April 2023

London Atmospheric Emissions Inventory 2019 Update

Summary

The London Atmospheric Emissions Inventory (LAEI) 2019[1] provides an update to the previous LAEI 2016 and a new baseline for 2019, as well as revised emissions for the previous baselines 2013 and 2016, and new forecast emissions and concentrations for 2025 and 2030, although it is important to note that the forecasts do not include the upcoming London-wide ULEZ. This document is an update to that published in 2021 and provides an overview of the LAEI 2019 output results for all years mentioned above, including:

- Changes in nitrogen oxides (NO_x) and particulate matter (PM_{10} and $PM_{2.5}$) emissions by source;
- Maps of annual mean concentrations for nitrogen dioxide (NO_2), PM_{10} and $PM_{2.5;}$
- Analysis of the proportion of London's major roads, and the Transport for London Road Network (TLRN - the London "Red Routes") meeting air quality targets; and
- The number of Londoners, and the number of schools, hospitals and care homes meeting air quality targets for NO_2 and $PM_{2.5}$.

Since the previous update of the LAEI, evidence of the health impacts of air pollution, even at levels previously considered to be low, has continued to increase. One consequence of this has been that the World Health Organization (WHO) updated their health-based guidelines for air quality in 2021, the first update since 2005. The new air quality guidelines reflect the best available health evidence and WHO's recommendations continue to be recognised globally as the targets that should be met to protect public health. The recommended level for annual mean NO_2 has been revised from 40 µg/m^3 in the 2005 guidelines to 10 µg/m^3 in the 2021 guidelines. Similarly, for $PM_{2.5}$ the 2005 guideline was 10 µg/m^3, in the 2021 update this was revised to 5 µg/m^3.

Table 1: Recommended WHO Air Quality Guidelines in 2005 and in 2021

Pollutant	Averaging Time	2005 Guideline	2021 Guideline
NO_2	Annual	40	10
PM_{10}	Annual	20	15
$PM_{2.5}$	Annual	10	5

These new WHO air quality guidelines for NO_2 and $PM_{2.5}$ were not achieved anywhere in London in 2019 and the forecasts show that they are very unlikely to be achieved anywhere in London in either 2025 or 2030.

[1] 2019 data is the most up to date available. Forecasts are modelled to a peer reviewed methodology.

Recognising that many places throughout the world are not yet close to achieving the latest guidelines, the WHO also introduced a series of "interim targets" designed to be used as incremental steps towards meeting the air quality guidelines. The interim targets and guidelines can be met with leadership and continued bold action by all those responsible. The LAEI forecast data shows that meeting the interim targets is possible within the timeframe of this dataset. In the London Environment Strategy, the Mayor committed to achieving annual mean concentrations of 10 μg/m^3 of $PM_{2.5}$ by 2030, a full decade before the new UK legal limits, the data demonstrated that this can be achieved only if further continued bold action is put in place.

The relationship between different clean air targets is described in more detail below.

Key findings are:

The overall findings of this data set demonstrate accelerated progress towards cleaner air since 2016. While strong progress is being made to bring large areas of London within the WHO's interim targets forNO_2, $PM_{2.5}$ and the WHO guideline for PM_{10}, on current projections no areas of London will come within WHO's guidelines for safe air by 2030 for NO_2 and $PM_{2.5}$ without further action. The Mayor has pledged to take further action by expanding the ULEZ London-wide at the end of August 2023. However the below projections were commissioned prior to that decision being taken and therefore do not account for the effects of ULEZ expansion, which is anticipated will lead to a greater drop in emissions.

<u>Emissions</u>

- There has been a clear accelerated reduction in emissions since the announcement and implementation of Mayoral policies on air pollution from 2016.
- NOx emissions reduced by 18% in Greater London between 2016-2019 and are forecast to reduce further by 31% in 2025, and 44% in 2030 compared to 2019 levels.
- The reduction in NO_x emissions from road transport between 2016 to 2019 was 31%, more than double the reduction between 2013-2016, which was just 14%. This is primarily influenced by strong Mayoral policies specifically targeting vehicle emissions.
- Compared to 2016, total PM_{10} emissions reduced by 4% in Greater London in 2019 and are forecast to reduce further by 7% in 2025, and 12% in 2030, from 2019 levels. The largest source of PM_{10} emissions is not road transport, which accounted for 27% of PM_{10} emissions in 2019, but key Mayoral policies, including the ULEZ are likely to have had an effect on PM_{10} and we have seen the pollutant reduce by 9% across all of London and 23% across central London between 2016-2019. Between 2013-2016 PM_{10} reduced by just 4%, showing the accelerated progress made in recent years thanks to bold Mayoral policies such asthe ULEZ.
- Compared to 2016, total $PM_{2.5}$ emissions reduced by 5% in Greater London in 2019 and are forecast to reduce further by 11% in 2025, and 18% in 2030, from 2019 levels.

<u>Concentrations</u>

- Despite progress towards the WHO interim targets due to Mayoral policies, all of London exceeds the WHO annual average guidelines of 10 μg/m^3 for NO_2 and 5 μg/m^3 for $PM_{2.5}$ in 2019 and forecasts show that all of London will continue to exceed them in both 2025 and 2030 without further action.
- None of the major roads in London met the WHO annual mean air quality guideline of 10 μg/m^3 for NO_2 in 2019, and that will still be the case by 2025 or 2030 without further action.

Population exposure

There have been significant reductions in the number of Londoners living in areas of that exceed the WHO interim targets, however further action is needed to make progress toward meeting the WHO guidelines for healthy air.

- Almost 9 million Londoners were living in areas exceeding the WHO interim annual mean of 20 $\mu g/m^3$ NO_2 in 2019. This is expected to reduce to about half in 2025 and just over half a million in 2030.All 8.8 million Londoners were living in areas exceeding the WHO interim target of 10 $\mu g/m^3$ for $PM_{2.5}$ in 2016. This reduced to just over 8 million exceeding in 2019 and it is forecasted to decrease to 2.5 million in 2025, and to 400,000 in 2030.
- **However, all Londoners live in areas exceeding the WHO Guidelines of 10 $\mu g/m^3$ for NO_2 or 5 $\mu g/m^3$ for $PM_{2.5}$ in 2019 and are forecast to continue to do so in 2025 or 2030 without further action.**

Educational establishments

- 99% of all educational establishments (3,218 establishments) were in areas exceeding the WHO interim air quality guideline of 20 $\mu g/m^3$ for NO_2 in 2019, with forecasts showing that without further action 1,528 (47%) would still be in areas exceeding the interim targets in 2025 and 219 (7%) in 2030.
- Of all state primary and secondary schools, 2,231 (99%) exceeded 20 $\mu g/m^3$ NO_2 in 2019, 948 (42%) will exceed it in 2025 and 115 (5%) in 2030.
- **However, without further action all educational establishments are forecast to be in areas exceeding the WHO guideline of 10 $\mu g/m^3$ for NO_2 still in 2025 and in 2030.**
- 88% of all educational establishments were in areas exceeding the WHO interim air quality guideline of 10 $\mu g/m^3$ for $PM_{2.5}$ in 2019. This is estimated to reduce to 27% in 2025 and 5% in 2030.
- **However, without further action all educational establishments are forecast to be in areas exceeding the WHO guideline of 5 $\mu g/m^3$ for $PM_{2.5}$ still in 2025 and in 2030.**

Hospitals

- For the WHO interim target of 20 $\mu g/m^3$ annual mean NO_2, 278 (98%) hospitals in London were in areas of exceedance in 2019, while 158 (56%) are expected to exceed in 2025 and 78 (27%) in 2030.
- **However, without further action all London hospitals are forecast to be in areas exceeding the WHO guideline of 10 $\mu g/m^3$ for NO_2 still in 2025 and in 2030.**
- 91% of London hospitals were in areas exceeding the WHO interim air quality guideline of 10 $\mu g/m^3$ for $PM_{2.5}$ in 2019. This is estimated to reduce to 39% in 2025 and 19% in 2030. **However, all London hospitals are forecast to be in areas exceeding the WHO guideline of 5 $\mu g/m^3$ for $PM_{2.5}$ still in 2025 and in 2030.**

Care Homes

- All 519 of London's care homes were in areas exceeding the WHO interim target of 20 $\mu g/m^3$ for NO_2 in 2019, with 156 (30%) expected to exceed in 2025 and only 8 (2%) in 2030.
- **However, without further action all London care homes are forecast to be in areas exceeding the WHO guideline of 10 $\mu g/m^3$ for NO_2 still in 2025 and in 2030.**
- 84% of care homes were in areas exceeding the WHO interim air quality guideline of 10 $\mu g/m^3$ for $PM_{2.5}$ in 2019. This is estimated to reduce to 14% in 2025 and none in 2030.

- **However, without further action all London care homes are forecast to be in areas exceeding the WHO guideline of 5 µg/m^3 for $PM_{2.5}$ still in 2025 and in 2030.**

The significant improvements in pollution levels seen are due to a number of different factors including the Mayor's work to improve air quality with schemes such as the Ultra Low Emission Zone (ULEZ) and its expansion to inner London; the London-wide Low Emission Zone (LEZ) for heavy vehicles; the Non Road Mobile Machinery Low Emission Zone; planning policies such as the Air Quality Positive and Neutral policies; progressive taxi licencing schemes and installation of electric vehicle charge points. Local action by boroughs has also brought improvements to pollution hotspots. Such action has accelerated the reduction in emissions and improvement in air quality concentrations above and beyond that of the natural churn of the vehicle fleet which has also helped reduce emissions and concentrations.

However, the forecast shows that further action will be needed to tackle emissions from both transport and non-transport sources of air pollution, such as wood burning, in order to meet the WHO air quality guidelines and protect health. This includes taking action in outer London where the upcoming further expansion of the ULEZ will help improve air quality for millions more Londoners.

Introduction

The London Atmospheric Emissions Inventory (LAEI) is produced by Transport for London and the Greater London Authority with input from project partners at Imperial College London, Aether, Ricardo, Heathrow Airport and the Port of London Authority.

The 2019 LAEI was published on 16 December 2021. It provides an update to the previous LAEI 2016 and a new baseline for 2019. Emissions and concentration map projections for the years 2025 and 2030 have also been published in April 2023.

The new base year is 2019 and includes the impacts associated with the operation of the central London Ultra Low Emission Zone (ULEZ). It does not include the impacts due to the introduction of tougher standards for the London-wide Low Emission Zone (LEZ) or ULEZ expansion to the North/South Circular Road, as these were not yet operational[2]. However, any pre-compliance that may have been taken by vehicle owners are reflected in fleet composition data for vehicles – for example, TfL bus preparation for the tougher LEZ standards. It is also important to note that all of the air quality improvements referred to in this summary for 2019 pre-date the COVID-19 pandemic. Finally, the 2025 and 2030 forecast air quality maps do include the 2021 ULEZ expansion to the North and South Circular and the tighter LEZ standards but do not include the future expansion of the ULEZ London-wide, which has been announced on 25 November 2022[3].

The data from the LAEI is publicly available on the London Data Store and is used as an evidence base for air quality policy work.

The comprehensive data set includes:

- Emissions trends
- Concentration maps for 2019, 2025 and 2030 for nitrogen dioxide (NO_2) and particulate matter (both PM_{10} and $PM_{2.5}$)
- Proportion of roads exceeding the NO_2 targets
- Population exposure data for NO_2 and $PM_{2.5}$
- Air pollution exposure at schools, care homes and hospitals
- Emissions by pollutant and source, split by London Zone and by borough
- Updated back projections for 2013 and 2016

[2] The tougher standards for the London-wide LEZ were enforced from 1 March 2021 and the ULEZ was expanded on 25 October 2021.
[3] The London-wide ULEZ will come into effect on 29 August 2023.

New World Health Organization (WHO) recommended air quality guidelines

In 2021, the WHO updated its recommended guidelines for air pollutants[4]. The new air quality guidelines reflect the best available health evidence and WHO's recommendations continue to be recognised globally as the targets that should be met to protect public health.

- For particulate matter (PM_{10}), it tightened the recommended annual average concentration guideline to 15 µg/m^3, while retaining 20 µg/m^3 as an interim target.

- For fine particulate matter ($PM_{2.5}$), it tightened the recommended annual average concentration guideline to 5 µg/m^3, while retaining 10 µg/m^3 as an interim target, which the Mayor committed to meet by 2030 within his London Environment Strategy.

- For nitrogen dioxide (NO_2) the WHO also tightened the recommended annual average guideline to 10 µg/m^3 (the previous WHO guideline was 40 µg/m^3), whilst introducing additional interim targets of 30 µg/m^3 and 20 µg/m^3, representing incremental steps to progressively reduce NO_2 levels and achieve the newly proposed air quality guideline level.

These changes underscore that, despite the significant progress made, accelerated additional action is needed to protect human health, since, as highlighted in the WHO air quality guidelines report 2021, available evidence cannot currently identify levels of exposure that are risk free. Delivering this action will require the Government to work with the Mayor of London and provide further powers and resources[5]. The Mayor continues to make the case for these.

Relationship between WHO guidelines and UK legal limits

Following passage of the Environment Act 2021 the Government has introduced two new legally binding limits for fine particulate matter ($PM_{2.5}$):

- An annual mean concentration target ('concentration target') - a maximum concentration of 10 µg/m^3, to be met across England by 2040, and

- A population exposure reduction target ('exposure target') - a 35% reduction in population exposure by 2040 (compared to a base year of 2018).

Existing legal limits, including those for the NO_2 annual and hourly means, remain in place.

The Mayor has long made the case for UK air pollution limits for all air pollutants to be aligned with the WHO recommended air quality guidelines, which are based on the best available health evidence. In the London Environment Strategy, the Mayor committed to achieving annual mean concentrations of 10 µg/m^3 of $PM_{2.5}$ by 2030, a full decade before the new UK legal limits, the LAEI data demonstrate that this can be achieved.

[4] "WHO global air quality guidelines: particulate matter ($PM_{2.5}$ and PM_{10}), ozone, nitrogen dioxide, sulfur dioxide and carbon monoxide" - https://www.who.int/publications/i/item/9789240034228

[5] As detailed in report "$PM_{2.5}$ in London: Road Map to Meeting WHO Guidelines by 2030" – GLA, October 2019 – https://www.london.gov.uk/sites/default/files/pm2.5_in_london_october19.pdf

Appendix 2 reports on the annual mean concentrations for NO_2 compared to UK legal limit values.

This LAEI summary provides supporting evidence for the WHO air quality guidelines to be adopted. In this document, annual mean concentrations for NO_2, PM_{10} and $PM_{2.5}$ have been compared to the new WHO air quality guidelines.

Action to improve air quality

The improvements in pollution levels seen are due to a number of different factors including the Mayor's work to improve air quality with schemes such as the Ultra Low Emission Zone (ULEZ) and its expansion; the London-wide Low Emission Zone (LEZ) for heavy vehicles; the Non Road Mobile Machinery Low Emission Zone; planning policies such as the Air Quality Positive and Neutral policies; progressive taxi licencing schemes and installation of electric vehicle charge points. Local action by boroughs has also brough improvements to pollution hotspots. Such action has accelerated the reduction in emissions and improvement in air quality concentrations above and beyond that of the natural churn of the vehicle fleet.

Comparison with 2019 snapshot analysis published in 2020 (MER2019)

In October 2020, City Hall published an initial assessment of London's air quality in 2019. The modelling for this was undertaken by King's College London and was based on the LAEI 2016, alongside a new Mayor's Evaluation Report snapshot model for 2019 (MER2019). It is important to note that the MER2019 was not a full LAEI model, but rather a snapshot, since, due to the time required to compile the input datasets, the full data for 2019 was not yet available. This meant that some input data for MER2019 had been scaled from previous years. In addition, some of the monitoring data against which the MER2019 was validated was still provisional at the time. As a result, greater uncertainty was associated to the MER2019 results compared to typical LAEI modelling results.

With the updated LAEI 2019, we now have a more complete understanding of emissions and concentrations for 2019. Therefore, whilst the MER2019 and LAEI 2019 analysis are very similar, there have been some minor changes in results. For example, the number of state primary and secondary schools that are located in areas exceeding legal pollution limits in 2019 is now estimated to be 20 rather than 14. Nonetheless the scale of improvement – a 96% reduction from 450 schools in 2016 – remains significant.

Key findings

Emissions Trends

Nitrogen Oxides (NO_x)

Since 2013, there has been a significant reduction in total NO_x emissions across the whole of London, including in central London. Figure 1 and Figure 2 show the trend in NO_x emissions per source. Compared to 2016, total NO_x emissions reduced by 18% in Greater London, and 17% in central London in 2019. The largest reduction in (tonnes of) NO_x emissions is from road transport in both Greater London and central London, as shown in the graphs below. Between 2016 and 2019, road transport NO_x emissions reduced by 31% across London, and 43% in central London, reflecting the impact of the central London ULEZ.

The pace of reductions notably accelerated from 2016[6]. Between 2013 and 2016, the change in road transport emissions in Greater London was a reduction of 14%, **therefore the rate of reduction has more than doubled between 2016 and 2019.** A comparison against UK emissions reductions[7] show that nationally, road transport NO_x emissions reduced by only 10% between 2016 and 2019, far slower than the reductions achieved in London.

This trend in NO_x reduction is expected to continue over the period modelled, although at a slightly lower rate than as observed between 2016 and 2019. Total NO_x emissions across Greater London are forecast to be 31% lower in 2025, and 44% lower in 2030, compared to 2019 emission levels (and respectively 44% and 54% lower if compared to 2016 emissions). In central London, the reduction is expected to be 24% in 2025, and 37% in 2030, compared to 2019 NO_x emissions (and respectively 37% and 48% if compared to 2016 emissions).

The largest reduction in NO_x emissions is forecast to come from road transport in both Greater London and central London, as shown in the graphs below. Road transport NO_x emissions are expected to reduce by 56% across London by 2025 and 77% by 2030, compared to 2019 (and by respectively 70% and 84% compared to 2016), as the vehicle fleet continues to become cleaner accelerated due to schemes such as the ULEZ. The expected reduction of NOx emissions from road transport in central London is 52% in 2025 and 75% in 2030 respectively, compared to 2019 (and respectively 72% and 85% compared to 2016). However, what is also clear is that despite significant improvements following bold policies, without further and urgent action, London will not be able to realise the emissions reductions required to help meet WHO air quality standards (see more in the air quality concentrations section).

It is important to note that, due to this significant reduction, **it is forecast that by 2025 road transport will no longer be the dominant source of NO_x across London anymore, overtaken by the industrial and commercial heat and power generation source category** (see further details pages 32 to34).

