First Month Report](#) followed the 2021 expansion of ULEZ up to, but not including, the North and South Circular roads.
- An [Expanded Ultra Low Emission Zone – Six Month Report, including a Low Emission Zone – One Year Report](#) indicated that these schemes are having a significant impact on the number of older, more polluting vehicles seen driving in London and the levels of harmful pollution Londoners are exposed to.
- An [Inner London Ultra Low Emission Zone Expansion One Year Report](#) evaluated the impacts of the ULEZ and the LEZ schemes, focusing on one year following the 2021 ULEZ expansion to inner London.
- The GLA commissioned a report that showed that the ULEZ policies [achieved improvements in air quality](#) between 2019 and 2022 that rivalled cleaning up the annual emissions produced by all of London's aviation, industrial and commercial heat and power generation, and domestic sources of air pollution combined.
- The [London-wide Ultra Low Emission Zone First Month Report](#) evaluated the impact of the London-wide scheme in its first month.

Guidance and tools

- The [London Atmospheric Emissions Inventory](#) (LAEI 2019), was updated, including forecast years 2025 and 2030.
- In February 2022, the GLA published updated [Air Quality Guides for Public Health Professionals](#), which were shared with local officials in every London borough to help them target local action and reduce health inequalities. These guides contain

borough-specific information on air pollution levels and data on the health impacts of air pollution both generally and in each borough.

- In February 2024, the Mayor of London and [London Air Quality and Health Programme Office](#) developed a new [Healthcare Air Quality Alert](#) as part of the wider Air Quality Alert system to raise awareness of high pollution episodes for healthcare professionals.

Air Quality Trends



This chapter considers the observed and predicted air quality trends across London from 2016 to 31 December 2023 for NO₂, PM_{2.5}, and PM₁₀.

The Mayor has pledged to continue his pioneering work to clean up the capital's air. Thanks to the ambitious policies introduced by the Mayor since 2016, Londoners have experienced significant reductions in NO₂, PM_{2.5}, and PM₁₀ pollution. The following sections provide a summary of analysis of data that shows that there has been significant progress in meeting the existing legal limits, whilst underlining the need for additional action – both locally and nationally - before London can meet legal and safer pollution limits and all Londoners can breathe cleaner air.

These improvements in air pollution confirm that schemes introduced by the Mayor, including the world's first 24-hour ULEZ, the Air Quality Positive and Neutral guidelines, cleaner bus and taxi fleets, and the installation of electric vehicle charging points, are achieving their intended purpose – to create a greener, healthier London for everyone.

Pollutant trends in the UK

London has seen accelerated reductions in air pollutant concentrations when compared with the rest of the UK, due to the ambitious policies implemented and progressed by the Mayor since 2016.

A report commissioned by the GLA showed that average concentrations of NO₂ were much higher in London than the rest of the UK in 2016 – and yet have fallen much more steeply in London compared to the rest of the country⁴⁶. Annual roadside NO₂ concentrations across London dropped by half (49.9 per cent) between 2016 and 2023, compared to 35 per cent in the rest of England. Concentrations decreased by 39.5 per cent in Scotland and 30.6 per cent in Wales during the same period. Preliminary figures also indicate that average annual concentrations of NO₂ in London dropped to the lowest levels ever recorded in 2023, lower even than the first year of COVID-19 lockdowns⁴⁶.

Impact of COVID-19

In March 2020, strict measures were introduced to tackle the COVID-19 pandemic, both in London and across the UK. This had a significant impact on London's air quality, particularly due to changes in road vehicle use. It is important that the change in air pollution concentrations as a result of COVID-19 measures are framed in the context of London's normal seasonal pattern for pollutants and the substantial improvements in London's air quality in recent years, in particular in central London where the ULEZ had already significantly reduced concentrations of certain pollutants prior to 2020.

Since the COVID-19 pandemic, multiple studies have been undertaken to evaluate its impact on air quality across the UK. Reductions in air quality concentrations were observed across the UK during 2020 and to some extent continuing to 2021, and these reductions were observed to be even higher at roadside sites⁴⁶. A report commissioned by the Mayor and published in April 2020 showed that in 2020, before measures to address the COVID-19 outbreak were introduced, hourly average NO₂ concentrations at all sites in central

⁴⁶ Air Quality Consultants (2024). Air Quality Fact Sheet: Pollutant Trends in the UK and London. Available at: <https://data.london.gov.uk/air-quality/#factsheets>

London had already reduced by over one third (35 per cent) compared to the same period in 2017⁴⁷.

In the years leading up to 2020, policies and measures were introduced in London (including Low Emission Bus Zones, the ULEZ and changes to the taxi fleet) that resulted in significant improvements in air quality. Other studies looking into the impact of lockdown on London's air quality have compared concentrations during lockdown to the same period for previous years. Whilst this may be appropriate for other locations, it is not appropriate for London due to the significant recent improvements which pre-date the COVID outbreak.

⁴⁷ GLA (2020). Estimation of changes in air pollution during the COVID-19 outbreak. Available at: <https://www.london.gov.uk/programmes-and-strategies/environment-and-climate-change/environment-publications/estimation-changes-air-pollution-during-covid-19-outbreak-0>

Trends in concentrations from air quality monitoring

London has the most comprehensive air quality monitoring network of any city in the world, with over 150 reference grade air quality monitoring sites and over 1,900 passive diffusion tubes, managed by the London boroughs, alongside the Breathe London Network. The reference sites provide accurate continuous air quality monitoring data that is crucial for research and regulatory reporting.

This section presents data from London's reference grade air quality monitoring stations, comparing monitored NO₂, PM_{2.5}, and PM₁₀ concentrations against the relevant legal limit values and/or WHO AQGs and interim targets from 2016 to 2023, and longer-term trends by site type and location from 2010 to 2023⁴⁸. The number of sites in operation for each pollutant has increased between 2016 and 2023, enabling greater understanding of pollutant concentrations across London.

The air quality monitoring stations presented in this section are operated and funded by the London boroughs, TfL and Heathrow and City airports. Data from these sites are publicly available in real time from the two organisations contracted to undertake the monitoring:

- Imperial College London records real time and historical monitoring data for the majority of sites in London and makes the data available through the [London Air](#) website (previously operated by King's College London).
- Ricardo Energy and Environment records real time and historical monitoring data for a number of additional sites across London and makes the data available through the [Air Quality England](#) website.

It is important to note that these websites provide snapshots of air quality that are not representative of air pollution levels and that annual concentrations should be used when assessing air pollution.

⁴⁸ Note, monitoring data for late 2023 is yet to be ratified and may be subject to change. The standard process of ratifying the data, i.e. undergoing the process of detailed quality assurance and control, can take between six months to a year and varies across monitoring stations in London. Data is not likely to change substantially or affect overall trends.

Types of monitoring sites

For some of the analysis in this chapter, air quality monitoring stations are grouped into two classifications based on site type.

- **Roadside sites** are generally within one to five metres of a busy road and usually located around 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 along busy roads. Roadside sites are useful for identifying air quality hotspots due to traffic that may have potential health impacts - especially those frequented by large numbers of pedestrians.
- **Urban background sites** are located further away from sources of emissions and are not influenced by one single nearby pollution source. In London, traffic is the main source for background sites to avoid and there are guidelines about how close background sites can be to roads. The benefit of urban background sites is they are usually representative of all other urban background locations within an area of several square kilometres. For this analysis “Suburban” and “Urban Centre” sites have been treated as “Urban Background.”

London also has a small number of industrial sites. Pollution levels at industrial sites are influenced predominantly by emissions from nearby industrial sources, such as power generation, incinerators, and waste treatment plants. Concentrations measured at industrial sites are only representative of the immediate local area.

Air pollution concentrations are highly sensitive to the prevailing meteorology, such as wind speed, wind direction, precipitation, and temperature, as well as the 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 wintertime 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. These seasonal and day-to-day variations can make it difficult to assess short term trends. 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 reduces the impact of weather and seasonal factors.

Location of monitoring sites

- **Central sites** are located within the Congestion Charge Zone, this does not include sites on the boundary roads.
- **Inner sites** are located outside the Congestion Charge Zone, but within (and not including) the North and South Circular roads.
- **Outer sites** are located outside (and including) the North and South Circular roads, but within Greater London.

Nitrogen dioxide (NO₂)

The number of air quality monitoring stations in London recording NO₂ has increased from 123 in 2016 to 149 in 2023.

NO₂ Hourly Mean Concentrations

Table 5 summarises the assessment of the number of sites where the number of NO₂ hourly means over 200 µg/m³ exceeded the limit value (18 permitted per year) between 2016 and 2023. The bottom row is the London-wide total of hours that exceeded 200µg/m³ for all sites that recorded monitoring data in that year. Whilst 25 monitoring sites breached the limit value in 2016, no exceedances were monitored in 2023. In 2016, monitoring sites in London recorded over 4,100 hours when NO₂ concentrations were above 200 µg/m³. In 2023 this reduced to only 22 hours, a reduction of 99 per cent.

Table 5: Summary of NO₂ hourly mean exceedances over 200µg/m³

	2016	2017	2018	2019	2020	2021	2022	2023
Number of sites exceeding the limit value (18 per year)	25	13	9	2	0	0	0	0
Total number of hours exceeding 200µg/m ³	4,130	944	404	161	20	26	23	22

NO₂ Annual Mean Concentrations

In this section, to ensure the comparison is robust, results are only compared for the sites that have sufficient data capture in each year. To be included in this analysis, monitoring sites had to collect data for over 75 per cent of the year, which is the requirement made by the European Environment Agency and recommended in LLAQM processes for annual statistics to be included in air quality assessments^{49,50}. There are many unavoidable reasons that may lead to low data capture, such as equipment failures. This does not mean that data was not recorded across the whole year, but that missing data is such that it did not meet the required data capture threshold to be considered representative of the year.

Table 6 shows the summary of monitoring sites that exceeded the limit value for the NO₂ annual mean (40 µg/m³) between 2016 and 2023. In 2016, the limit value was breached at 56 sites. The number of sites exceeding the limit value significantly reduced over the years, with only five sites exceeding in 2023. Note that one of these (Haringey Wood Green roadside site) was only installed recently, in 2022.

The largest reduction was measured at the Westminster – Strand site, where the annual mean concentration reduced from 101 µg/m³ in 2016 to 27 µg/m³ in 2023 (73 per cent).

Table 6: Sites with NO₂ annual mean above the limit value of 40 µg/m³

	2016	2017	2018	2019	2020	2021	2022	2023
Number of sites	56	53	46	47	14	18	14	5

Trends in NO₂

In this analysis, monitoring sites have been grouped by site type and location (central, inner, or outer London), before calculating aggregated monthly average concentrations between 2010 and 2023. Grouping sites together reduces the impact of local factors (e.g. road works near a site) to provide a better estimate for all sites with the same characteristics.

⁴⁹ GLA (2019). London Local Air Quality Management Technical Guidance 2019. Available at: https://www.london.gov.uk/sites/default/files/llaqm_technical_guidance_2019.pdf

⁵⁰ Air quality annual statistics calculated by the EEA are available at: <https://www.eea.europa.eu/data-and-maps/data/aqereporting-9/eststatistics>

Figure 4 and Figure 5 show trends in NO₂ in London from January 2010 to December 2023 at roadside and urban background sites respectively. The graphs show the aggregated monthly average NO₂ by location, statistically smoothed to reduce the impact of seasonal weather patterns. Note that data for late 2023 is yet to be ratified⁵¹, but this is not likely to change substantially or affect overall trends.

Both Figure 4 and Figure 5 show a gradual reduction in monthly average concentrations over the period, with particularly marked reductions at roadside locations from 2016. It is clear that policies aimed at reducing road transport emissions such as the central London ULEZ and the upgrading of the bus fleet contributed to the sharp decrease in NO₂ concentrations at roadside sites in central London, delivering real world health benefits and bringing NO₂ closer to compliance with the legal limit of 40 µg/m³.