[6] A separate study by King's College London looking at the overall rate of improvement in NO_2 levels across London before 2016 found that if the trend of inaction seen between 2010 and 2016 continued, it would take 193 years to reach legal compliance. However, further modelling undertaken for City Hall by King's College London suggests the Mayor's far-reaching policies would reduce this significantly, meaning London's air would be within legal pollution limits for NO_2 by 2025. This report shows we are on track to meet this target. See further details at https://www.london.gov.uk/press-releases/mayoral/dramatic-improvement-in-londons-air-quality

[7] "Emissions of air pollutants in the UK, 1970 to 2019". https://www.gov.uk/government/statistical-data-sets/env01-emissions-of-air-pollutants

Figure 1 - NO_x Emissions Trend by Source in Greater London

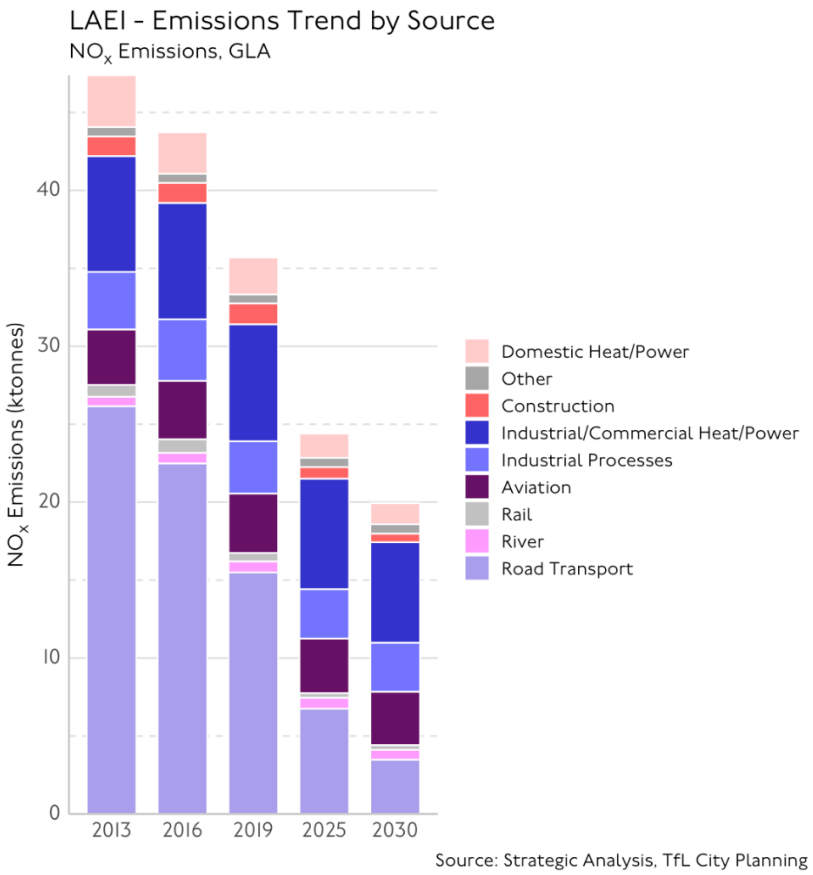
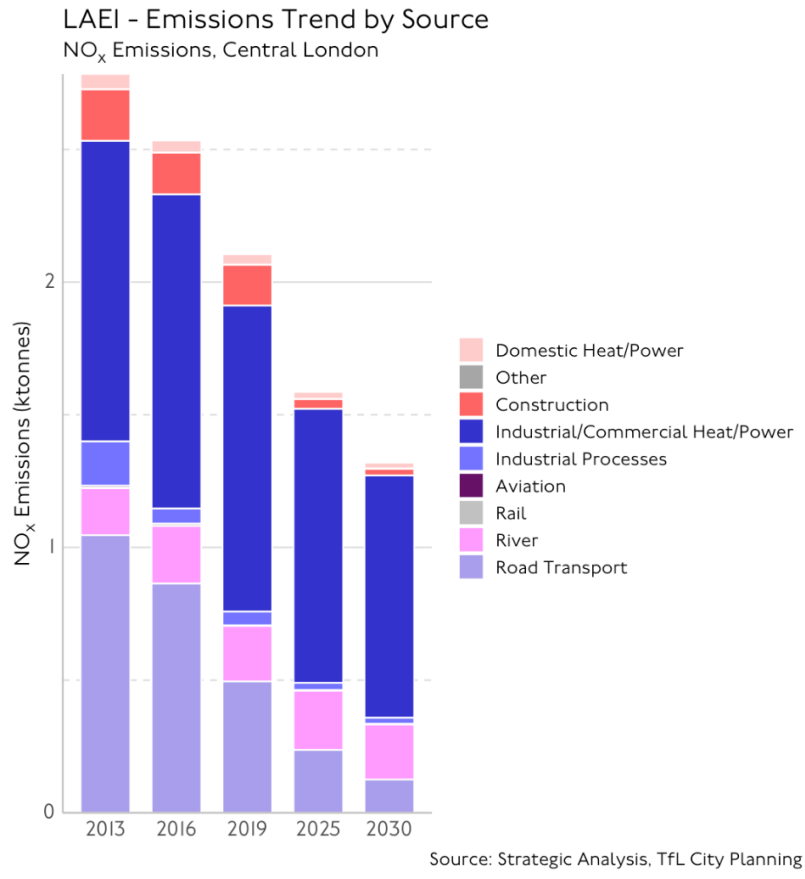


Figure 2 - NO_x Emissions Trend by Source in Central London



Particulate Matter (PM_{10})

Figure 3 and Figure 4 show the trend in PM_{10} emissions per source. In 2019 construction emissions contributed the largest single source of PM_{10} accounting for 30% of total emissions in London. This was followed by road transport at 27% and resuspension at 15%.

Compared to 2016, total PM_{10} emissions educed by 4% in Greater London, and 0.5% in central London[8] by 2019.

Total PM_{10} emissions across Greater London are forecast to be 7% lower in 2025, and 12% lower in 2030, compared to 2019 emission levels (and respectively 11% and 16% lower if compared to 2016 emissions). In central London, the reduction is expected to be 24% in 2025, and 32% in 2030, compared to 2019 PM_{10} emissions (the same if compared to 2016).

Despite not being the main source for this pollutant, the largest reduction in PM_{10} emissions between 2016 and 2019 is from road transport in both Greater London and central London, as shown in the graphs below, influenced by the central London ULEZ. Road transport PM_{10} emissions reduced by 9% across London, and 23% in central London. Between 2013 and 2016, the change in road transport PM_{10} emissions in Greater London was a reduction of 4%, which shows that (as for NO_x) the rate of reduction has more than doubled between 2016 and 2019**.**

When looking at forecasts, road transport PM_{10} emissions are expected to reduce by 16% in 2025 and 29% in 2030 across London compared to 2019 (and by respectively 24% and 36% compared to 2016), a significant improvement influenced by strong Mayoral policies specifically targeting vehicle emissions. However, these reductions are less than for NO_x, due to the non-exhaust (brake and tyre wear, road abrasion) component of PM emissions, which will continue to be a significant source of pollution, even for electric vehicles. The expected reduction in road transport PM_{10} emissions in central London is 24% in 2025 and 34% in 2030 respectively compared to 2019 (and respectively 42% and 50% compared to 2016).

[8] Note that the increase in PM_{10} in between 2013 and 2016, particularly visible in central London, was due to a significant increase in national emission factors to estimate PM_{10} from the construction sector. However, this source of PM is subject to particularly significant uncertainties.

Figure 3 - PM_{10} Emissions Trend by Source in Greater London

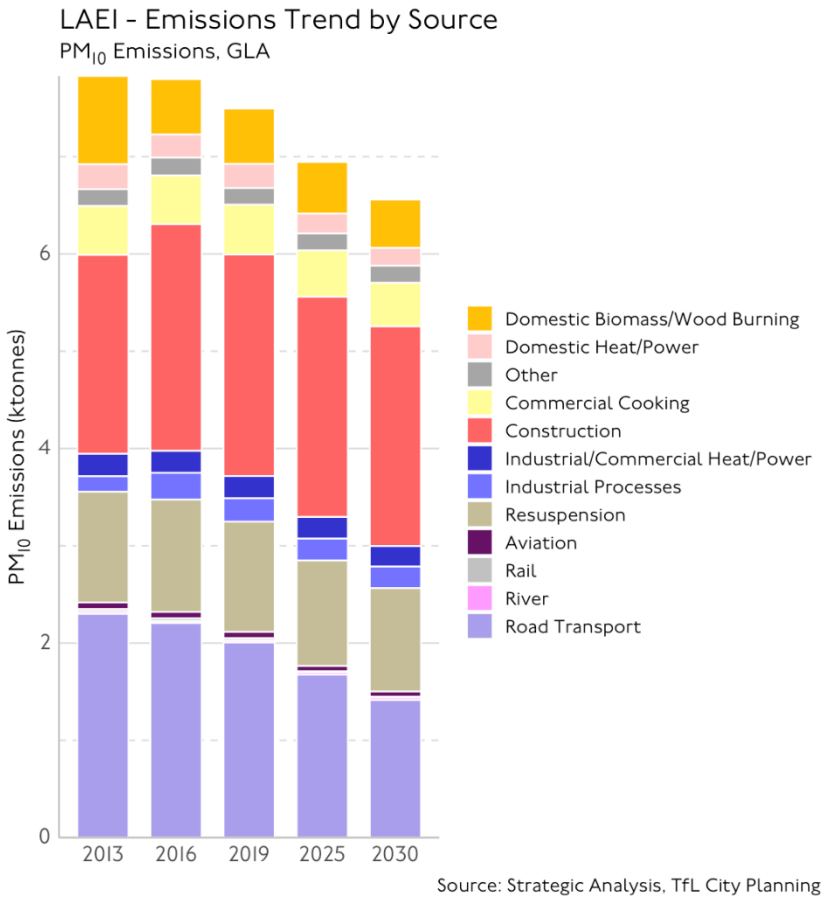
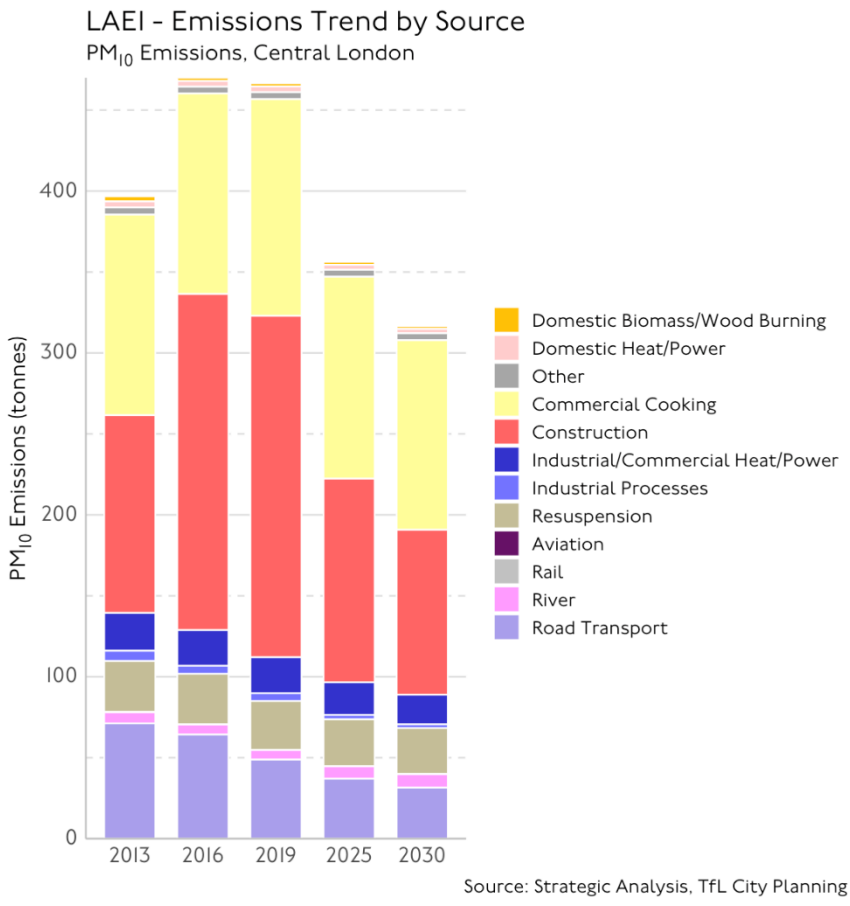


Figure 4 - PM_{10} Emissions Trend by Source in Central London



Particulate Matter ($PM_{2.5}$)

$PM_{2.5}$ emissions have gradually reduced since 2013 across London, as shown in Figure 5 and Figure 6. Compared to 2016, total $PM_{2.5}$ emissions reduced by 5% in Greater London, and 1% in central London by 2019.

Total $PM_{2.5}$ emissions across Greater London are forecast to be 11% lower in 2025, and 18% lower in 2030, compared to 2019 emission levels(and respectively 16% and 22% lower if compared to 2016 emissions). In central London, the reduction is expected to be slightly higher, 13% in 2025 and 20% in 2030, compared to 2019 $PM_{2.5}$ emissions (respectively 15% and 21% if compared to 2016 emissions).

The largest reduction of $PM_{2.5}$ emissions is from road transport in both Greater London and central London. **Road transport $PM_{2.5}$ emissions in 2019 reduced by 14% across London, and 36% in central London, compared to 2016. However, little change was seen in other sources. This underlines once again why it is so essential that the Mayor has additional powers to tackle non-road transport sources of pollution, including from buildings, construction, wood burning, commercial cooking and the river.**

When looking at forecasts, road transport $PM_{2.5}$ emissions are expected to reduce by 21% in 2025 and 33% in 2030 across Greater London compared to 2019 (and by respectively 32% and 42% compared to 2016). The expected reduction in road transport $PM_{2.5}$ emissions in central London is 28% in 2025 and 40% in 2030 respectively (and respectively 54% and 61% compared to 2016). The percentage reductions in $PM_{2.5}$ emissions are smaller than those seen for NOx, this is due in part to the non-exhaust component of $PM_{2.5}$ which occurs even with electric vehicles and will continue as engine emissions reduce unless further action is taken on this component specifically.

Figure 5 - $PM_{2.5}$ Emissions Trend by Source in Greater London

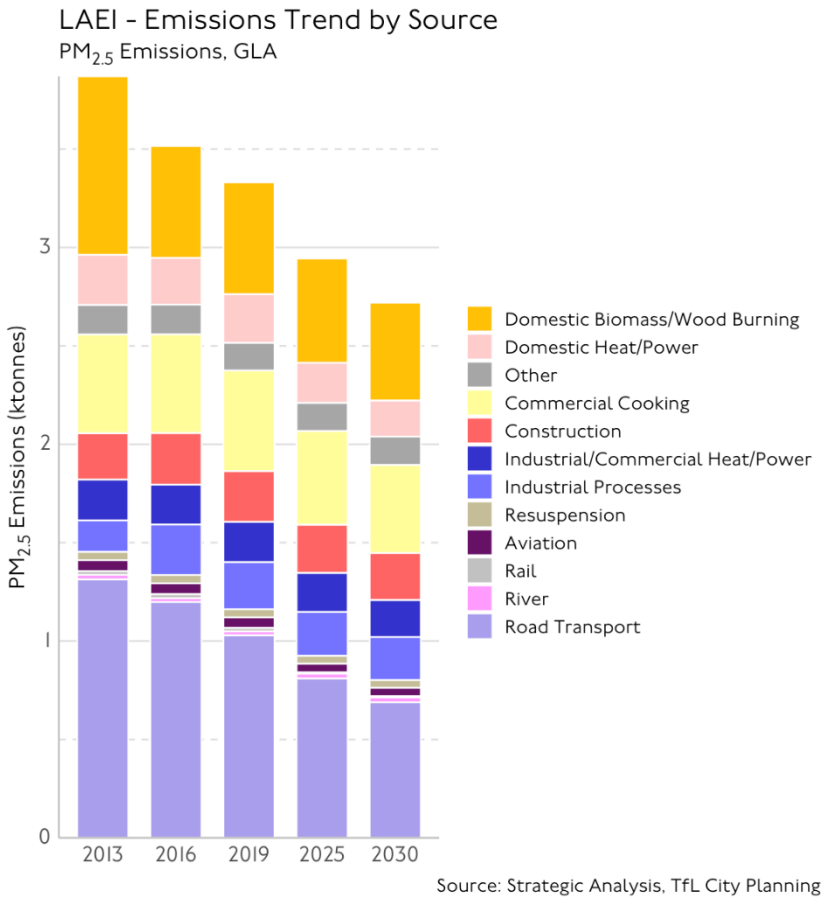
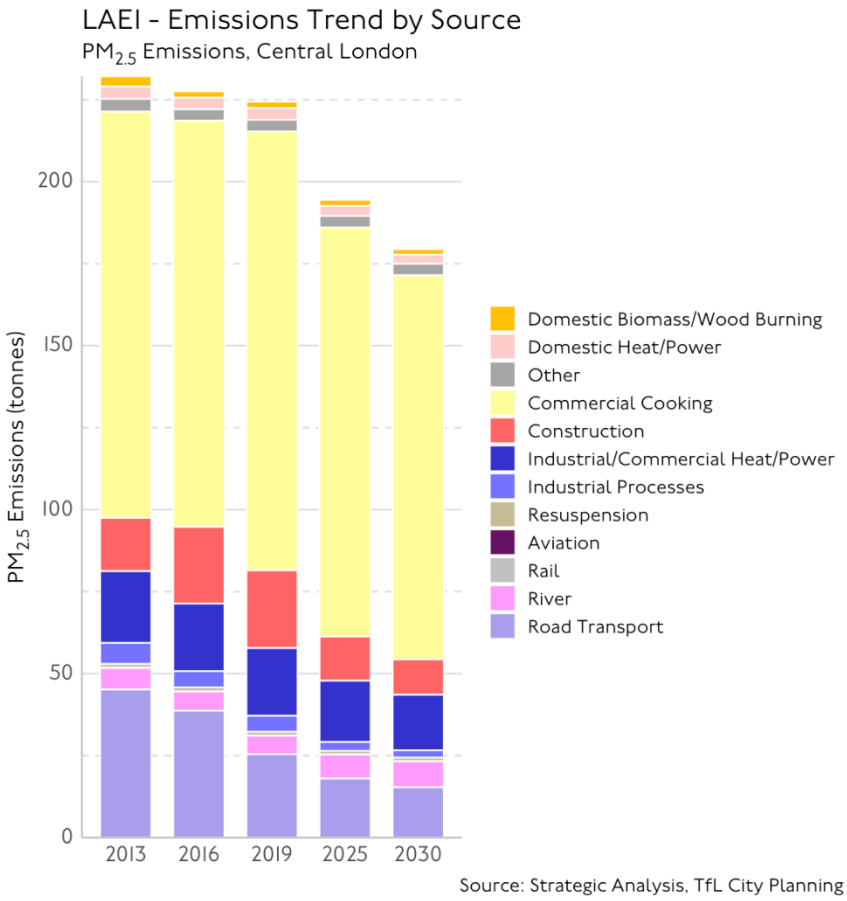


Figure 6 - $PM_{2.5}$ Emissions Trend by Source in Central London



Concentration Maps

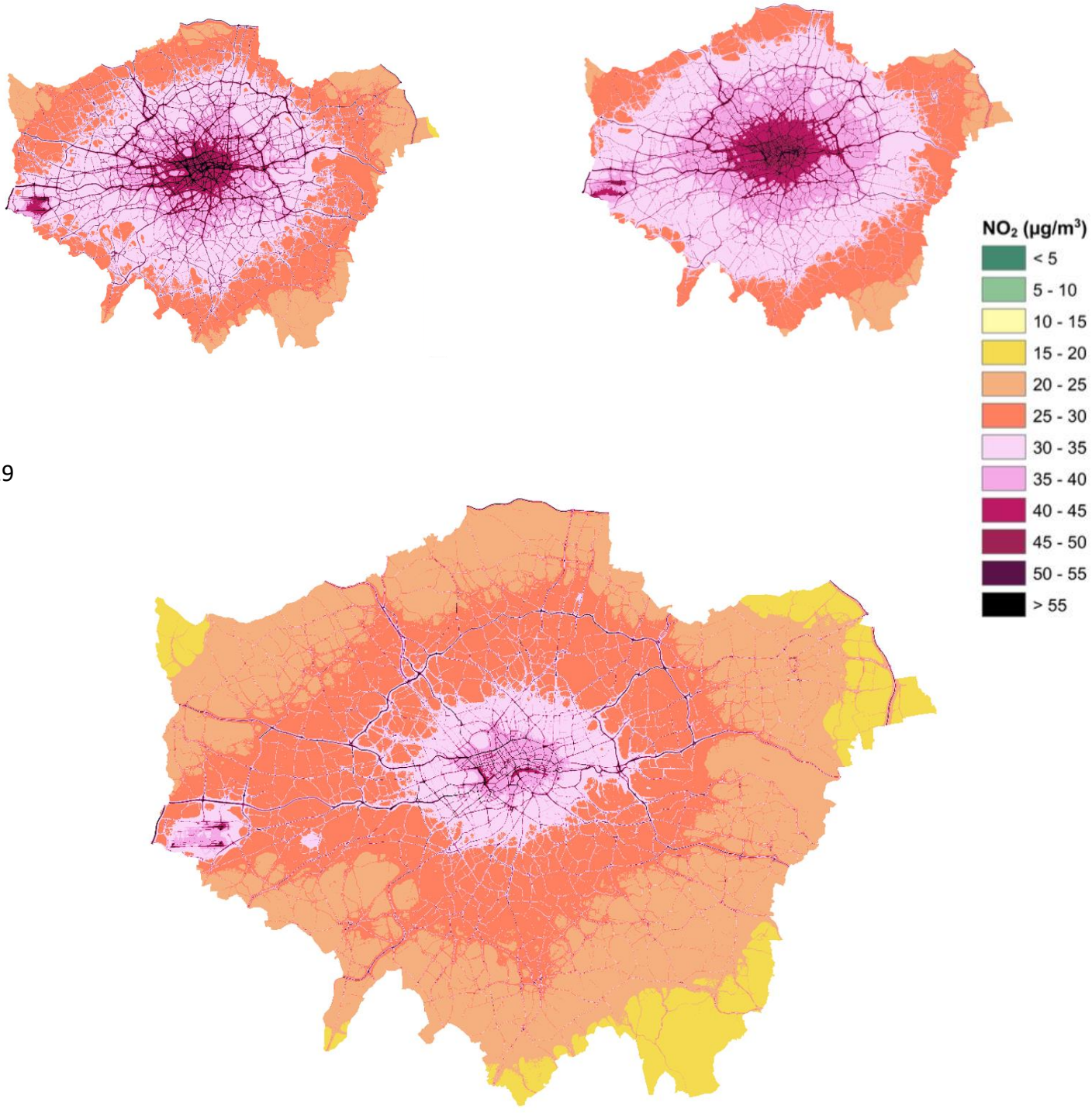
The 2019 LAEI provides maps of modelled annual mean concentration across Greater London for NO_2, PM_{10} and $PM_{2.5}$ for 2019, 2025 and 2030. Previous LAEI maps from the 2013 and 2016 base years are also provided in Figure 7 (NO_x), Figure 9 (PM_{10}) and Figure 11 ($PM_{2.5}$) for comparison. Note that the symbology has been modified for all maps compared to previous LAEI releases, in order to make the lower air pollutant concentrations more apparent and to reflect the updated WHO Guidelines.

Nitrogen Dioxide (NO_2)

Figure 7 – NO_2 Concentrations across London – 2013 to 2019

2013

2016

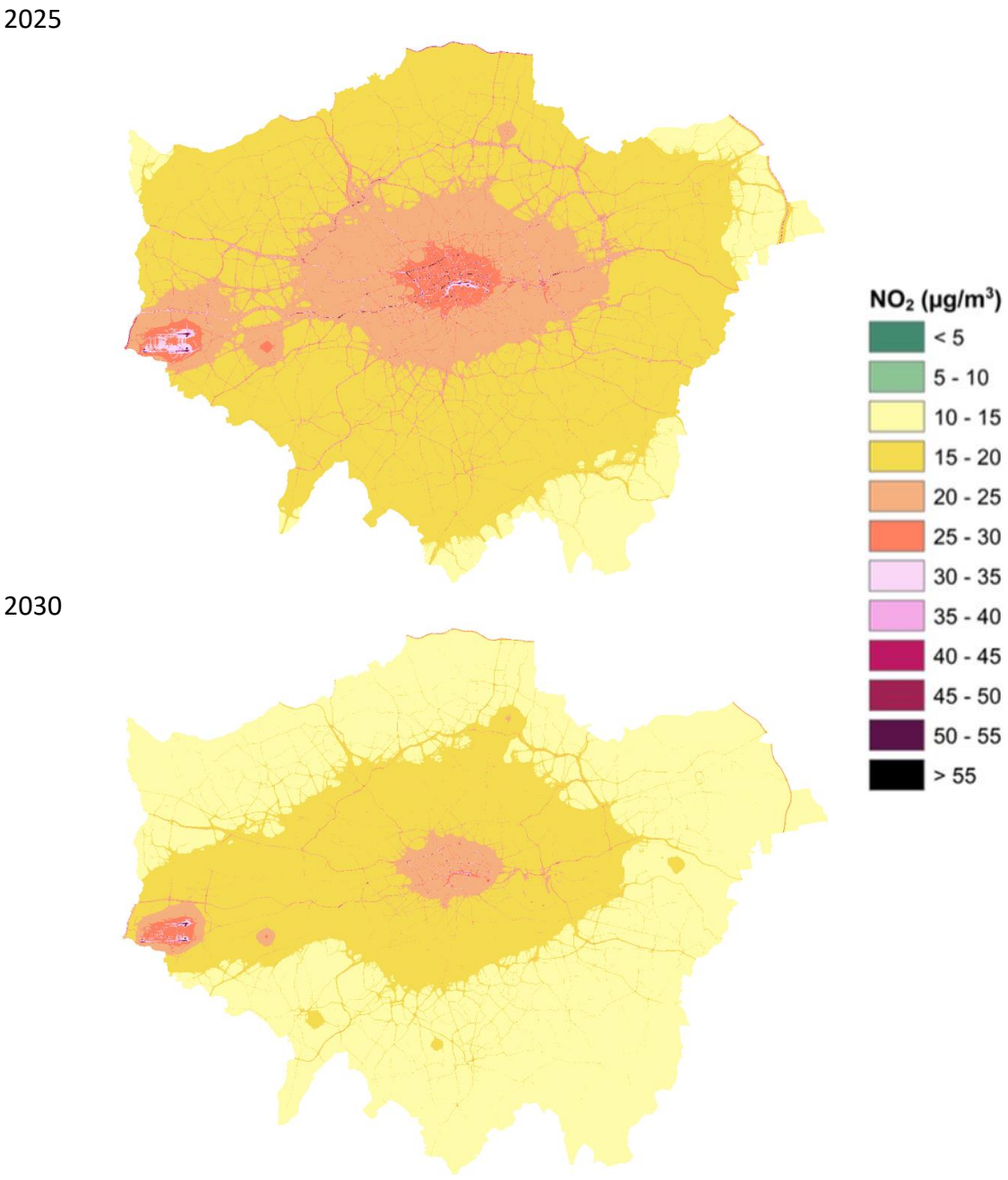


2019

The NO_2 concentration maps in Figure 7 show a significant reduction in concentrations across the whole of Greater London from 2016 to 2019, with average NO_2 concentrations in 2019 were approximately 22% lower than in 2016.

As shown in the NO_2 concentration maps for 2025 and 2030 in Figure 8, these improvements will continue, with the expansion of the ULEZ up to the North and South Circular roads, as well as the electric vehicle uptake. By 2030, over three quarters of London is expected to meet the latest NO_2 WHO annual average interim air quality target of 20 µg/m^3, however **nowhere in London will meet the WHO annual average air quality guideline of 10 µg/m^3.**

Figure 8 - NO_2 Concentrations across London – 2025 and 2030

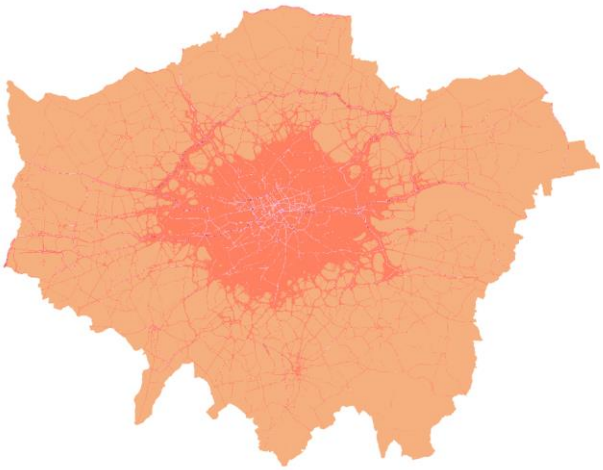


Particulate Matter (PM_{10})

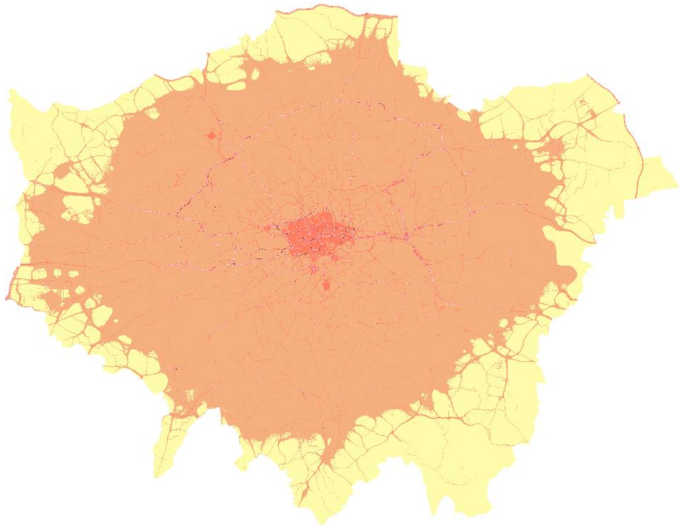
Please note PM_{10} is a transboundary pollutant and therefore concentrations are heavily influenced by meteorology, background concentrations and sources outside of London, including on the continent, on top of local emissions. Therefore, local transport policies to reduce emissions such as the ULEZ will have a smaller impact on concentrations.

Figure 9 – PM_{10} Concentrations across London – 2013 to 2019

2013



2016



2019

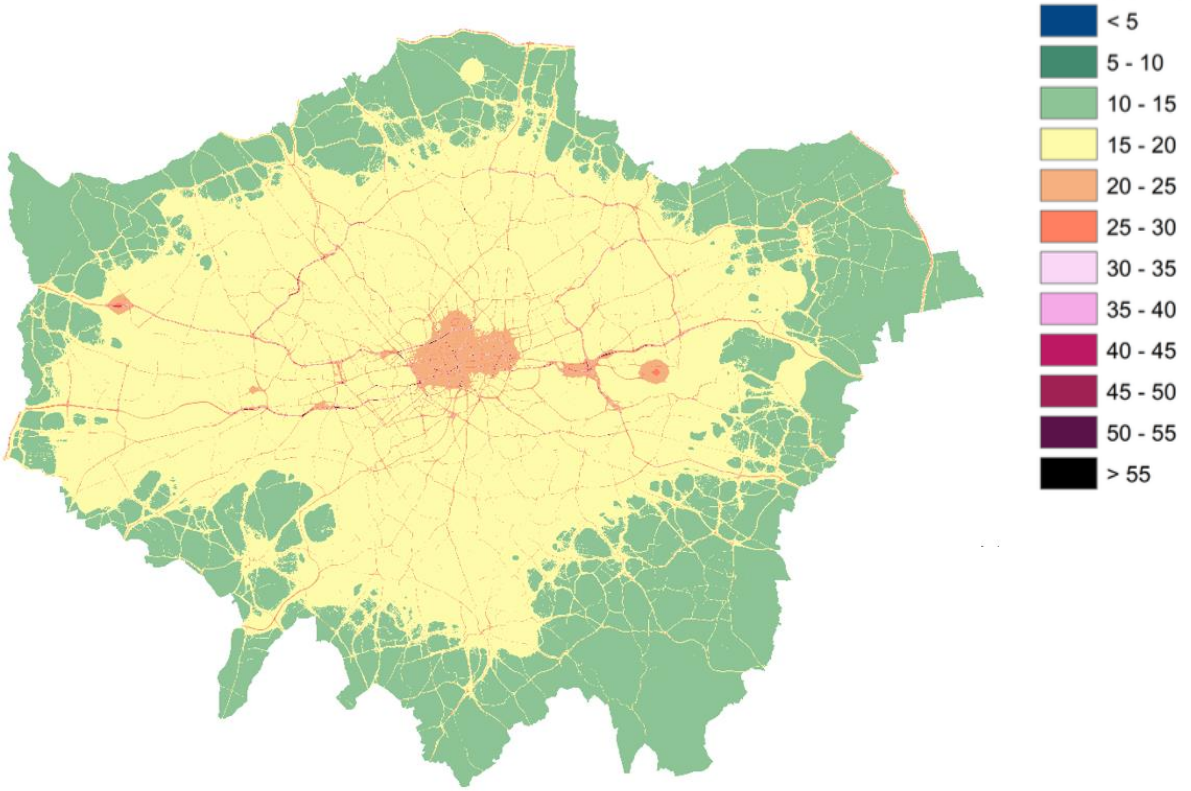
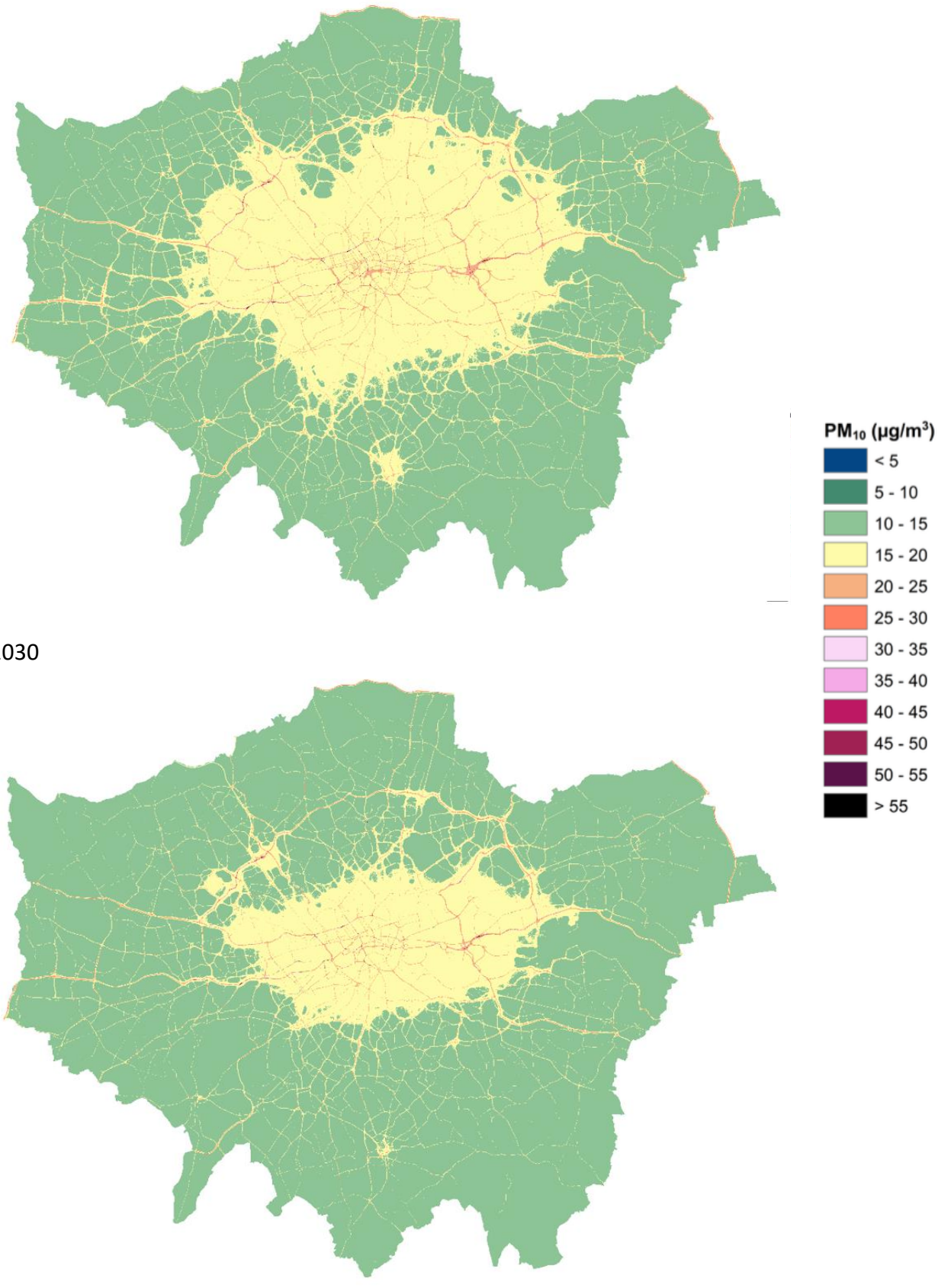


Figure 10 - PM_{10} Concentrations across London –2025 and 2030

2025



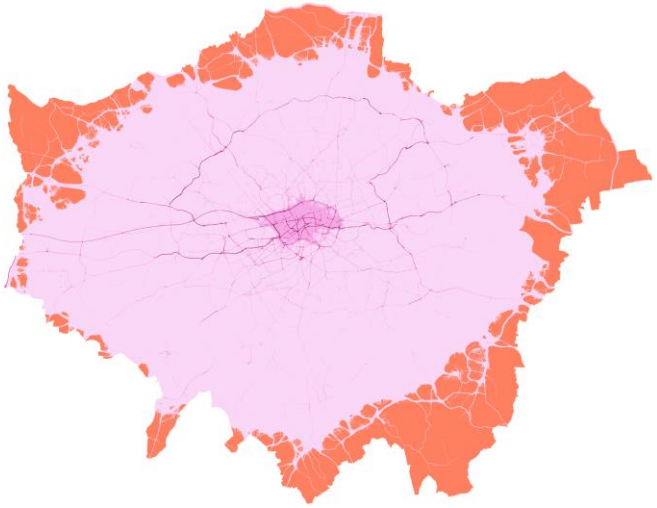
2030

The PM_{10} concentration maps in Figure 9 and 10 show that the whole of Greater London has experienced reductions in PM_{10} concentrations from 2016, with large areas of inner and outer London meeting the latest WHO annual average guideline of 15 µg/m^3 for PM_{10} from 2019 onwards.. Annual average concentrations of PM_{10} were approximately 24% lower in 2019 compared to 2016. As highlighted above, it is important to note that PM_{10} is a transboundary pollutant and therefore concentrations are heavily influenced by meteorology, background concentrations and sources outside of London, including on the continent, on top of local emissions. Therefore local transport policies to reduce emissions, such as the ULEZ, will have a smaller impact on concentrations. the largest source of PM_{10} emissions for 2019 was construction. Road transport, which accounted for 27% of PM_{10} emissions in 2019, will have been influenced by key Mayoral policies, including the ULEZ. Despite having seen positive progress on PM_{10} pollution, $PM_{2.5}$ concentrations remain above the WHO guideline (see section below). Research shows that $PM_{2.5}$is associated with more significant health effects than PM_{10}.