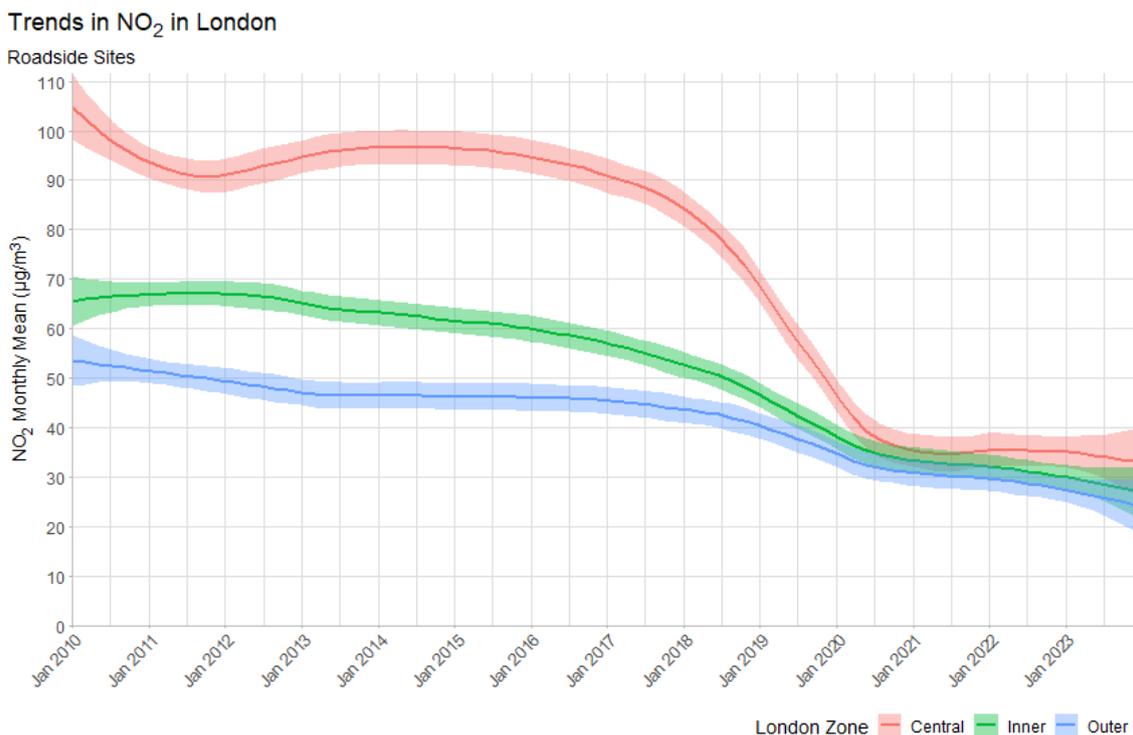


Figure 4: Monthly average NO₂ roadside concentrations in London from 2010 to 2023

⁵¹ Provisional data has been included to provide the most recent data and a current snapshot of air quality conditions. 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 and varies across monitoring stations in London. Data is not likely to change substantially or affect overall trends.

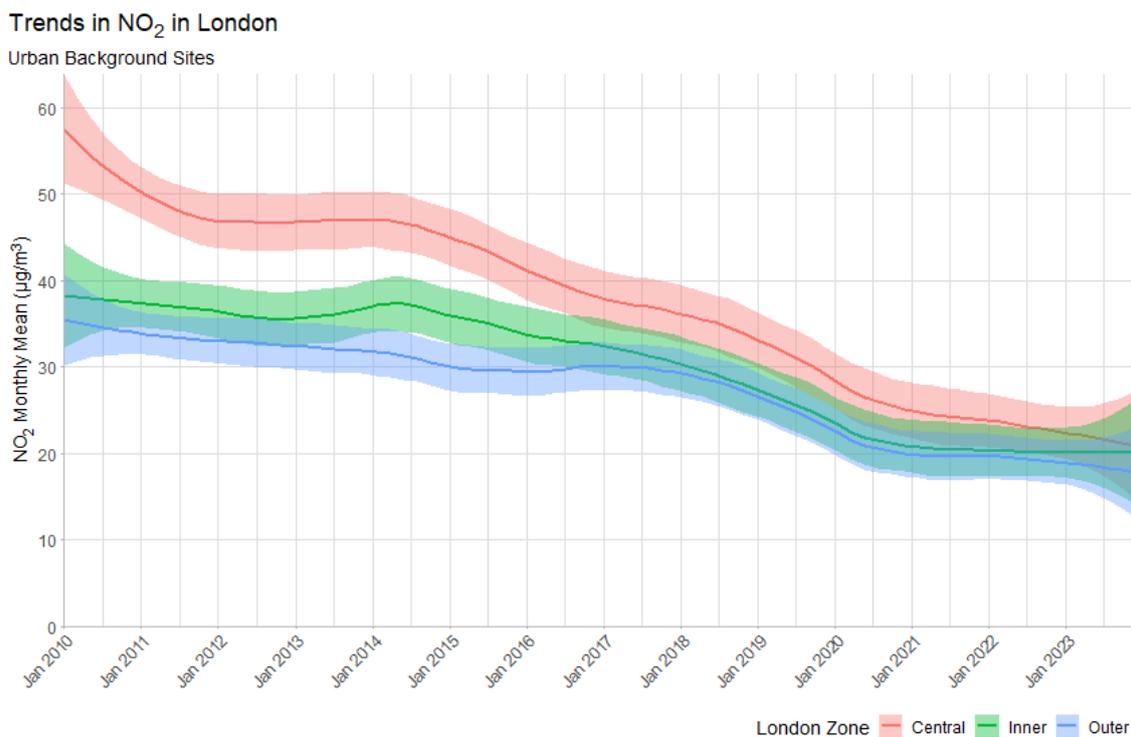


Figure 5: Monthly average NO₂ urban background concentrations in London from 2010 to 2023

Annual average concentrations vary by site. However, to inform general trends across London, Table 7 shows annual mean NO₂ grouped by site type and location. The largest reduction, of 60 µg/m³ (65 per cent), was recorded at roadside sites in central London. The next largest reductions were at roadside sites in inner and outer London, respectively. Reductions at urban background sites over the period were also significant, ranging from a 47 per cent decrease in central London to a 40 per cent decrease in outer London.

The average roadside concentration across all active sites exceeded the annual mean limit value of 40 µg/m³ from 2016 to 2019 in central, inner and outer London. Since 2020, the average across all active sites has been below the limit value. It is worth noting that average roadside concentrations have exceeded the annual mean WHO AQG for NO₂ of 10 µg/m³ in every year.

Table 7: Reduction in annual average NO₂ 2016 - 2023

Year	Average NO ₂ (µg/m ³) in London					
	Roadside			Urban Background		
	Central	Inner	Outer	Central	Inner	Outer
2016	93	61	47	41	34	31
2017	88	54	45	37	31	30
2018	81	49	41	34	28	28
2019	63	45	40	33	28	27
2020	36	33	30	25	21	20
2021	36	34	31	24	20	19
2022	39	32	29	24	20	21
2023	33	29	26	21	19	18
Reduction (µg/m³)	60	32	21	19	15	12
Reduction (%)	65%	53%	45%	47%	45%	40%

In red, exceedance of the limit value

Fine particulate matter (PM_{2.5})

There are fewer PM_{2.5} monitors in London than several other pollutants, as historically the focus for boroughs was on pollutants with a larger local component and that exceeded the legal limits, such as NO₂ and PM₁₀.