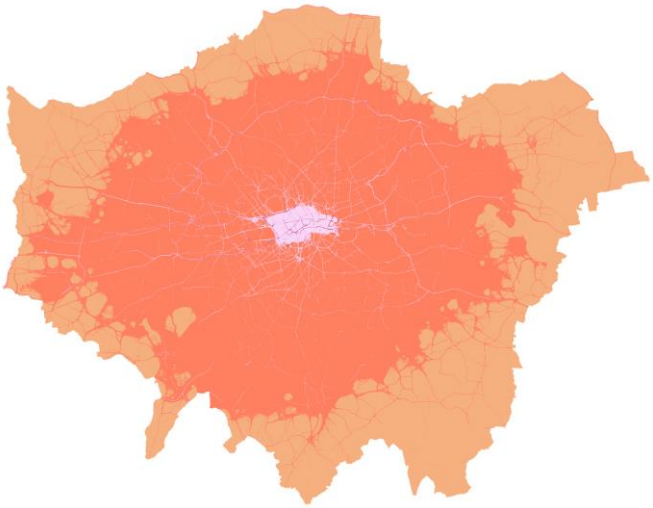
Particulate Matter ($PM_{2.5}$)

Figure 11 – $PM_{2.5}$ Concentrations across London – 2013 to 2019

2013



2016



2019

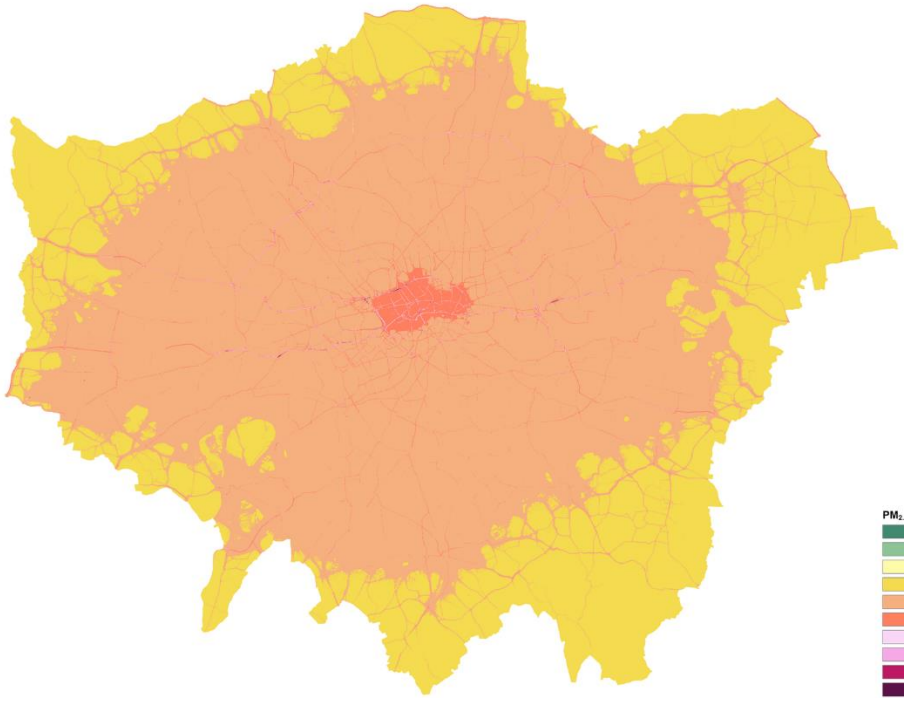
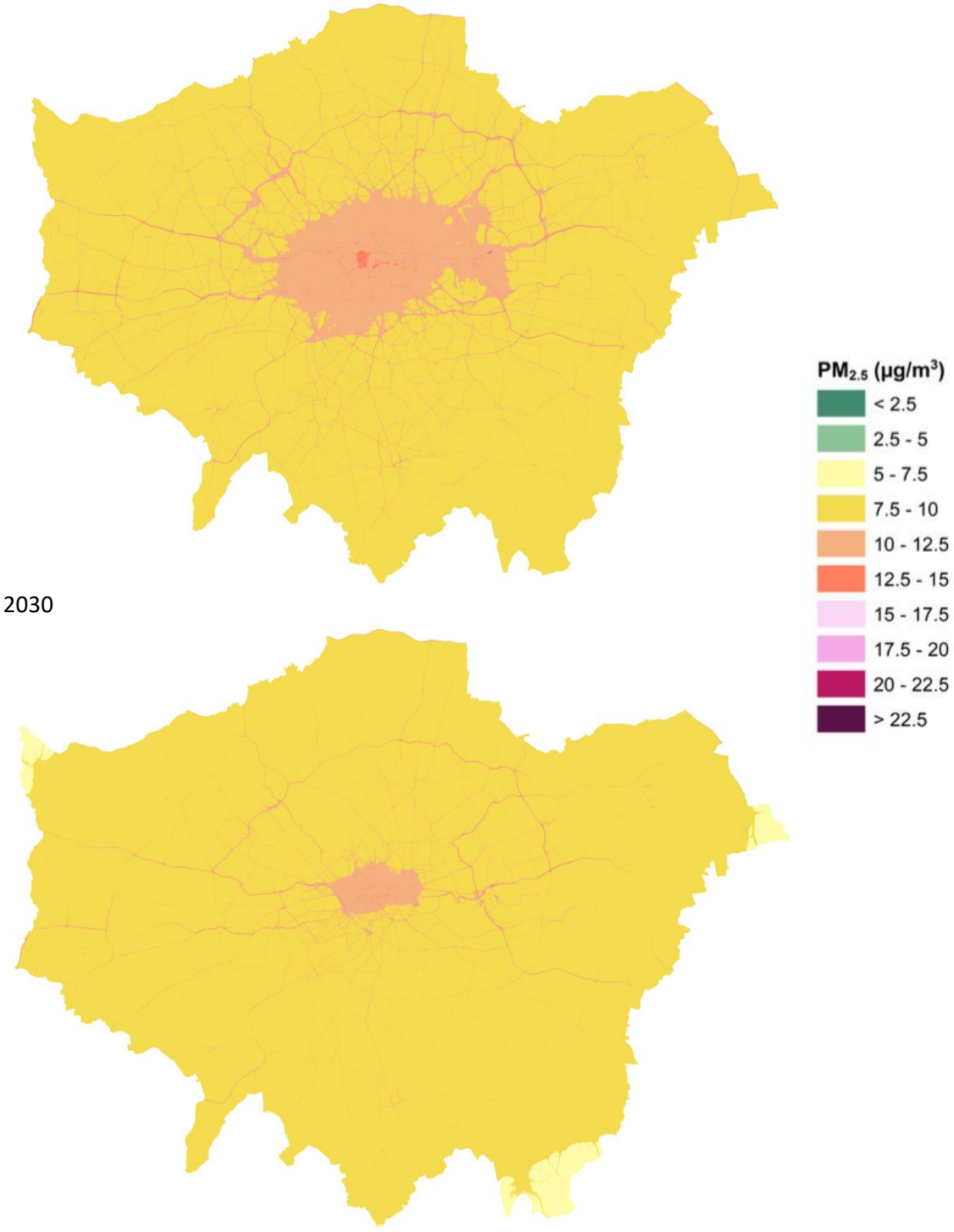


Figure 12 - $PM_{2.5}$ Concentrations across London – 2025 and 2030

2025



The $PM_{2.5}$ concentration maps in Figure 11 show that there has been a reduction in $PM_{2.5}$ across the whole of the city, with many parts of outer London meeting the WHO interim air quality target of 10 µg/m^3 as an annual average, for the first time in 2019. As seen in Figure 12, this reduction goes further in 2025 and 2030 with most of inner London under the WHO interim target therefore showing that meeting this interim WHO target by 2030 is possible. However nowhere in London is predicted to meet the WHO annual average guideline of 5 µg/m^3 in 2025 or 2030.

Annual average concentrations of $PM_{2.5}$ in 2019 were approximately 19% lower than in 2016 – this includes background and roadside locations. In addition to local reductions in emissions, $PM_{2.5}$ is a transboundary pollutant which is influenced by background concentrations and meteorology.

Major roads meeting air quality targets

The proportion of major road lengths[9] exceeding NO_2 WHO air quality guidelines (interim targets 30 µg/m^3, 20 µg/m^3 and guideline 10 µg/m^3) have been assessed. This is estimated based on analysis of concentrations along the edge of roads at approximately 4m distance.[10]

A weighted average along the distance of each road link is used as the concentration varies alongside roads depending on traffic flows and geography, including road width and dispersive characteristics such as tall street canyons and road type. This method presents a reasonably conservative estimate of how compliance against national legal limits is being achieved in London. It should be noted that although the formal assessment of compliance is undertaken by Defra using their Pollution Climate Mapping model, using this methodology for the LAEI provides a useful way of comparing progress.

- None of the major roads in London met the WHO annual mean air quality guideline of 10 µg/m^3 for NO_2 in 2019, and this will still be the case by 2025 or 2030.
- No major road lengths meet the WHO interim annual mean air quality target of 20 µg/m^3 for NO_2 in central London in 2019, 2025 or in 2030 (see Table 3).
- None of major roads in London met the WHO interim annual mean air quality target of 20 µg/m^3 for NO_2 in 2016 or 2019. This is expected to improve in 2025 with 32% and in 2030 with 86% of major roads meeting this interim target (see Table 3).
- 6% of major road lengths in London met the WHO interim annual mean air quality target of 30 µg/m3 for NO2 in 2016. This percentage increased in 2019, with 37% of major roads meeting this limit, and it is expected to go up to 95% and 100% in 2025 and 2030 respectively (see Table 2)
- In central and inner London, no major road lengths met the WHO interim annual mean air quality target of 30 µg/m3 for NO2 in 2016 and 2019. However, 54% and 97% of major road lengths are forecast to meet this interim target in 2025 and 2030 respectively (see Table 2)

[9] Major roads are road links in the LAEI which are assigned traffic flows based on TfL strategic transport models and exclude minor roads and most smaller residential roads across London where there is much lower risk of exceeding the legal limits for NO_2 concentrations.

[10] This provides a similar approach to the national assessment of compliance. Moreover, it can be replicated when new LAEI concentrations become available providing a consistent way of indicating the changes in modelled roadside concentrations.

Table 2 - Proportion of Major Roads Network Length Below / Over the NO_2 Annual Mean WHO Interim target of 30 µg/m³

WHO interim target 30 µg/m³ NO_2 annual average	Exceeding Central	Meeting Central	Exceeding Inner Zone	Meeting Inner Zone	Exceeding Outer Zone	Meeting Outer Zone	Exceeding GLA	Meeting GLA
2016	100%	0%	100%	0%	91%	9%	94%	6%
2019	100%	0%	100%	0%	50%	50%	63%	37%
2025	46%	54%	8%	92%	2%	98%	5%	95%
2030	3%	97%	0%	100%	0%	100%	0%	100%

Table 3 - Proportion of Major Roads Network Length Below / Over the NO_2 Annual Mean WHO Interim target of 20 µg/m³

WHO interim target 20 µg/m³ NO_2 annual average	Exceeding Central	Meeting Central	Exceeding Inner Zone	Meeting Inner Zone	Exceeding Outer Zone	Meeting Outer Zone	Exceeding GLA	Meeting GLA
2016	100%	0%	100%	0%	100%	0%	100%	0%
2019	100%	0%	100%	0%	99%	1%	100%	0%
2025	100%	0%	96%	4%	53%	47%	68%	32%
2030	100%	0%	24%	76%	5%	95%	14%	86%

Table 4 - Proportion of Major Roads Network Length Below / Over the NO_2 Annual Mean WHO Guideline target of 10 µg/m3

WHO interim target 30 µg/m³ NO_2 annual average	Exceeding Central	Meeting Central	Exceeding Inner Zone	Meeting Inner Zone	Exceeding Outer Zone	Meeting Outer Zone	Exceeding GLA	Meeting GLA
2016	100%	0%	100%	0%	100%	0%	100%	0%
2019	100%	0%	100%	0%	100%	0%	100%	0%
2025	100%	0%	100%	0%	100%	0%	100%	0%
2030	100%	0%	100%	0%	100%	0%	100%	0%

Transport for London Road Network (TLRN) or London's 'Red Routes'

London's red routes form a network of major roads that only make up 5% of the roads, however it represents up to 30% of the city's traffic.

- None of the TLRN is expected to meet the WHO annual mean air quality guideline of 10 µg/m³ for NO_2 in 2025 or in 2030.
- None of the TLRN is expected to meet the WHO interim annual mean air quality target of 20 µg/m³ for NO_2 until 2025, where 17% of the TLRN will meet this value. This is forecast to go up to 77% in 2030.
- Only 2% of the TLRN met the WHO interim annual mean air quality target of 30 µg/m³ for NO_2 in 2016. This improved to 20% in 2019 and will go up to 89% and 99% in 2025 and 2030, respectively.

Figure 13 and Figure 14 show the estimated proportion of TLRN, by borough, exceeding the WHO interim targets of 30 µg/m³ and 20 µg/m³ respectively. There is no graph for the WHO guideline of 10 µg/m³ as no roads meet it in any scenario therefore would give an empty graph.
Appendix 1 gives the figures from the graphs in table form.