Through the LLAQM, boroughs are expected to work towards reducing emissions and concentrations of PM_{2.5}. Boroughs are not required to carry out any additional local review and assessment (including monitoring) but often instead make use of the PM_{2.5} modelling and source apportionment provided in the LLAQM, or estimated from PM₁₀ monitoring data. Whilst there is no monitoring requirement, the GLA has encouraged boroughs to seek funding to instal PM_{2.5} monitors where possible. The number of sites measuring PM_{2.5} increased from 41 in 2016 to 84 in 2023, but many sites struggled with insufficient data capture.

Road transport is the largest single source of PM_{2.5} in London, accounting for around 30 per cent of local emissions in 2019 and forecast to still account for about 25 per cent of total PM_{2.5} emissions by 2030⁵². There is also a large proportion of PM_{2.5} emitted within London that the Mayor does not currently have the powers to address. Additionally, a growing

⁵² GLA and TfL (2023) London Atmospheric Emissions Inventory 2019 (LAEI 2019). Available at: <https://data.london.gov.uk/dataset/london-atmospheric-emissions-inventory--laei--2019>

proportion of road transport PM_{2.5} emissions is now non-exhaust emissions, including road wear, tyre and brake wear, and resuspension of road dust.

PM_{2.5} Annual Mean Concentrations

In this section, to ensure the comparison is robust, results are only compared for the sites that have enough data capture in each year. To be included in this analysis, monitoring sites had to collect data for over 75 per cent of the year.

Table 8 summarises the number of monitoring sites that exceeded the latest interim WHO target for annual mean PM_{2.5} (10 µg/m³) between 2016 and 2023. In 2016, the latest interim WHO target was breached at 24 sites. The number of sites exceeding the interim target significantly reduced over the years, with only seven sites exceeding in 2023. Note that a number of these have only been installed recently, such as Regent Street (The Crown Estate) site. The largest reduction was measured at the RBKC Cromwell Road site, where the annual mean concentration reduced from 17.4 µg/m³ in 2016 to 7.1 µg/m³ in 2023 (equivalent to 59 per cent).

Table 8: Sites with PM_{2.5} annual mean concentrations above the latest interim WHO target of 10 µg/m³

	2016	2017	2018	2019	2020	2021	2022	2023
Number of sites	24	22	24	26	14	16	21	7

Trends in PM_{2.5}

As for NO₂, monitoring sites have been grouped by site type and location, before calculating aggregated monthly average concentrations between 2010 and 2023. Note that data for late 2023 is yet to be ratified but this is not likely to change it substantially or affect overall trends. Figure 6 and Figure 7 show trends in PM_{2.5} in London from January 2010 to December 2023 at roadside and urban background sites, respectively. Both figures show a gradual reduction in monthly average concentrations over the period, with steeper reductions in roadside concentrations.

It is important to note that, compared to NO₂, there are far fewer PM_{2.5} monitoring sites installed across London, although more sites have been added to the network over the past few years. As a result, the aggregated monthly concentration by site type and location can

be based on a small number of sites. For example, in Figure 6 it can be seen that, prior to 2016, there were no roadside PM_{2.5} monitoring sites in central London, and only one such site (Farringdon Street) until 2023, when for the first time three sites could be used to calculate the average monthly concentrations.

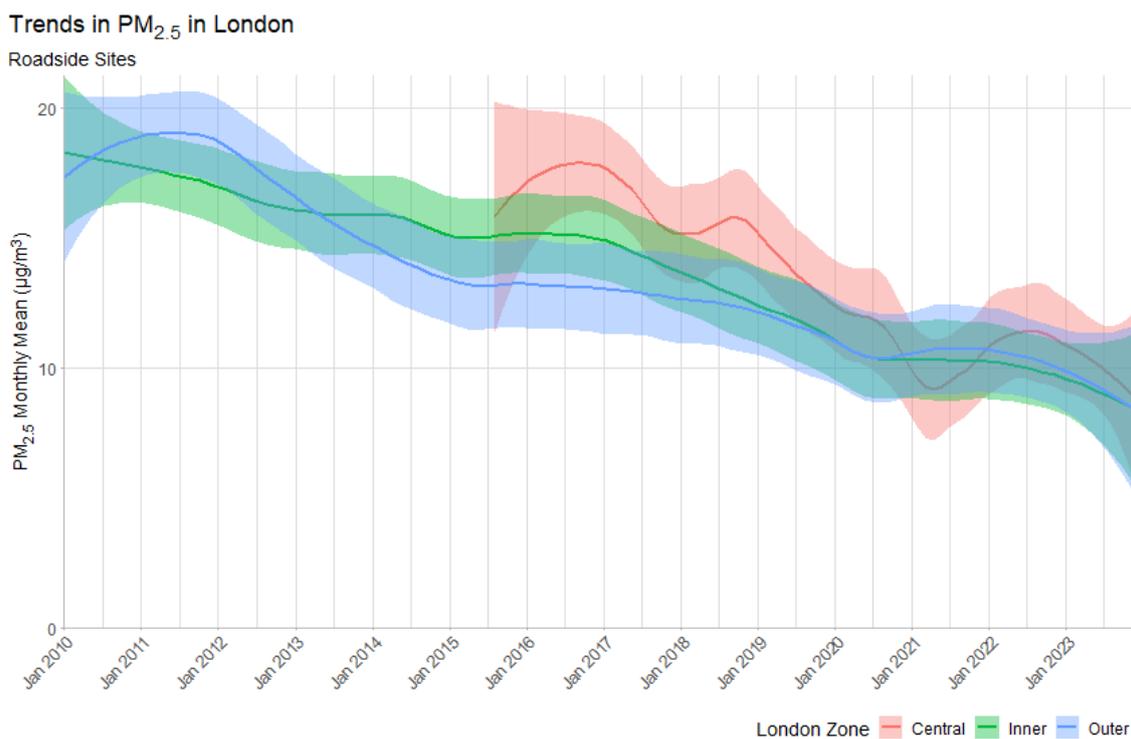


Figure 6: Monthly average PM_{2.5} roadside concentrations in London from 2010 to 2023