Figure 13 - Proportion of TLRN Meeting the NO_2 Annual Mean WHO Interim Target of 30 µg/m³

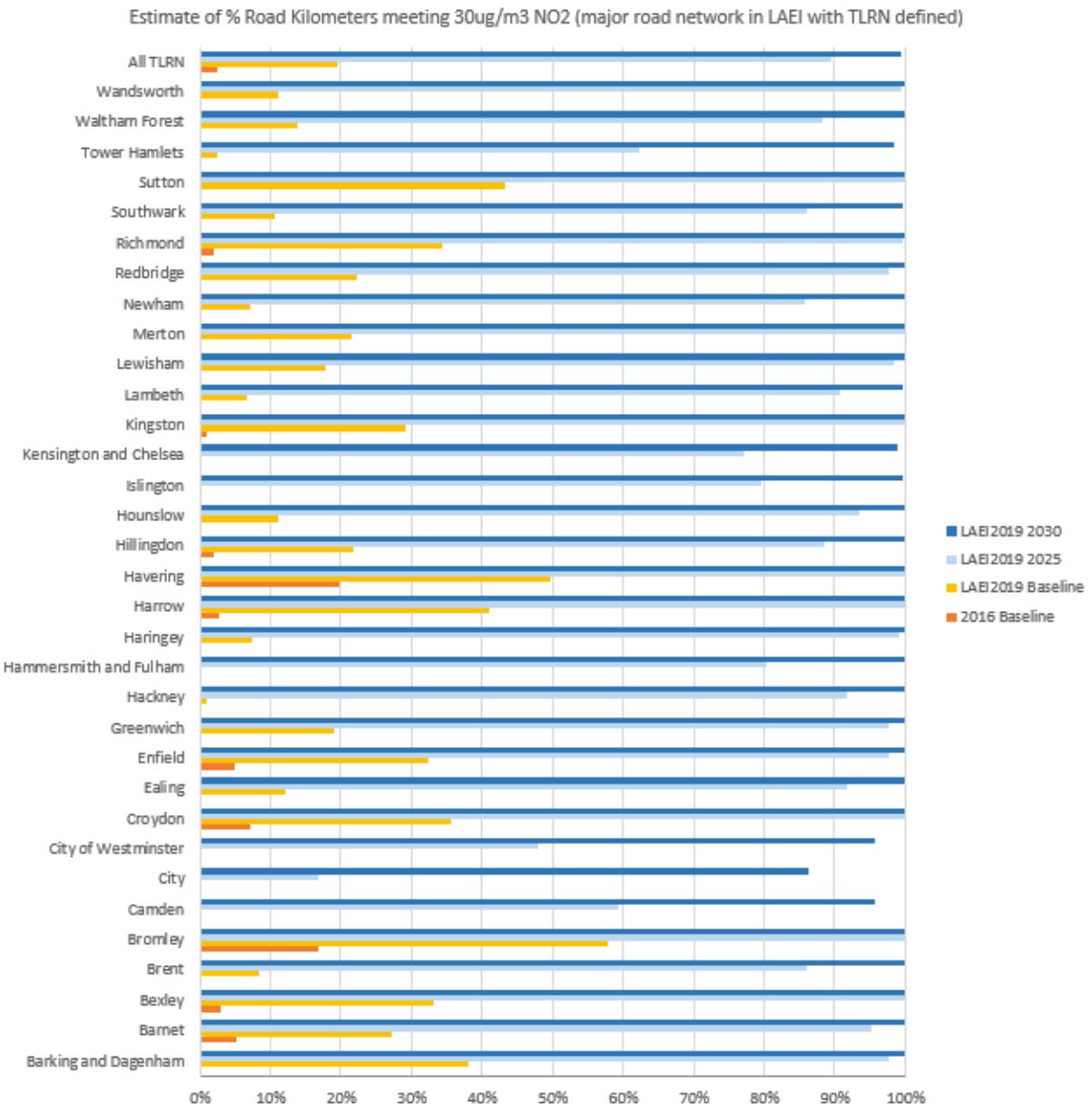
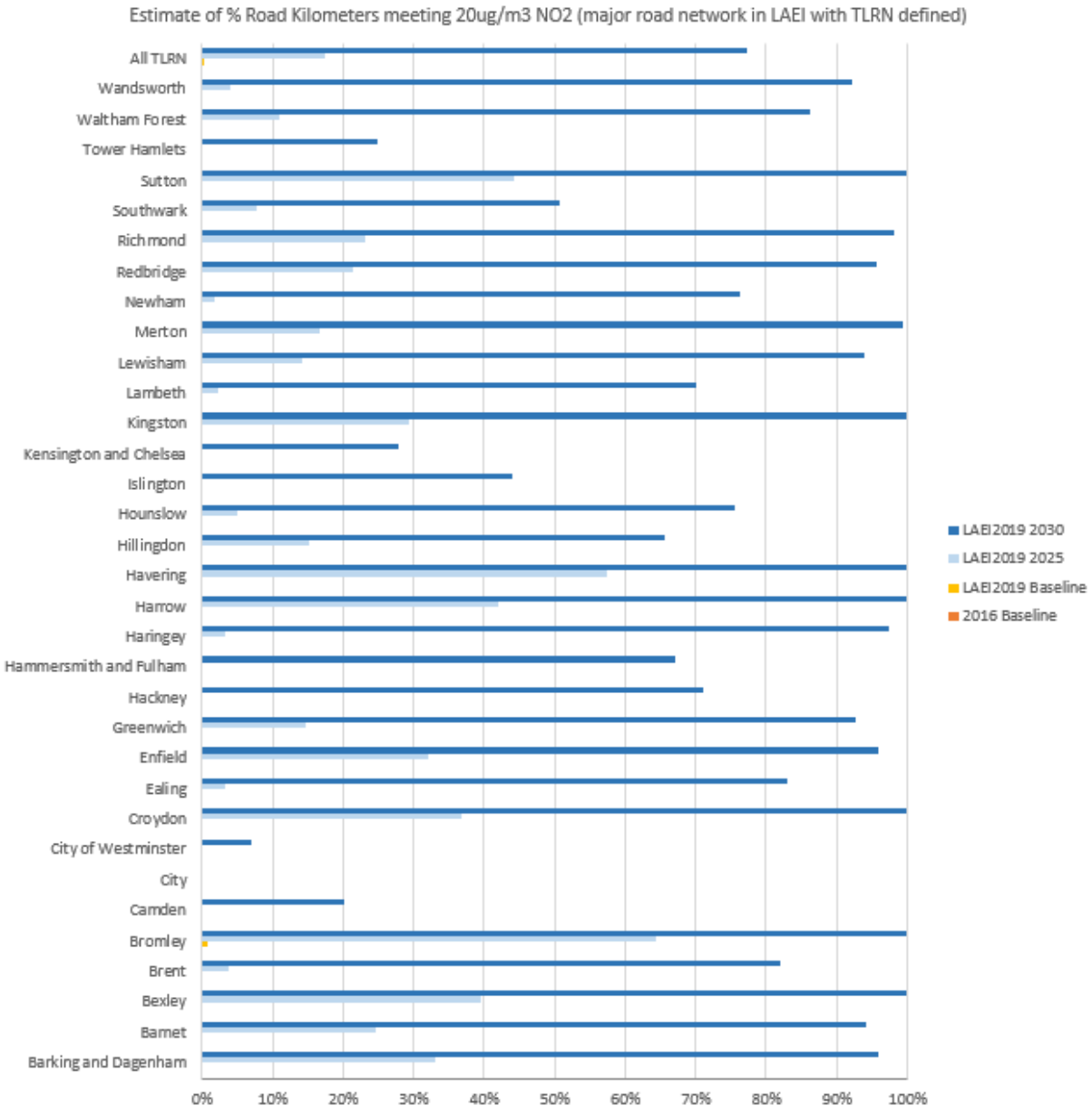


Figure 14 - Proportion of TLRN Meeting the NO_2 Annual Mean WHO Target Guideline of 20 µg/m³



Population exposure

The population exposure data shows that there have been significant reductions in the number of Londoners living in areas of high pollution.

Nitrogen Dioxide (NO_2)

- All Londoners are living in areas exceeding the WHO recommended annual mean guideline of 10µg/m^3 for NO_2 in 2019 and are forecast to continue to do so in 2025 or 2030.
- Most Londoners living in central London will still exceed the WHO interim annual mean target of 20 µg/m^3 in 2030.
- Almost 9 million Londoners were living in areas exceeding the WHO interim annual mean target of 20 µg/m^3 NO_2 in 2019. This is expected to reduce to about half in 2025 and just over half a million in 2030.
- All Londoners living in central London lived in areas that exceed the WHO interim annual mean target of 30 µg/m^3 for NO_2 in 2019, but this is expected to improve with only 10% expected to exceed this limit in 2025 and none in 2030.
- Over 2 million Londoners were living in areas exceeding the WHO interim annual mean target of 30 µg/m^3 for NO_2 in 2019. This is expected to reduce to nearly 40,000 in 2025 and just over 200 in 2030.
- Average concentrations of NO_2 in 2019 were approximately 22% lower than in 2016. NO_2 concentrations are expected to be 29% lower in 2025 and 44% lower in 2030 than in 2019. This includes background and roadside locations because the population estimates are based on average concentrations across census output areas which include all modelled concentrations in that area based on 20m spaced dispersion modelling.

Particulate Matter ($PM_{2.5}$)

- All Londoners are living in areas exceeding the WHO recommended annual mean guideline of 5µg/m^3 for $PM_{2.5}$ in 2019 and are forecast to continue to do so in 2025 or 2030.
- Everyone in London has benefited from improvements in air quality. Nearly 1.2 million Londoners were living in areas meeting the WHO interim target of 10 µg/m^3 in 2019. Previously no Londoners were living in areas meeting this target in 2016.
- Modelled London-wide annual average $PM_{2.5}$ concentrations were 2.5 µg/m^3 lower than in 2016, with an average of 10.8 µg/m^3 in 2019 compared to 13.3 µg/m^3 in 2016. This $PM_{2.5}$ concentration average lowers to 9.7 µg/m^3 in 2025 and to 8.8 µg/m^3 in 2030. However, all Londoners would still be living in areas above the newly recommended WHO guideline of 5 µg/m^3 annual average $PM_{2.5}$.
- Average concentrations of $PM_{2.5}$ are approximately 19% lower in 2019 than in 2016, and from 2019 $PM_{2.5}$ concentrations are expected to decrease 10% more in 2025 and 18% in 2030 compared to 2019 - this includes background and roadside locations.
- All Londoners living in areas meeting the 10 µg/m^3 $PM_{2.5}$ WHO interim target in 2019 are in outer London, though not all of outer London met the interim target. Areas in inner and central London are expected to reduce and be under the WHO interim target of 10 µg/m^3 in 2025 and 2030.

Schools

Analysis on concentration data allows us to determine the number of each type of educational facility located in areas exceeding the WHO interim air quality targets (30 µg/m^3, 20 µg/m^3 and 10 µg/m^3) as well as those in areas exceeding the $PM_{2.5}$ annual mean WHO air quality guidelines (10 µg/m^3 and 5 µg/m^3) in 2019, 2025 and 2030. The concentration figures have been calculated as an average within a 150m buffer of each educational establishment.

Nitrogen Dioxide (NO_2)

As shown in Table 7, all educational establishments were in areas exceeding the WHO annual average guideline of 10 µg/m^3 for NO_2 in 2019 and are forecast to continue to do so in 2025 and 2030.

Please note that earlier analysis for 2019 baseline suggested slightly different numbers than these now reported. The variation is due to an updated version of the school database (Edubase from the Department of Education) being used in this analysis.

As shown in Table 5, a total of 1,042 (32%) educational establishments were in areas exceeding the WHO interim annual mean target of 30 µg/m^3 for NO_2 in 2019, and only 14 (0.4%) are expected in 2025 and none in 2030. For this WHO interim target, a total of 606 (27%) of state primary and secondary schools exceeded it in 2019, and this is expected to reduce to 0% in 2025 and 2030.

For the tighter WHO interim annual mean target of 20 µg/m^3 NO_2, as shown in Table 6, exceedances occurred at 3,218 (99%) educational establishments in 2019, with forecasts showing 1,528 (47%) in 2025 and 219 (7%) in 2030. Of all state primary and secondary schools, 2,231 (98.6%) exceeded 20 µg/m^3 NO_2 in 2019, 948 (42%) will exceed it in 2025 and 115 (5%) in 2030.

The spatial distribution of all educational facilities meeting or exceeding the relevant NO_2 annual mean thresholds discussed above is provided on the maps in Figure 15.

Table 5 - Schools exceeding the NO_2 Annual Mean WHO Interim Air Quality Target of 30 µg/m^3

		NO_2 Annual Mean WHO Interim target 30 µg/m^3					
		2019 baseline		**2025**		**2030**	
Establishment Type	**Total Number**	**Number Exceeding**	**% Exceeding**	**Number Exceeding**	**% Exceeding**	**Number Exceeding**	**% Exceeding**
Nursery	79	38	48.1%	0	0.0%	0	0.0%
Primary	1803	492	27.3%	2	0.1%	0	0.0%
Secondary	459	114	24.8%	1	0.2%	0	0.0%
16 plus	46	25	54.3%	1	2.2%	0	0.0%
Community Special School	81	31	38.3%	0	0.0%	0	0.0%
Higher Education Institutions	36	25	69.4%	6	16.7%	0	0.0%
Other Independent School	475	224	47.2%	4	0.8%	0	0.0%
Other Independent Special School	52	20	38.5%	0	0.0%	0	0.0%
Pupil Referral Unit	36	11	30.6%	0	0.0%	0	0.0%
Other	188	62	33.0%	0	0.0%	0	0.0%
Total	3255	1042	32.0%	14	0.4%	0	0.0%

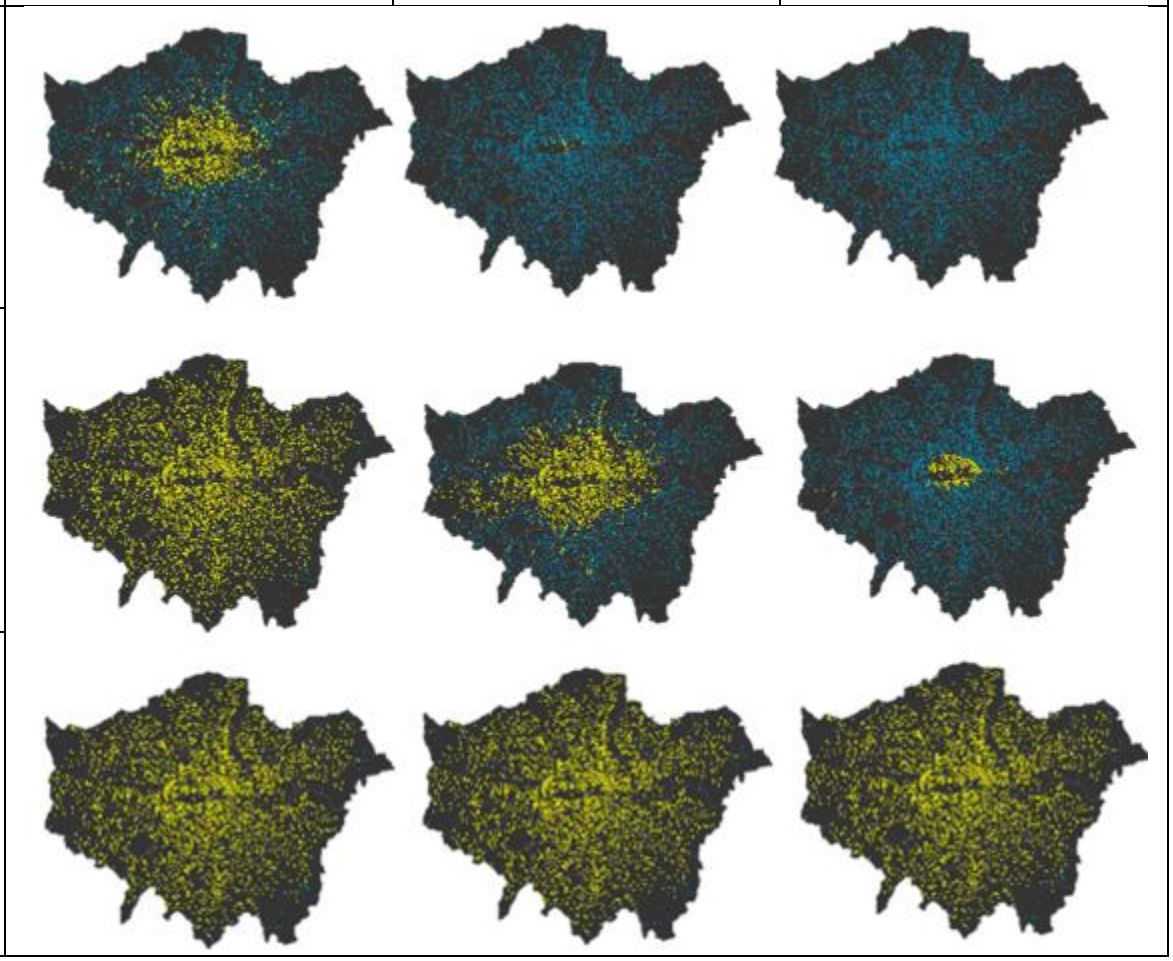
Table 6 - Schools exceeding the NO_2 Annual Mean WHO Interim Air Quality Guideline of 20 µg/m³

		NO_2 Annual Mean WHO Interim target 20 µg/m³					
		2019 baseline		2025		2030	
Establishment Type	Total Number	Number Exceeding	% Exceeding	Number Exceeding	% Exceeding	Number Exceeding	% Exceeding
Nursery	79	79	100.0%	55	69.6%	5	6.3%
Primary	1803	1784	98.9%	763	42.3%	92	5.1%
Secondary	459	447	97.4%	185	40.3%	23	5.0%
16 plus	46	46	100.0%	31	67.4%	10	21.7%
Community Special School	81	81	100.0%	41	50.6%	4	4.9%
Higher Education Institutions	36	36	100.0%	29	80.6%	19	52.8%
Other Independent School	475	474	99.8%	297	62.5%	49	10.3%
Other Independent Special School	52	50	96.2%	30	57.7%	4	7.7%
Pupil Referral Unit	36	36	100.0%	15	41.7%	2	5.6%
Other	188	185	98.4%	82	43.6%	11	5.9%
Total	3255	3218	98.9%	1528	46.9%	219	6.7%

Table 7 - Schools exceeding the NO_2 Annual Mean WHO Air Quality Guideline of 10 µg/m³

		NO_2 Annual Mean WHO Guideline 10 µg/m³					
		2019 baseline		2025		2030	
Establishment Type	Total Number	Number Exceeding	% Exceeding	Number Exceeding	% Exceeding	Number Exceeding	% Exceeding
Nursery	79	79	100.0%	79	100.0%	79	100.0%
Primary	1803	1803	100.0%	1803	100.0%	1803	100.0%
Secondary	459	459	100.0%	459	100.0%	459	100.0%
16 plus	46	46	100.0%	46	100.0%	46	100.0%
Community Special School	81	81	100.0%	81	100.0%	81	100.0%
Higher Education Institutions	36	36	100.0%	36	100.0%	36	100.0%
Other Independent School	475	475	100.0%	475	100.0%	475	100.0%
Other Independent Special School	52	52	100.0%	52	100.0%	52	100.0%
Pupil Referral Unit	36	36	100.0%	36	100.0%	36	100.0%
Other	188	188	100.0%	188	100.0%	188	100.0%
Total	3255	3255	100.0%	3255	100.0%	3255	100.0%

Figure 15 - Schools Meeting / Exceeding the NO_2 Annual Mean UK Legal Limit / WHO Air Quality Guidelines

	2019	2025	2030
WHO Interim target 30 µg/m³			
WHO Interim target 20 µg/m³			
WHO Guideline 10 µg/m³			

Particulate Matter ($PM_{2.5}$)

As shown in Table 9, all educational establishments will continue to exceed the WHO air quality guideline of 5 µg/m^3 annual average $PM_{2.5}$.

As shown in Table 8, the analysis of $PM_{2.5}$ annual mean concentrations (based on a 150 m buffer) indicates that 88% of schools (2,879 establishments) are in areas exceeding the WHO interim air quality target of 10 µg/m^3 in 2019, and this number goes down to 27% and 5% in 2025 and 2030, respectively.