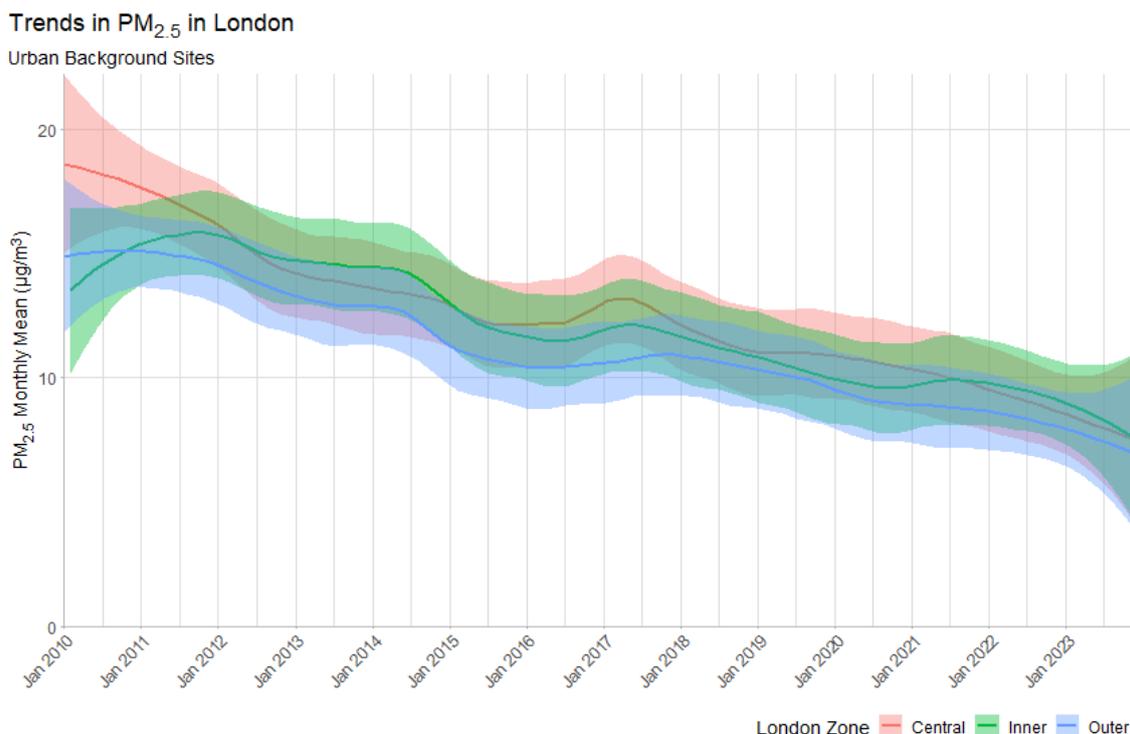


Figure 7: Monthly average PM_{2.5} urban background concentrations in London from 2010 to 2023

Annual average concentrations vary by site. However, to inform general trends across London, Table 9 shows the annual mean PM_{2.5} grouped by site type and location. The largest reduction, 6.5 µg/m³ (41 per cent), was recorded at roadside sites in inner London. The reduction was similar for central London, although the comparison is for 2017, as no data was available for 2016.

The average concentration across all active sites exceeded the annual mean latest interim WHO target of 10 µg/m³ from 2016 to 2019 at all locations in London. In 2020, the average started to be below the latest interim WHO target at urban background inner and outer London locations. The annual mean PM_{2.5} concentration across all active outer London sites continued to exceed the latest interim WHO target until 2023, which was the first year when the annual mean for each site type was below the latest interim WHO target at all locations, although only very slightly below for roadside sites. However, it is worth noting that average roadside concentrations have exceeded the annual mean WHO AQG for PM_{2.5} of 5 µg/m³ in every year.

As mentioned previously, PM_{2.5} is more complex due to the large transboundary contribution. This highlights the need for local action but also more action at regional, national, and international levels to tackle the sources of PM_{2.5} emissions.

Table 9: Reduction in annual average PM_{2.5} 2016 - 2023

Year	Average PM _{2.5} (µg/m ³) in London					
	Roadside			Urban Background		
	Central	Inner	Outer	Central	Inner	Outer
2016		15.7	13.6	12.9	12.1	10.2
2017	16.4	13.7	12.2	12.2	11.6	10.5
2018	15.6	12.8	12.6	11.0	11.1	10.4
2019	13.9	12.2	12.4	11.4	10.8	10.4
2020		10.2	10.3	10.6	9.5	9.1
2021	8.8	9.8	11.4	10.1	9.1	8.5
2022	11.0	10.3	10.8	8.8	9.9	8.7
2023	10.0	9.2	9.4	8.3	8.5	7.8
Reduction (µg/m³)	6.4 *	6.5	4.2	4.7	3.6	2.4
Reduction (%)	39% *	41%	31%	36%	30%	24%

* Compared to 2017 as no data for 2016

In red, exceedance of the latest interim WHO target of 10 µg/m³

Particulate matter (PM₁₀)

PM₁₀ Daily Mean Concentrations

The number of monitoring sites recording PM₁₀ has risen from 107 in 2016 to 121 in 2023.

Table 10 summarises the number of sites where the number of PM₁₀ daily means over 50 µg/m³ exceeded the limit value (35 permitted per year) between 2016 and 2023, as well as the total number of days each year above the limit value.

Whilst four monitoring sites breached the limit value in 2016, no exceedances were monitored in 2023. In 2016, monitoring sites in London recorded a cumulated 963 days when PM₁₀ concentrations were above 50 µg/m³. In 2023 this reduced to only 300 cumulated days, a reduction of 69 per cent.

Table 10: Summary of PM₁₀ daily mean exceedances over 50µg/m³

	2016	2017	2018	2019	2020	2021	2022	2023
Number of sites exceeding limit value (35 days/year)	4	2	2	1	1	1	2	0
Total number of days above 50µg/m ³	963	805	435	932	612	431	602	300

PM₁₀ Annual Mean Concentrations

Table 11 summarises the number of monitoring sites that exceeded the latest interim WHO target for annual mean PM₁₀ (20 µg/m³) between 2016 and 2023.

In 2016, the latest interim WHO target was breached at 50 sites. This reduced to 14 sites in 2023. Note that one of these (Haringey Wood Green roadside site) was only installed recently, in 2022. The largest reduction was measured at the Lambeth – Brixton Road site, where the annual mean concentration reduced from 36.2 µg/m³ in 2016 to 18.1 µg/m³ in 2023, a reduction of 50 per cent.

Table 11: Sites with PM₁₀ annual mean concentrations above the latest interim WHO target of 20 µg/m³

	2016	2017	2018	2019	2020	2021	2022	2023
Number of sites	50	44	44	42	31	23	28	14

Trends in PM₁₀

As for the NO₂ and PM_{2.5} trends, monitoring sites have been grouped by site type and location, before calculating aggregated monthly average concentrations between 2010 and 2023.