Table 8 - Schools exceeding the $PM_{2.5}$ Annual Mean WHO Interim Air Quality Target of 10 µg/m^3

		$PM_{2.5}$ Annual Mean WHO Interim target 10 µg/m^3					
		2019 baseline		**2025**		**2030**	
Establishment Type	**Total Number**	**Number Exceeding**	**% Exceeding**	**Number Exceeding**	**% Exceeding**	**Number Exceeding**	**% Exceeding**
Nursery	79	79	100.0%	33	41.8%	4	5.1%
Primary	1803	1580	87.6%	417	23.1%	54	3.0%
Secondary	459	382	83.2%	100	21.8%	17	3.7%
16 plus	46	43	93.5%	21	45.7%	9	19.6%
Community Special School	81	74	91.4%	25	30.9%	0	0.0%
Higher Education Institutions	36	33	91.7%	25	69.4%	14	38.9%
Other Independent School	475	444	93.5%	173	36.4%	43	9.1%
Other Independent Special School	52	48	92.3%	15	28.8%	3	5.8%
Pupil Referral Unit	36	32	88.9%	9	25.0%	1	2.8%
Other	188	164	87.2%	58	30.9%	9	4.8%
Total	3255	2879	88.4%	876	26.9%	154	4.7%

Table 9 - Schools exceeding the $PM_{2.5}$ Annual Mean WHO Air Quality Guideline of 5 µg/m^3

		$PM_{2.5}$ Annual Mean WHO Guideline 5 µg/m^3					
		2019 baseline		**2025**		**2030**	
Establishment Type	**Total Number**	**Number Exceeding**	**% Exceeding**	**Number Exceeding**	**% Exceeding**	**Number Exceeding**	**% Exceeding**
Nursery	79	79	100.0%	79	100.0%	79	100.0%
Primary	1803	1803	100.0%	1803	100.0%	1803	100.0%
Secondary	459	459	100.0%	459	100.0%	459	100.0%
16 plus	46	46	100.0%	46	100.0%	46	100.0%
Community Special School	81	81	100.0%	81	100.0%	81	100.0%
Higher Education Institutions	36	36	100.0%	36	100.0%	36	100.0%
Other Independent School	475	475	100.0%	475	100.0%	475	100.0%
Other Independent Special School	52	52	100.0%	52	100.0%	52	100.0%
Pupil Referral Unit	36	36	100.0%	36	100.0%	36	100.0%
Other	188	188	100.0%	188	100.0%	188	100.0%
Total	3255	3255	100.0%	3255	100.0%	3255	100.0%

Hospitals

As illustrated in Table 10, all hospitals are in areas exceeding the WHO annual average guideline of 10 µg/m^3 for NO_2 and are forecast to continue to in 2025 and 2030.

For the WHO interim target of 20 µg/m^3 annual mean NO_2, 278 (98%) hospitals in London were in areas of exceedance in 2019, while 158 (56%) are expected in 2025 and 78 (27%) in 2030.

One hundred and twenty-eight (45%) hospitals exceeded the WHO interim target of 30 µg/m^3 for annual average NO_2 in 2019 and this is expected to reduce to 6 (2%) in 2025, and none in 2030.

All hospitals were in areas exceeding the WHO $PM_{2.5}$ annual mean guideline of 5 µg/m^3 in 2019, 2025 and 2030.

Two hundred and fifty-eight (91%) of these facilities were in areas exceeding the annual mean WHO interim $PM_{2.5}$ annual mean guideline of 10 µg/m^3 in 2019, and future years show a reduction to 111 (39%) and 53 (19%) hospitals exceeding this value in 2025 and 2030 respectively.

Table 10 - Hospitals exceeding the NO_2 or $PM_{2.5}$ Annual Mean WHO Air Quality Guidelines

Hospitals		Total Number	2019 baseline		2025		2030	
			Number Exceeding	% Exceeding	Number exceeding	% Exceeding	Number Exceeding	% Exceeding
NO_2 Annual Mean	WHO Interim target (30 µg/m^3)	**284**	128	45%	6	2%	0	0%
	WHO Interim target (20 µg/m^3)	**284**	278	98%	158	56%	78	27%
	WHO Guideline (10 µg/m^3)	**284**	284	100%	284	100%	284	100%
$PM_{2.5}$ Annual Mean	WHO Interim target (10 µg/m^3)	**284**	258	91%	111	39%	53	19%
	WHO Guideline (5 µg/m^3)	**284**	284	100%	284	100%	284	100%

Care Homes

As illustrated in Table 11, all care homes are in areas exceeding the WHO annual average guideline of 10 µg/m^3 for NO_2 and are forecast to continue to in 2025 and 2030.

With the WHO NO_2 annual mean interim target of 20 µg/m^3, 519 (99%) of all care homes in London were in areas of exceedance in 2019, with 156 (30%) expected in 2025 and only 8 (2%) in 2030.

One hundred and four (20%) care homes exceeded a limit of the WHO NO_2 annual mean interim target of 30 µg/m^3 in 2019, whilst none are expected to exceed this interim value in 2025 or 2030.

Table 11 – Care Homes exceeding the NO_2 or $PM_{2.5}$ Annual Mean WHO Air Quality Guidelines

Care Homes		Total Number	2019 baseline		2025		2030	
			Number Exceeding	% Exceeding	Number Exceeding	% Exceeding	Number Exceeding	% Exceeding
NO_2 Annual Mean	WHO Interim target (30 µg/m³)	**525**	104	20%	0	0%	0	0%
	WHO Interim target (20 µg/m³)	**525**	519	99%	156	30%	8	2%
	WHO Guideline (10 µg/m³)	**525**	525	100%	525	100%	525	100%
$PM_{2.5}$ Annual Mean	WHO Interim target (10 µg/m³)	**525**	440	84%	75	14%	1	0%
	WHO Guideline (5 µg/m³)	**525**	525	100%	525	100%	525	100%

Emissions Data – Source Apportionment

The LAEI provides a breakdown of pollutant emissions by source, for 1km grid square resolution. The summary charts below show that, in 2019, the largest contributing source for NO_x and $PM_{2.5}$ emissions was from road transport at 44% and 31% respectively.

For $PM_{10,}$ in 2019, the largest contributing source is construction at 30%, closely followed by road transport at 27%. The $PM_{2.5}$ chart also shows that domestic biomass/wood burning is a significant contributor at 17% of total emissions.

In future years, however, the proportion of road transport contributing to total emissions is expected to reduce significantly. By 2025, road transport emissions are expected to contribute 28% of total NO_x emissions and would be overtaken as the main source of pollution across Greater London by the industrial/commercial heat and power generation source (29% of total NO_x). By 2030, road transport would only represent 17% of total NO_x emissions, a similar proportion to aviation and industrial processes.

The contribution by source from 2016 is also provided for comparison. It shows a similar source apportionment compared to 2019, although the road transport NOx contribution reduced notably (52% in 2016 vs. 44% in 2019), whilst the contribution of industrial/commercial heat and power combustion sources increased (from 17% in 2016 to 21% in 2019).

Whilst the Mayor, working with boroughs, has put in place some programmes and policies which are having an effect (e.g. the Non Road Mobile Machinery Low Emission Zone, Air Quality Positive and Neutral planning policies which are reducing emissions from construction and buildings), this data shows why it is so essential that the Mayor has additional powers to tackle non-road transport sources of pollution, including from buildings, construction, wood burning, commercial cooking and the river.

Figure 16 - 2016 NO_x Emissions by Source in Greater London

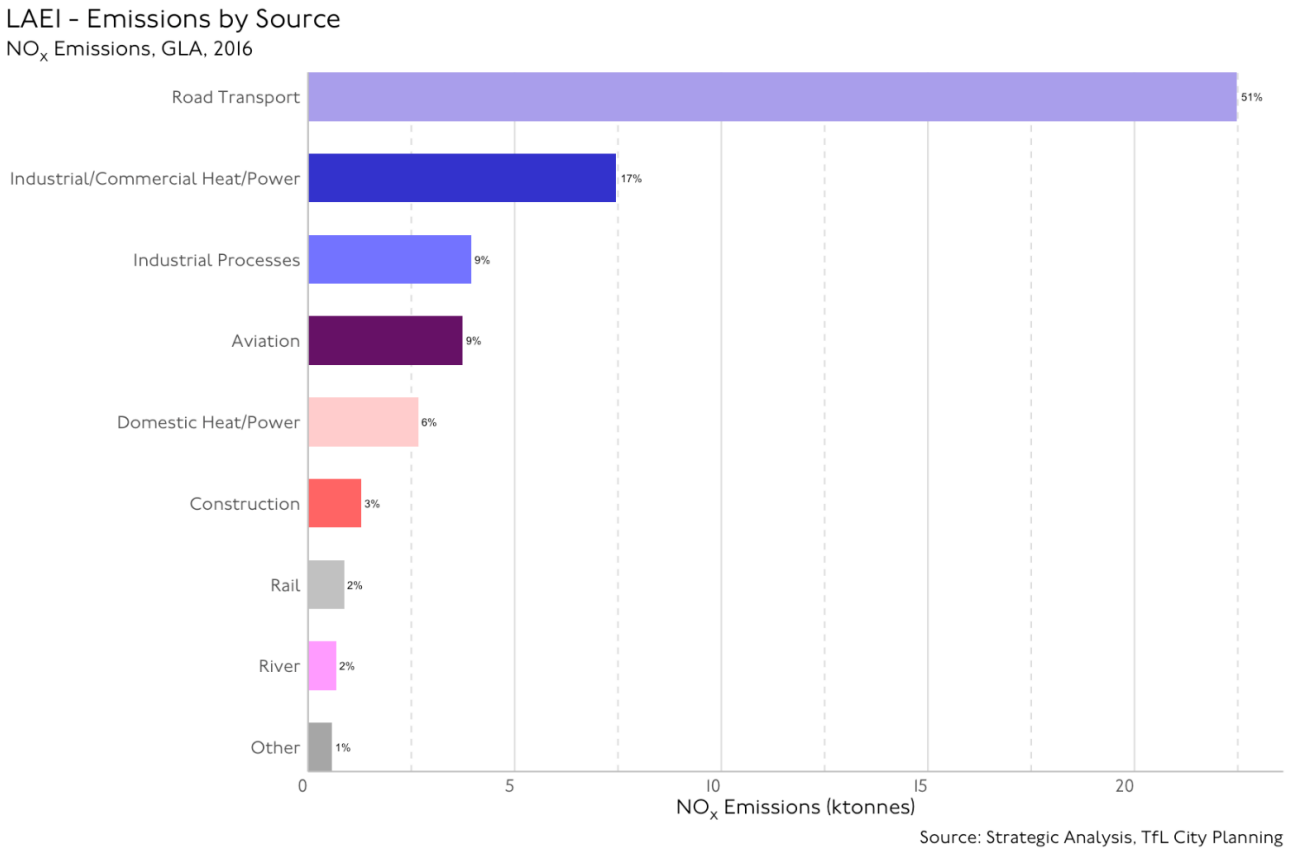


Figure 17 - 2019 NO_x Emissions by Source in Greater London

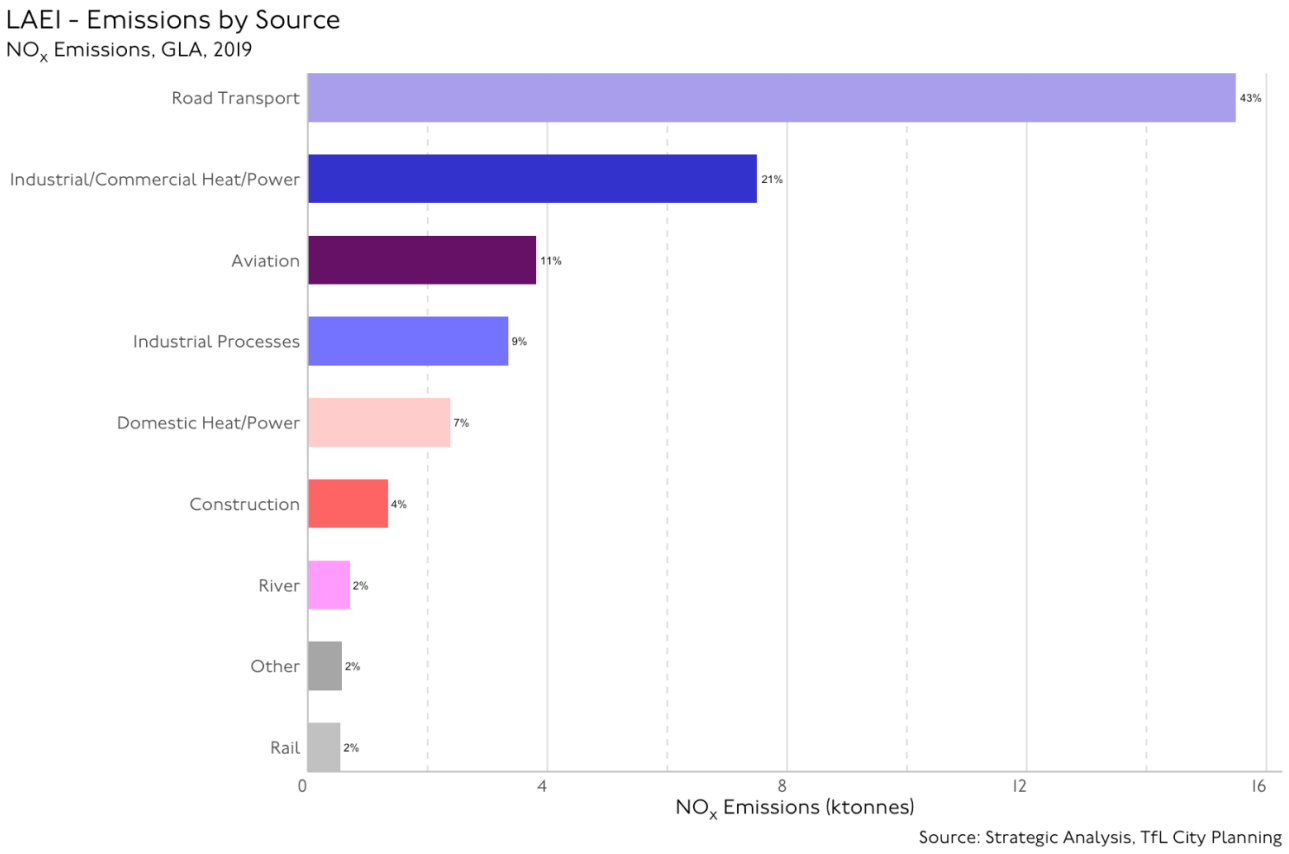


Figure 18 - 2025 NO_x Emissions by Source in Greater London

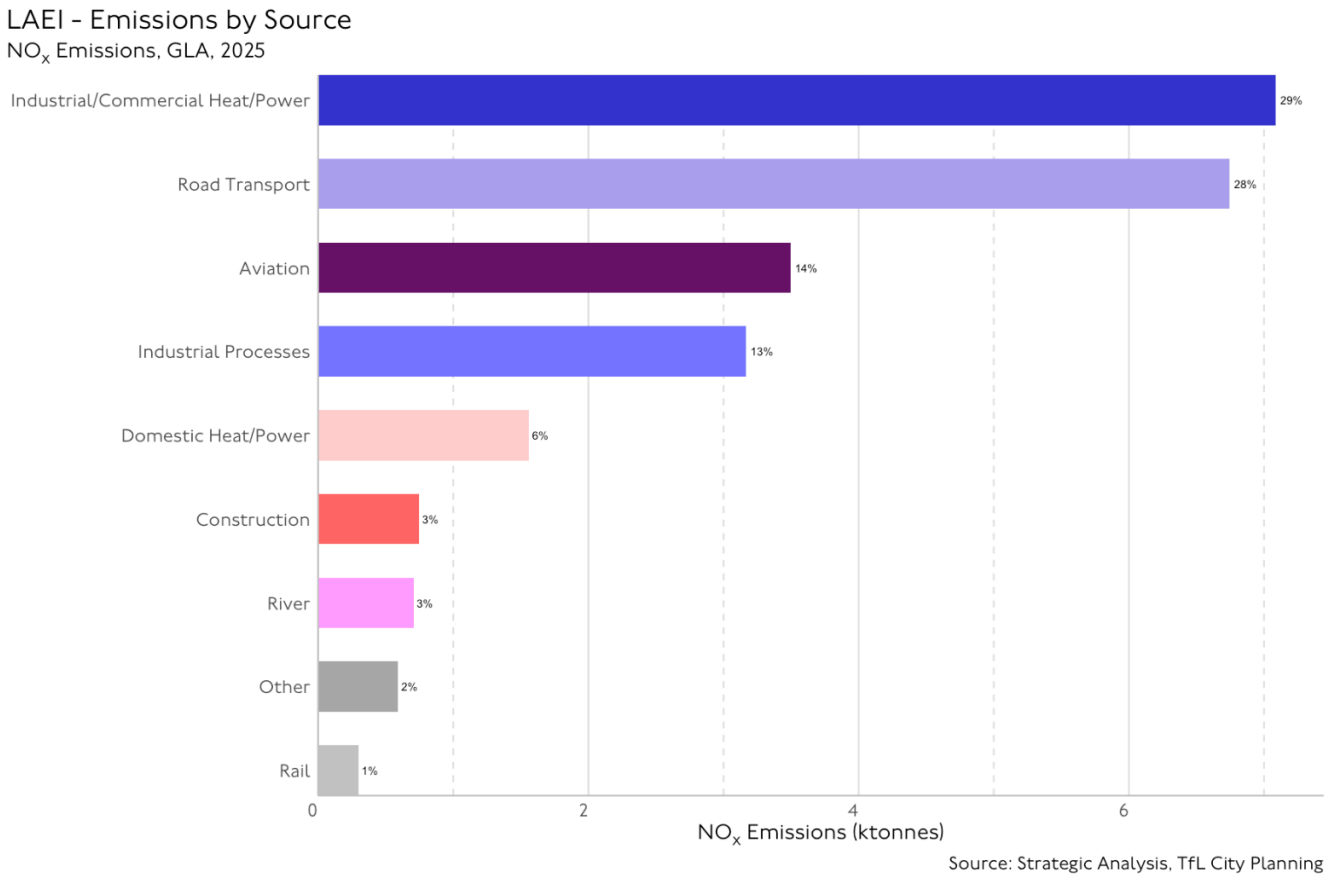


Figure 19 – 2030 NO_x Emissions by Source in Greater London

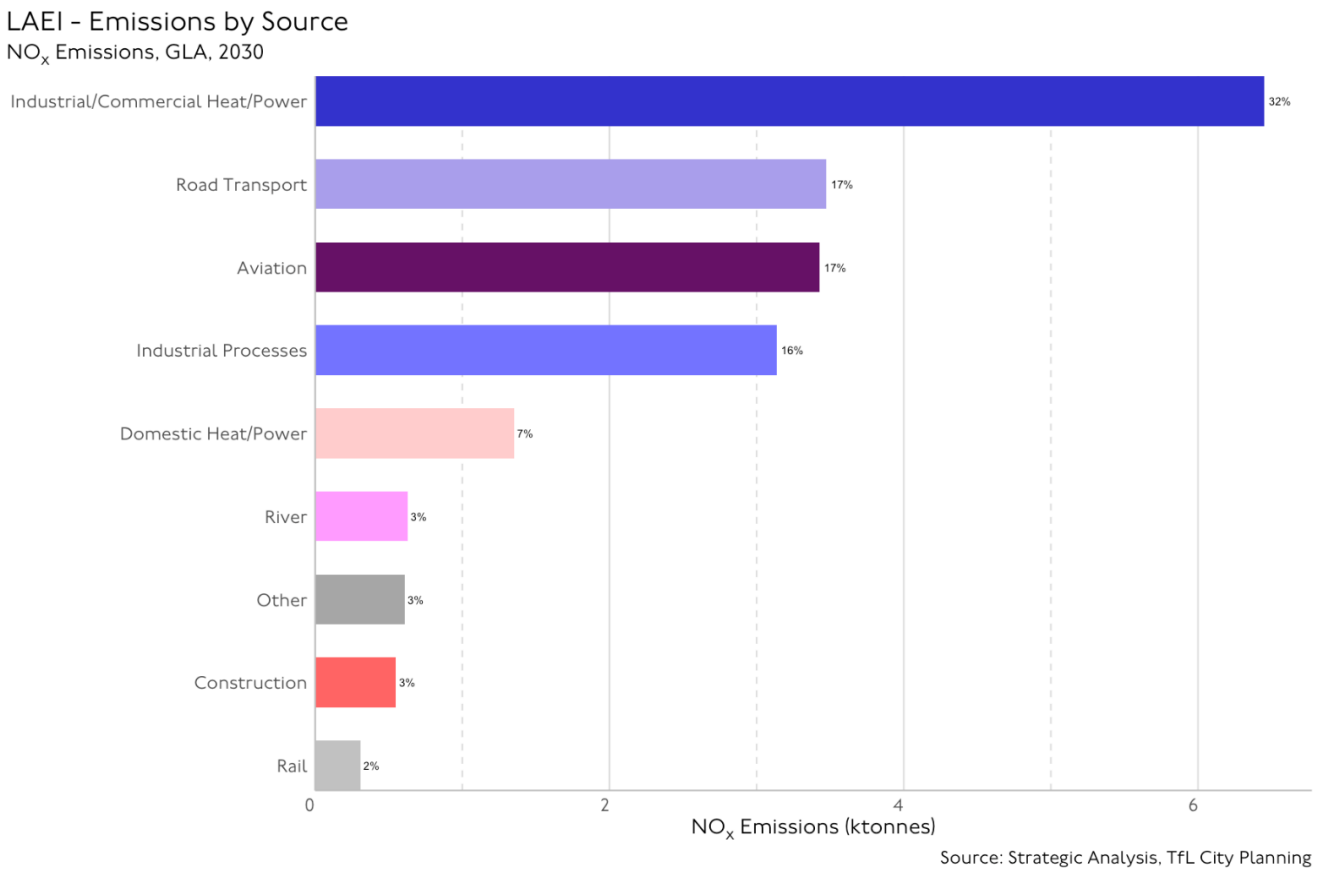


Figure 20 - 2016 PM_{10} Emissions by Source in Greater London

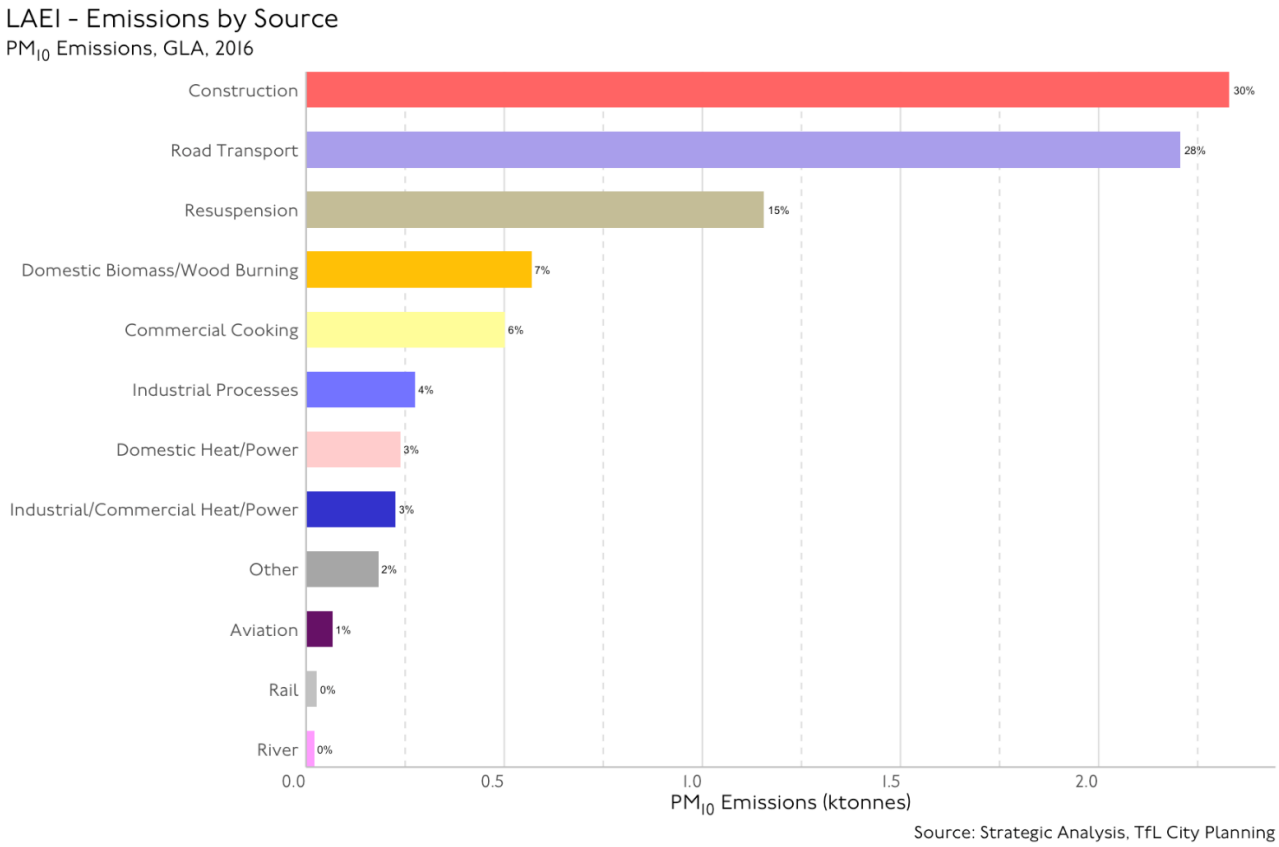


Figure 21 - 2019 PM_{10} Emissions by Source in Greater London

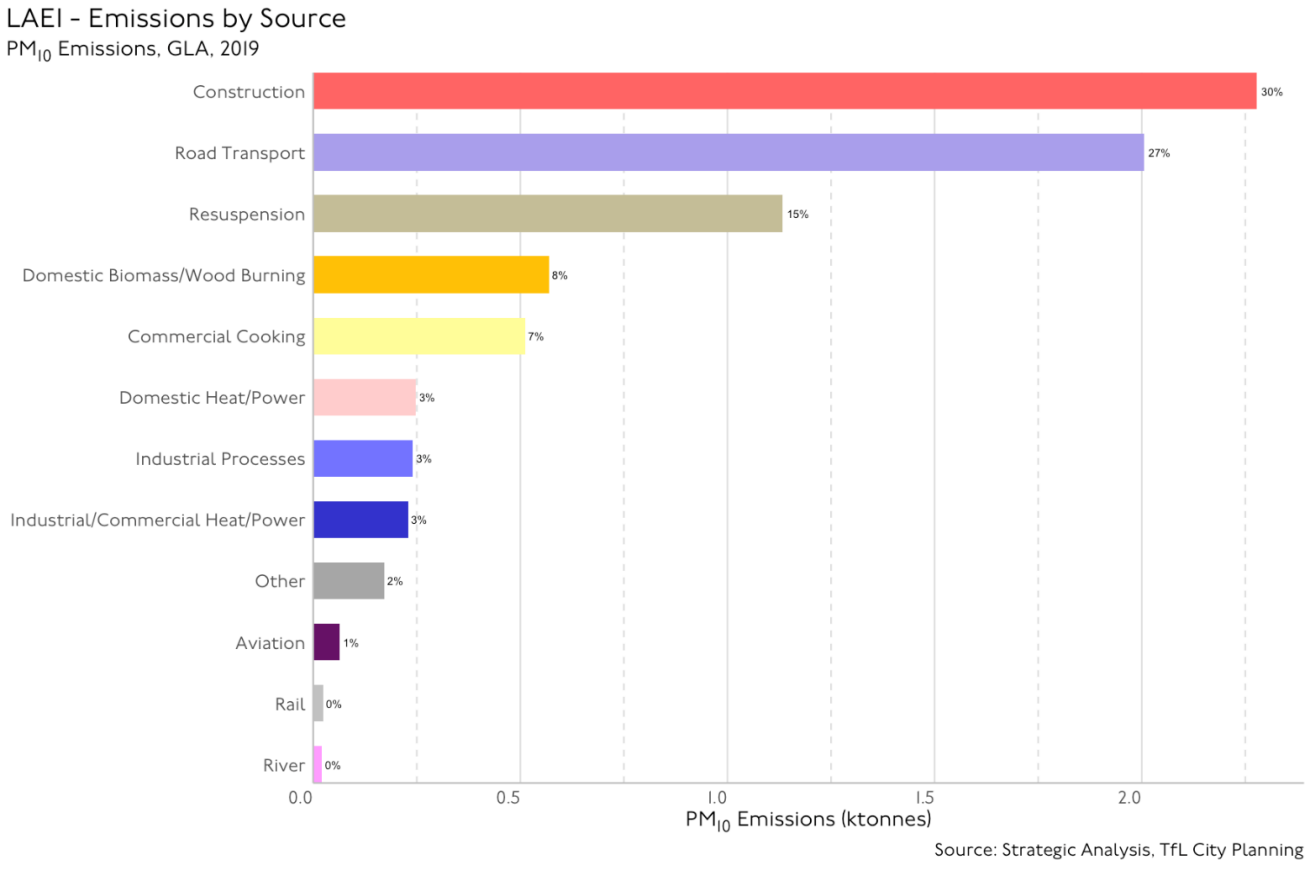


Figure 22 - 2025 PM_{10} Emissions by Source in Greater London

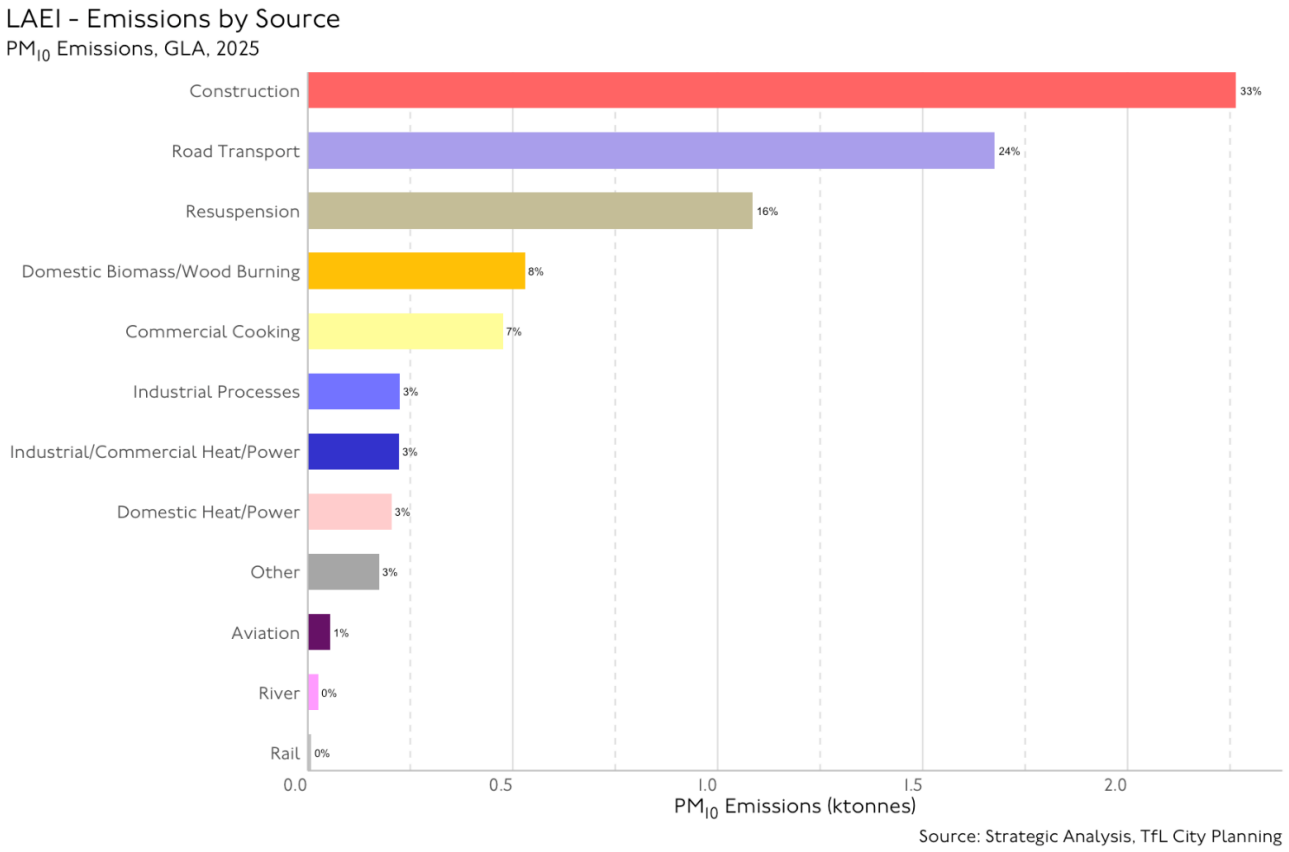


Figure 23 - 2030 PM_{10} Emissions by Source in Greater London

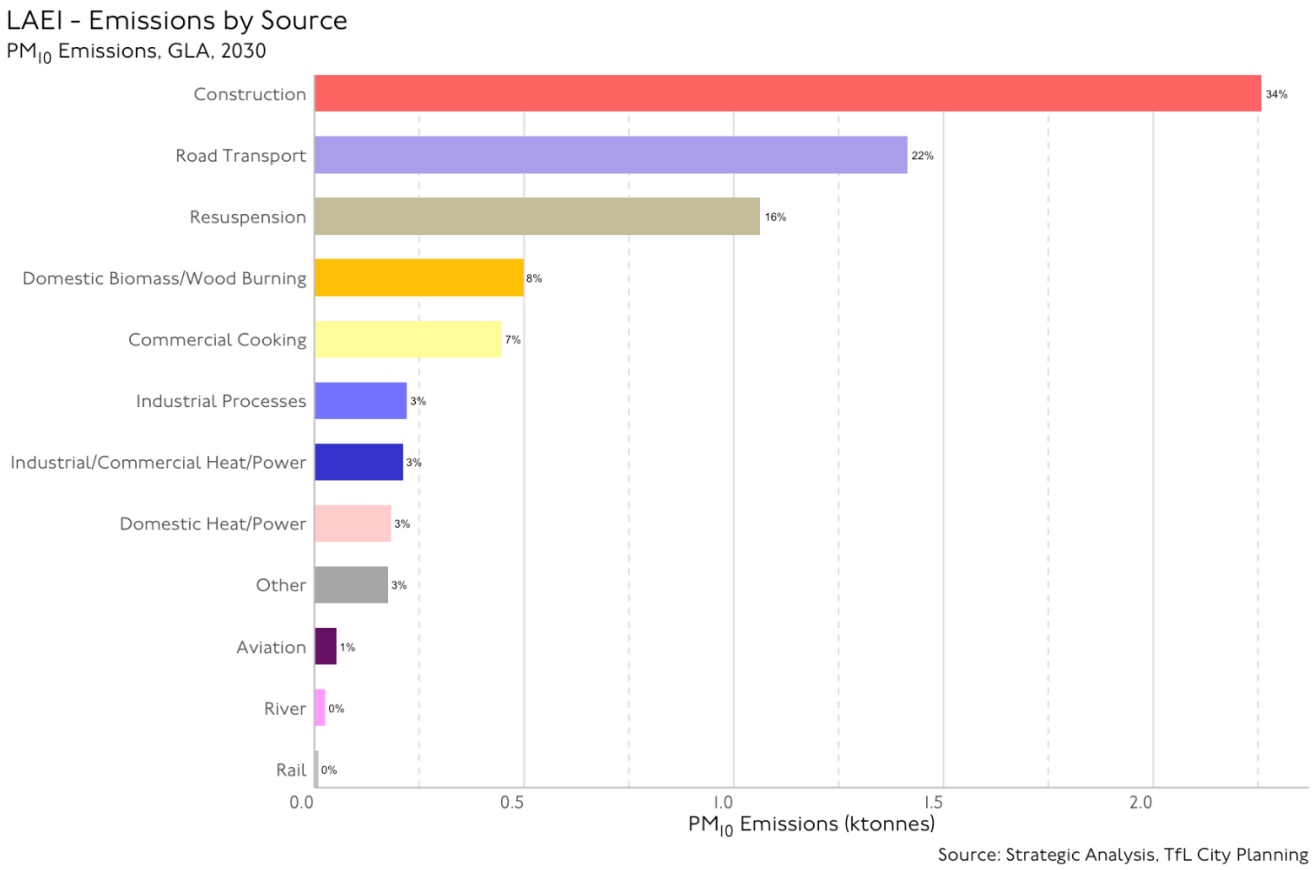


Figure 24 - 2016 $PM_{2.5}$ Emissions by Source in Greater London

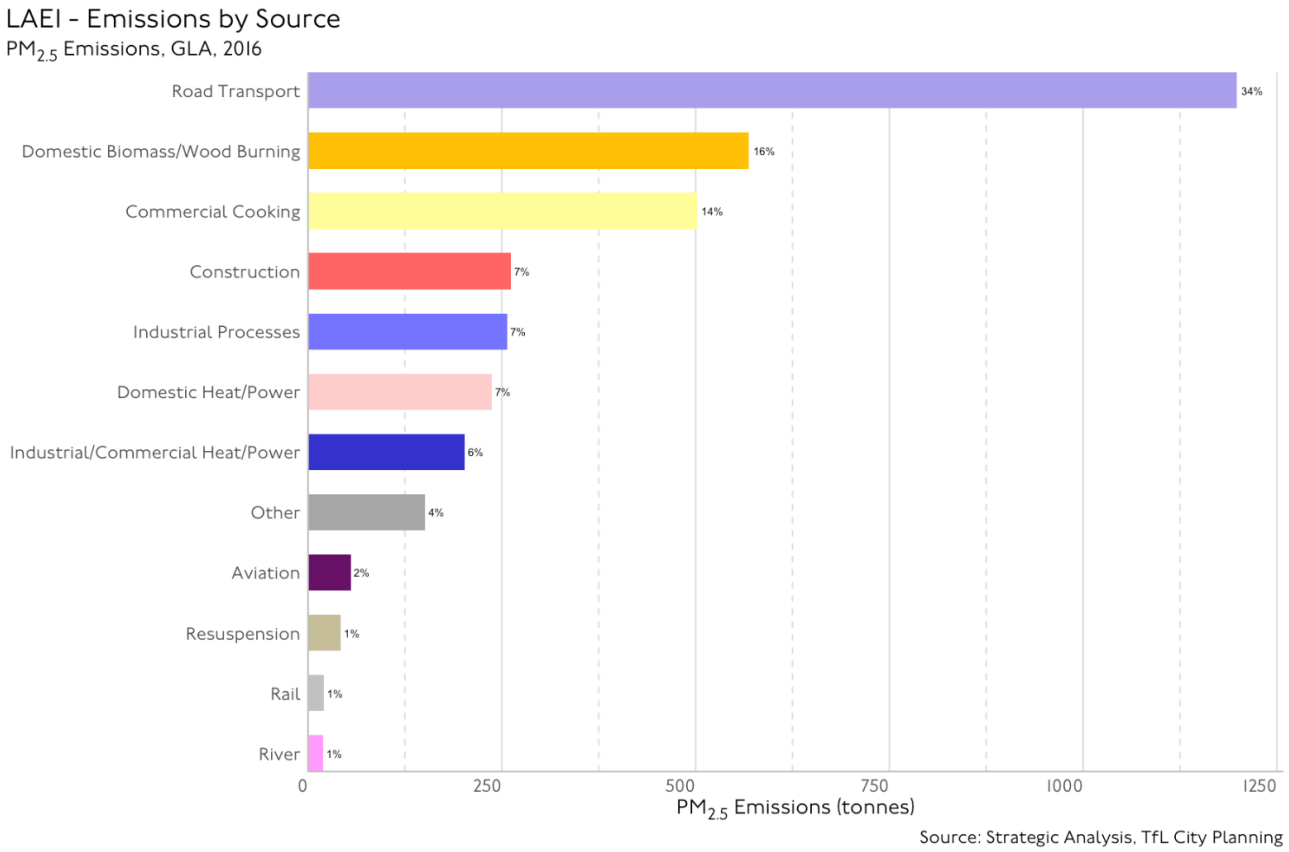


Figure 25 - 2019 $PM_{2.5}$ Emissions by Source in Greater London

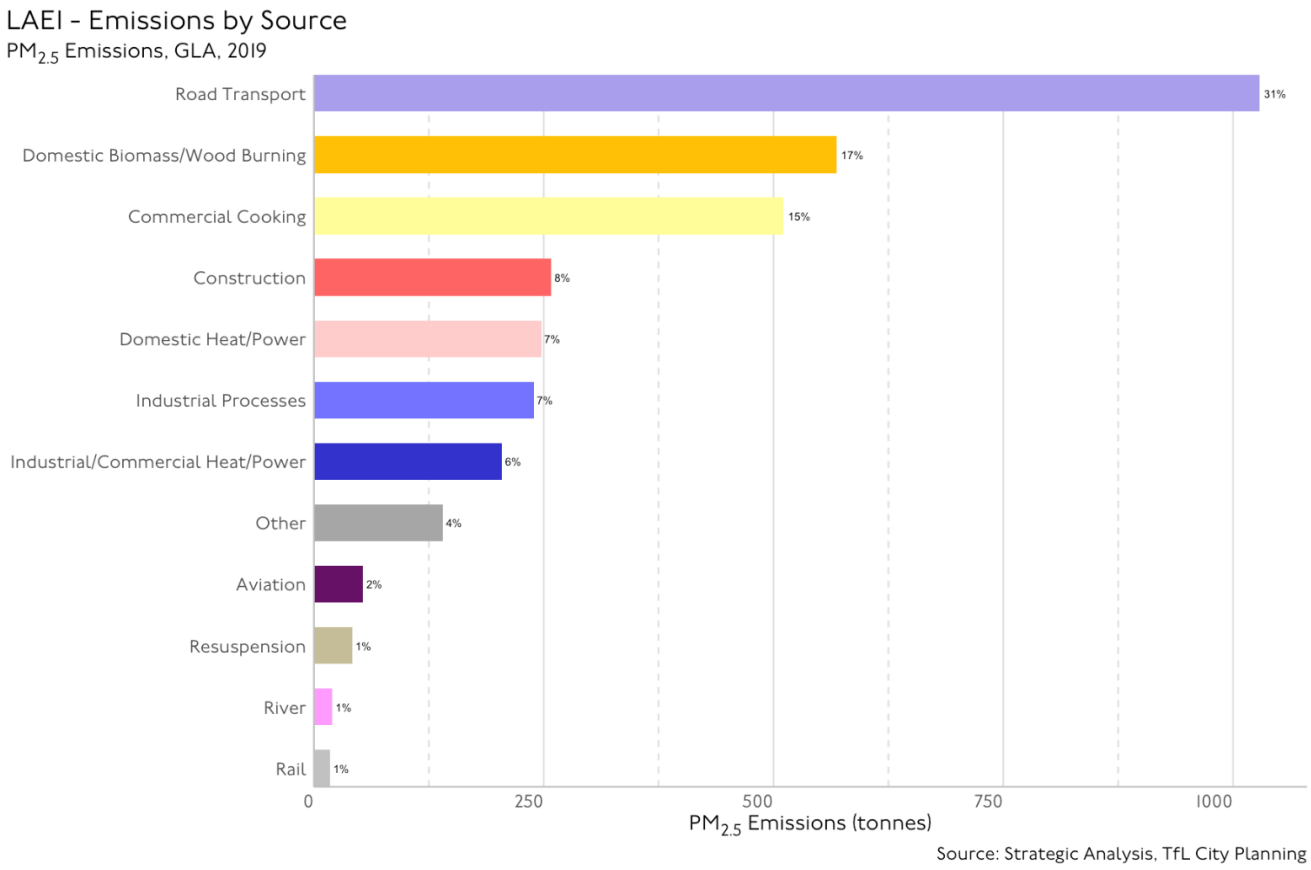


Figure 26 – 2025 $PM_{2.5}$ Emissions by Source in Greater London

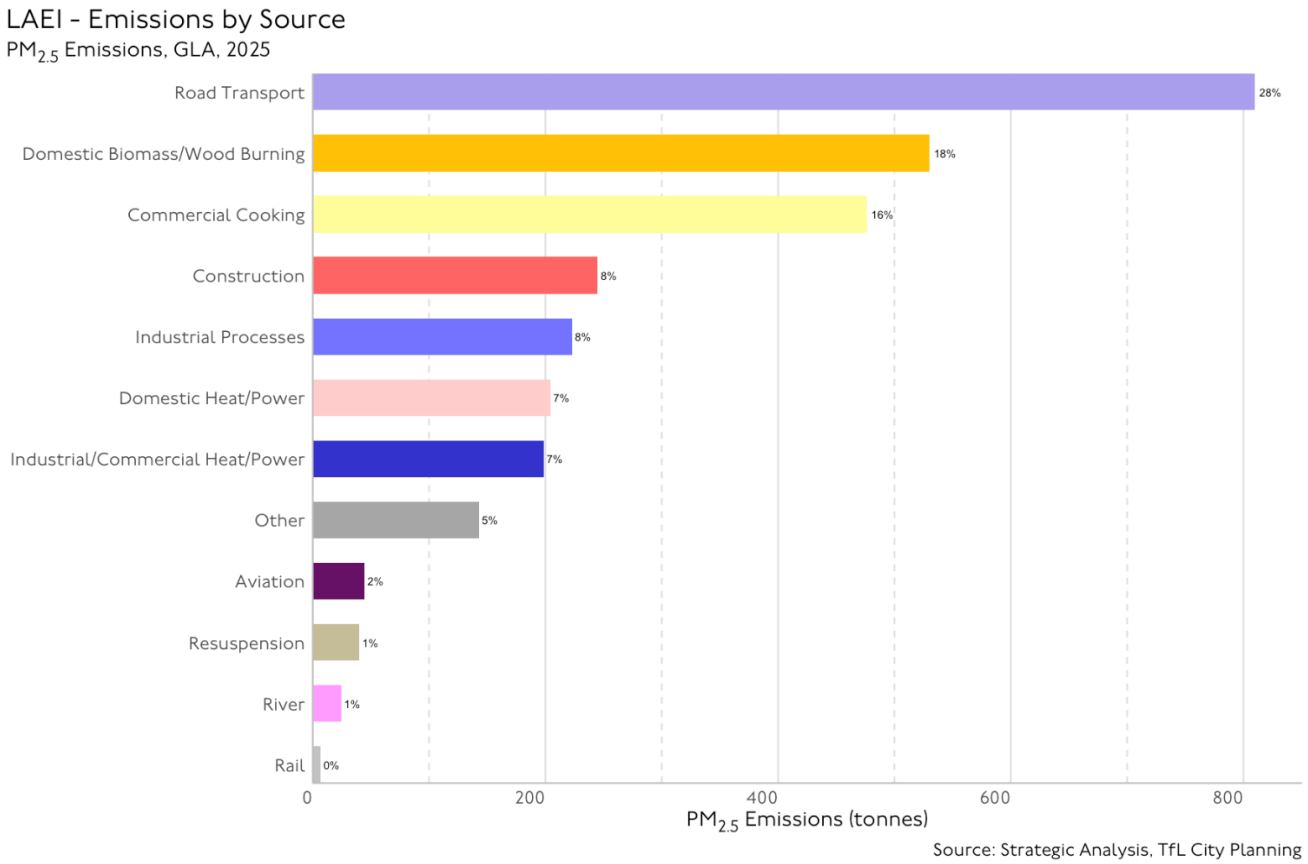
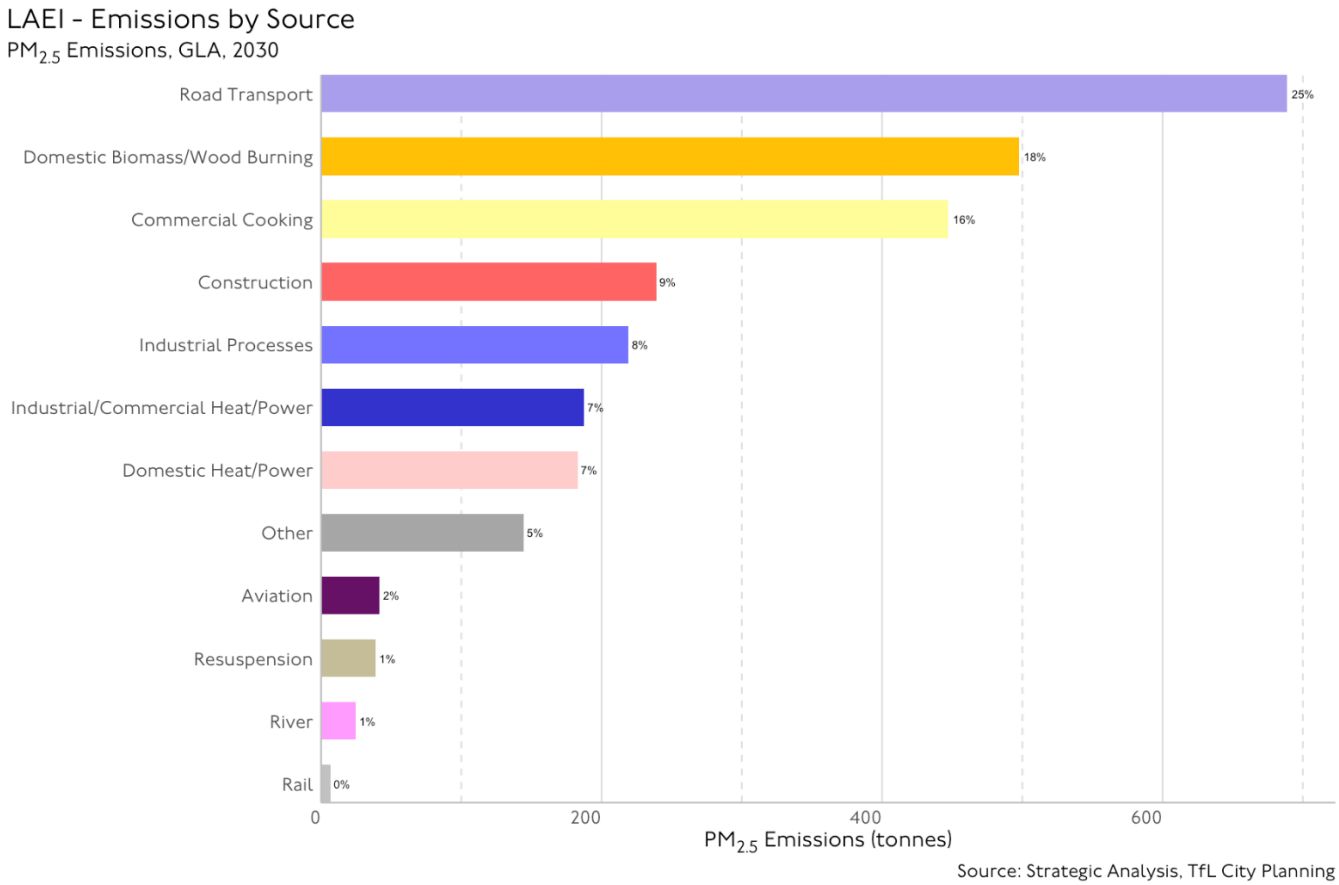


Figure 27 - 2030 $PM_{2.5}$ Emissions by Source in Greater London



Appendix 1

Proportion of TLRN Meeting the NO_2 Annual Mean Limit Value of 40 µg/m^3 by borough

	2016 Baseline	LAEI2019 Baseline	LAEI2019 2025	LAEI2019 2030
All TLRN	28%	70%	99%	100%
Barking and Dagenham	44%	81%	100%	100%
Barnet	34%	74%	100%	100%
Bexley	58%	82%	100%	100%
Brent	19%	75%	100%	100%
Bromley	79%	100%	100%	100%
Camden	1%	27%	95%	100%
City	0%	8%	87%	99%
City of Westminster	0%	15%	92%	100%
Croydon	52%	96%	100%	100%
Ealing	15%	62%	100%	100%
Enfield	45%	83%	100%	100%
Greenwich	25%	75%	100%	100%
Hackney	0%	63%	100%	100%
Hammersmith and Fulham	5%	57%	99%	100%
Haringey	8%	78%	100%	100%
Harrow	77%	99%	100%	100%
Havering	72%	97%	100%	100%
Hillingdon	31%	70%	100%	100%
Hounslow	21%	77%	100%	100%
Islington	0%	47%	100%	100%
Kensington and Chelsea	0%	24%	99%	100%
Kingston	40%	79%	100%	100%