Figure 8 and Figure 9 show trends in PM₁₀ in London from January 2010 to December 2023 at roadside sites and urban background sites, respectively. The graphs show the aggregated monthly average PM₁₀ by location, statistically smoothed to reduce the impact of seasonal weather patterns. Note that data for late 2023 is yet to be ratified, but this is not likely to change it substantially or affect overall trends.

Figure 8 and Figure 9 show a gradual reduction in monthly average concentrations over the period, although there was a small increase between 2016 and 2018 in central London. However, like for PM_{2.5}, there are only a limited number of PM₁₀ sites installed in central London compared to NO₂ sites, and the aggregated concentrations for London central roadside sites is based on one site only (Upper Thames Street) until 2019 (this increased to five sites in 2023), therefore, this is not necessarily representative.

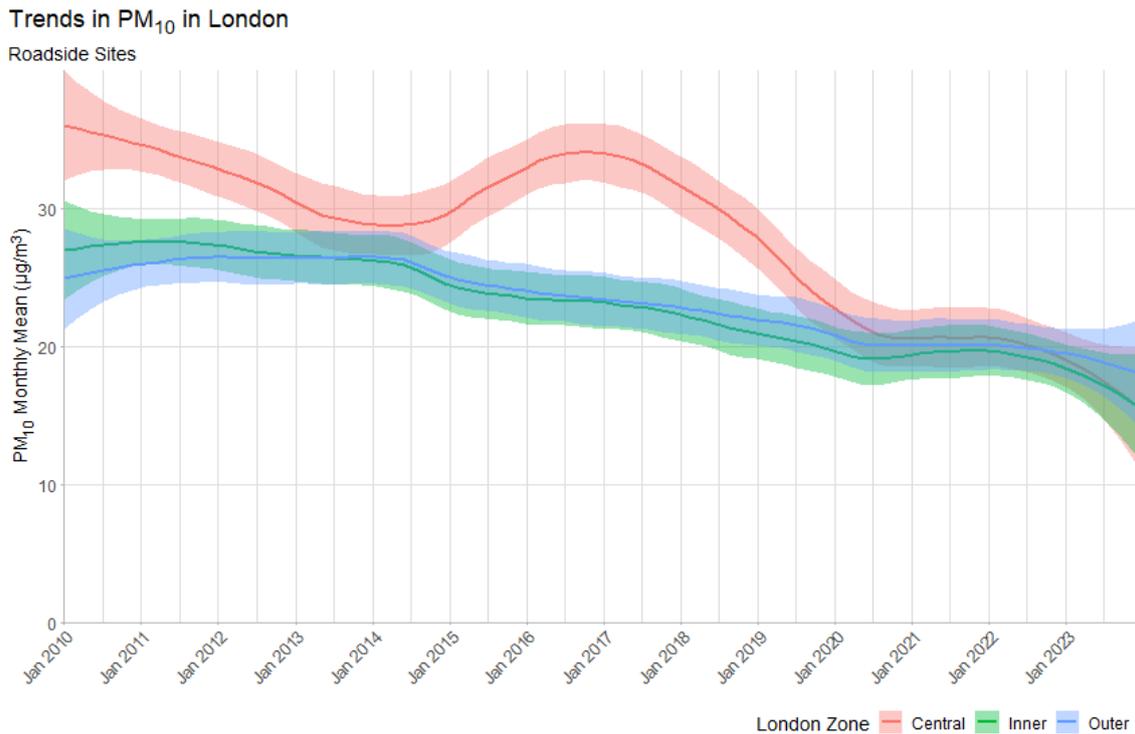


Figure 8: Monthly average PM₁₀ roadside concentrations in London from 2010 to 2023

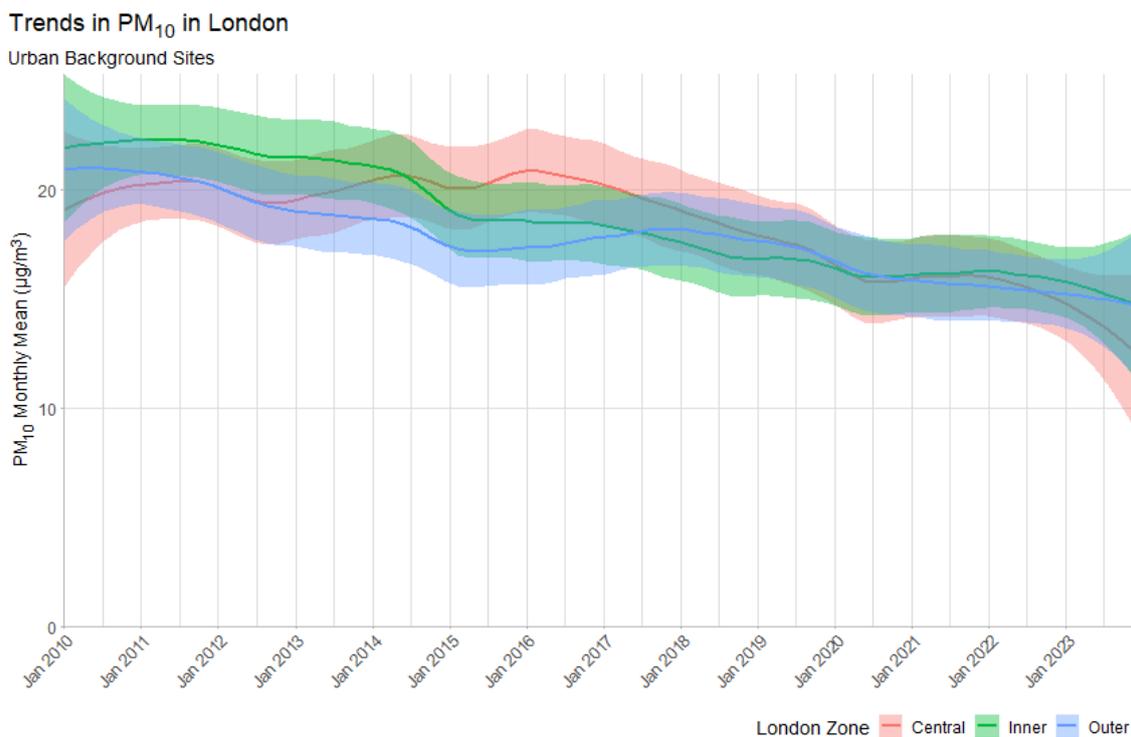


Figure 9: Monthly average PM₁₀ urban background concentrations in London from 2010 to 2023

Annual average concentrations vary by site. However, to inform general trends across London, Table 12 shows annual mean PM₁₀ grouped by site type and location. The largest reduction, 18 µg/m³ (52 per cent), was recorded at roadside sites in central London. The next largest reduction was at urban background sites in central London (18 µg/m³, a 35 per cent reduction).

In 2023, the average concentration in London was below the latest interim WHO target of 20 µg/m³ at all locations for both roadside and urban background sites but remained above the WHO AQG of 15 µg/m³ at all roadside locations.

Table 12: Reduction in annual average PM₁₀ - 2016 - 2023

Year	Average PM ₁₀ (µg/m ³) in London					
	Roadside			Urban Background		
	Central	Inner	Outer	Central	Inner	Outer
2016	35	24	24	21	19	18
2017	32	22	23	19	18	17
2018	32	22	22	19	17	19
2019	26	21	22	17	17	17
2020	21	19	21	16	17	17
2021	20	19	20	16	15	15
2022	22	20	21	17	16	16
2023	17	18	19	14	15	15
Reduction (µg/m³)	18	6	5	8	4	2
Reduction (%)	52%	26%	20%	35%	21%	13%

In red, exceedance of the latest interim WHO target of 20 µg/m³

London-wide Modelling and Future Predictions

The previous section evaluated measured changes in concentrations from London's air quality monitoring stations. Even though London has one of the most extensive monitoring networks in the world, the monitoring network cannot provide London-wide coverage. For this, dispersion modelling is required.

This section provides a summary of the modelling from the [London Atmospheric Emissions Inventory \(LAEI\) 2016](#) and the [London Atmospheric Emissions Inventory \(LAEI\) 2019](#). The LAEI will be updated in 2024, and it will include a new baseline (2022) for pollutant emissions and concentrations. The LAEI 2019 is therefore the latest version of the LAEI and replaces previous versions of the inventory, providing a new baseline for 2019, as well as new forecasts for 2025 and 2030. However, it is important to note that the forecasts do not include the London-wide ULEZ, which will have further air quality benefits that are not accounted for in this modelling⁵³.

The overall findings of the LAEI modelling, together with the monitoring of all air quality sites in London, demonstrate that the Mayor's policies have accelerated progress towards cleaner air since 2016, and that these improvements are set to continue to 2025 and 2030.

However, there is still more work to be done before London meets legal and safer pollution limits and all Londoners can breathe cleaner air. With the much stricter AQGs introduced by the WHO in 2021, more action is needed across all levels of government to protect the health of Londoners.

Nitrogen dioxide (NO₂)

Parts of London still exceed the annual UK limit for NO₂ (40 µg/m³), however the Mayor is committed to achieving the much stricter WHO AQG (10 µg/m³) London-wide as soon as possible.

⁵³ More detail on LAEI including the policies included in the LAEI modelling can be found in the LAEI 2019 Summary Note, available at: <https://data.london.gov.uk/download/london-atmospheric-emissions-inventory--laei--2019/06aab8a6-79a6-40ae-8038-8303ac82a3aa/LAEI%202019%20Summary%20Note%20FINAL.pdf>

In 2016, over two million Londoners, including 400,000 children, lived in areas exceeding the annual mean legal limit for NO₂⁵⁴. In 2019, this was estimated to have fallen to 161,000 people, a reduction of 92 per cent⁵⁵. The number of educational establishments located in areas exceeding the legal limit for NO₂ fell from 793 in 2016 to 50 in 2019, a reduction of 94 per cent⁵⁶. Due to ambitious air quality action by the Mayor, it is estimated that London will be legally compliant with the NO₂ annual mean UK limit by 2025.

Continued action is important to meet the legal limit for NO₂, as relatively small increases could bring areas home to hundreds of thousands of Londoners back over the legal limit. An increase of just 1 µg/m³ from 2019 levels of NO₂ would result in an additional 68,200 people living in areas exceeding the legal limit. An increase of 2 µg/m³ would result in a return of a further 156,000 people living in areas exceeding the legal limit.

There have been significant improvements in concentrations of NO₂ London-wide between 2016 and 2019, with modelled London-wide NO₂ concentrations reducing by 22 per cent over this period. Looking forward, concentrations are predicted to further reduce by 56 per cent between 2016 and 2030. By 2030, over three quarters of London is expected to meet the latest NO₂ WHO annual average interim target of 20 µg/m³, however nowhere in London will meet the WHO annual average AQG of 10 µg/m³.

The most significant source of NO_x emissions across London is road transport. NO_x emissions from vehicles have reduced by 31 per cent in London and are expected to reduce by 70 per cent in 2025 and by 85 per cent in 2030, compared to 2016. This is mostly due to the impact of the central ULEZ, which reduced vehicle exhaust emissions in central London by 43 per cent between 2016 and 2019.

Due to the impacts of the Mayor's ambitious air quality policies, which have reduced the contribution of road traffic emissions, it is forecast that by 2025 road transport will no longer

⁵⁴ For this analysis, concentrations are averaged over census output areas, which typically represent about 350 people.

⁵⁵ This is much larger than the reduction in annual average NO₂. This is because in 2016 there were many areas with NO₂ concentrations just above the legal limit value.

⁵⁶ London-wide modelling used for this evaluation cannot consider local measures such as installing green infrastructure, school streets or anti-idling campaigns.

be the dominant source of NO_x across London, and it will be overtaken industrial and commercial heat and power generation.

Fine particulate matter (PM_{2.5})

The Mayor has committed to achieving the latest WHO interim target of 10 µg/m³ London-wide by 2030, and achieving the ultimate AQG of 5 µg/m³ as soon as possible.

On average, London-wide PM_{2.5} concentrations reduced by 19 per cent between 2016 and 2019. The number of educational establishments located in areas exceeding the latest interim WHO target for PM_{2.5} fell from 3,242 in 2016 (100 per cent of establishments) to 2,879 in 2019. For the first time, modelling has estimated some areas of London to be within the latest interim WHO target of 10 µg/m³ in 2019. In 2016, 100 per cent of the London population were living in areas exceeding 10 µg/m³ PM_{2.5}, reducing to 89 per cent per cent in 2019.

However, as discussed in the previous section, there is still more work to do to bring levels of PM_{2.5} within the WHO interim target and recommended AQG. Compared to 2016, concentrations of PM_{2.5} in 2025 and 2030 are predicted to reduce by 27 per cent and 33 per cent, respectively. The LAEI 2019 predicts that 27 per cent of Londoners in 2025 and four per cent in 2030 will be living in areas exceeding the latest interim WHO PM_{2.5} target.

There has been a general reduction in PM_{2.5} emissions across London, although the reduction has not been as significant as seen for NO_x. This is in part due to the non-exhaust component of PM_{2.5} road traffic emissions, which occurs even with electric vehicles. This shows the importance of accelerating efforts across the country to tackle PM_{2.5} emissions coming from other sources. The largest London-wide reduction of PM_{2.5} emissions was, and is predicted to be, from road transport. In 2019 road transport PM_{2.5} emissions reduced by 14 per cent across London and 34 per cent in central London compared to 2016. The impact of transport policies such as the ULEZ on PM_{2.5} concentrations is evident, particularly in central London.

Particulate matter (PM₁₀)

The Mayor has committed to achieving the WHO AQG for PM₁₀ (15 µg/m³) London-wide as soon as possible, and achieving the latest interim WHO target (20 µg/m³) is a step towards this ultimate goal.

On average, modelled London-wide PM₁₀ concentrations have reduced by 24 per cent between 2016 and 2019 and are projected to reduce further by 29 per cent in 2025 and 34 per cent in 2030. Compared to 2016, total PM₁₀ emissions had reduced by four per cent London-wide, and one per cent in central London in 2019. PM₁₀ emissions are forecast to reduce a further 11 per cent in 2025 and 16 per cent in 2030 London-wide. In central London, the reduction is estimated to be 24 per cent in 2025 and 33 per cent in 2030.

The highest proportion of these PM₁₀ reductions come from road transport, which is highly influenced by the ULEZ in central London. Road transport PM₁₀ emissions reduced by nine per cent London-wide, and 24 per cent in central London from 2016 to 2019. Emissions London-wide are forecast to reduce by 24 per cent in 2025 and 36 per cent in 2030, compared to 2016.

It is worth noting that local transport policies to reduce emissions will have a smaller impact on PM₁₀ concentrations compared to NO_x emissions. This is due to PM₁₀ being highly influenced by meteorological conditions, background concentrations, sources from outside London, and the non-exhaust component of PM emissions (brake and tyre wear and road abrasion). Sources outside London and the non-exhaust component will remain significant sources of pollution and thus more needs to be done, both at a local and national scale, to reduce PM₁₀.

Conclusion and Looking Ahead



Since 2016, the Mayor of London has embarked on an ambitious programme of air quality action. This included introducing the world's first 24-hour ULEZ, cleaning up London's bus and taxi fleets, introducing new air-quality focused planning guidance, and taking action to reduce exposure to air pollution at some of the city's most polluted schools. The evidence from London's air quality monitoring network and London-wide modelling shows that this bold action has delivered significant real-world improvements for London's air quality.

Since the Mayor took office in 2016, monitoring from the expansive network of reference-grade air quality monitors across London shows that NO₂ concentrations have reduced London-wide, with average roadside reductions of 65 per cent, 53 per cent and 45 per cent at central, inner, and outer monitoring locations, respectively. Across London as a whole, average roadside NO₂ concentrations have been reduced by 50 per cent.

Furthermore, monitored data across London shows that average roadside PM_{2.5} concentrations in central, inner, and outer London have reduced by 39 per cent, 41 per cent, and 31 per cent, respectively.

These reductions show how much progress has been made across London since the Mayor first took office in 2016, demonstrating that significant improvements in London have been driven by bold local policies. These reductions are already having health benefits for Londoners and will continue to do so for years to come, which will help reduce costs to the NHS and wider economy.

Looking Ahead

However, there is much more work still to be done locally and nationally. Whilst the air quality data presented in this report represent a substantial improvement in air quality over both Mayoral terms, significant work remains to bring pollution down to levels where it does not have a harmful impact on public health. The Mayor has been clear that he is committed to meeting the new WHO AQGs as soon as possible. This will require coordinated action from all levels of government, working with both public and private sectors.

Whilst significant reductions in NO₂ concentrations have been recorded, none of the major roads or educational establishments in London met the WHO annual mean AQG of 10 µg/m³ for NO₂ in 2019, and this is predicted to still be the case by 2025 and 2030. Further action will be necessary if London is to meet its target of achieving the new WHO AQGs as soon as possible.

The Mayor has ruled out introducing a new pay-per-mile road charging scheme. He has set ambitious targets in other areas, such as the aim for 80 per cent of all trips in London to be made on foot, by bike or using public transport by 2041, for more electric vehicle charging points across London, as well as for the entire bus fleet of around 9,000 buses to be zero-emission by no later than 2034.

Due to the impacts of the Mayor's ambitious air quality policies, which have reduced the contribution of road traffic emissions (where he has the powers to act), it is forecast that by 2025 road transport will no longer be the dominant source of NO_x emissions across London, and it will be overtaken by industrial and commercial heat and power generation. The London Environment Strategy laid out the additional powers required by the Mayor to tackle

non-transport sources. He has continued to lead the way on these issues, despite the lack of powers. The Mayor, working with the London boroughs, has put in place programmes and policies that are having an effect on non-transport sources, such as setting an ambitious target of all NRMM used in construction in London being zero-emission by 2040, and introducing Air Quality Positive and Neutral planning policies that will reduce emissions from construction and buildings.

For PM_{2.5} the challenge is greater still, with 89 per cent of Londoners living in areas exceeding the latest interim WHO target in 2019, which the Mayor has committed to achieving by 2030, and all Londoners living in areas exceeding the ultimate WHO AQG of 5 µg/m³. Road transport is the largest single source of PM_{2.5} in London, accounting for around 30 per cent of local emissions in 2019 and forecast to still account for about 25 per cent of total PM_{2.5} emissions by 2030. The LAEI has forecast that PM_{2.5} concentrations will reduce in future years. However, 27 per cent of Londoners in 2025 and four per cent of Londoners in 2030 will still live in areas exceeding the latest interim annual mean WHO target.

PM_{2.5} is more complex due to the large transboundary contribution. This highlights the need for local action and more action at a regional, national and international level to tackle the sources of PM_{2.5} emissions. Therefore, new powers allowing London to tackle local sources of PM_{2.5}, as well as action across wider public and private sectors will be essential for London to meet the latest interim annual mean WHO target by 2030 and the WHO AQG as soon as possible, delivering further vital health improvements for Londoners. The evidence presented in this report underlines that whilst significant progress has been made towards complying with UK legal limits, further action is necessary to achieve the WHO AQGs as soon as possible.

Although this report has focused on the action and progress in tackling ambient air pollution, the Mayor has also demonstrated leadership on indoor air quality by identifying it as a key issue and taking steps to address it ahead of most other policy makers.⁵⁷

⁵⁷ More information is available in the London Environment Strategy progress reports, which are available at: <https://www.london.gov.uk/programmes-and-strategies/environment-and-climate-change/london-environment-strategy>

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