Lambeth	4%	62%	100%	100%
Lewisham	23%	84%	100%	100%
Merton	46%	93%	100%	100%
Newham	10%	68%	100%	100%
Redbridge	30%	71%	100%	100%
Richmond	37%	91%	100%	100%
Southwark	11%	65%	99%	100%
Sutton	60%	99%	100%	100%
Tower Hamlets	3%	37%	98%	100%
Waltham Forest	20%	72%	100%	100%
Wandsworth	14%	71%	100%	100%

Proportion of TLRN Meeting the NO_2 WHO Interim target of 30 µg/m^3 by borough

	2016 Baseline	LAEI2019 Baseline	LAEI2019 2025	LAEI2019 2030
All TLRN	2%	20%	89%	99%
Barking and Dagenham	0%	38%	98%	100%
Barnet	5%	27%	95%	100%
Bexley	3%	33%	100%	100%
Brent	0%	8%	86%	100%
Bromley	17%	58%	100%	100%
Camden	0%	0%	59%	96%
City	0%	0%	17%	86%
City of Westminster	0%	0%	48%	96%
Croydon	7%	36%	100%	100%
Ealing	0%	12%	92%	100%
Enfield	5%	32%	98%	100%
Greenwich	0%	19%	98%	100%
Hackney	0%	1%	92%	100%
Hammersmith and Fulham	0%	0%	80%	100%
Haringey	0%	7%	99%	100%
Harrow	3%	41%	100%	100%
Havering	20%	50%	100%	100%
Hillingdon	2%	22%	89%	100%
Hounslow	0%	11%	93%	100%
Islington	0%	0%	80%	100%
Kensington and Chelsea	0%	0%	77%	99%
Kingston	1%	29%	100%	100%
Lambeth	0%	7%	91%	100%
Lewisham	0%	18%	98%	100%
Merton	0%	21%	100%	100%
Newham	0%	7%	86%	100%
Redbridge	0%	22%	98%	100%
Richmond	2%	34%	100%	100%
Southwark	0%	10%	86%	100%
Sutton	0%	43%	100%	100%
Tower Hamlets	0%	3%	62%	98%
Waltham Forest	0%	14%	88%	100%
Wandsworth	0%	11%	99%	100%

Proportion of TLRN Meeting the NO_2 WHO Interim target of 20 µg/m^3 by borough

	2016 Baseline	LAEI2019 Baseline	LAEI2019 2025	LAEI2019 2030
All TLRN	0%	0%	17%	77%
Barking and Dagenham	0%	0%	33%	96%
Barnet	0%	0%	25%	94%
Bexley	0%	0%	40%	100%
Brent	0%	0%	4%	82%
Bromley	0%	1%	64%	100%
Camden	0%	0%	0%	20%
City	0%	0%	0%	0%
City of Westminster	0%	0%	0%	7%
Croydon	0%	0%	37%	100%
Ealing	0%	0%	3%	83%
Enfield	0%	0%	32%	96%
Greenwich	0%	0%	15%	93%
Hackney	0%	0%	0%	71%
Hammersmith and Fulham	0%	0%	0%	67%
Haringey	0%	0%	3%	97%
Harrow	0%	0%	42%	100%
Havering	0%	0%	57%	100%
Hillingdon	0%	0%	15%	66%
Hounslow	0%	0%	5%	76%
Islington	0%	0%	0%	44%
Kensington and Chelsea	0%	0%	0%	28%
Kingston	0%	0%	29%	100%
Lambeth	0%	0%	2%	70%
Lewisham	0%	0%	14%	94%
Merton	0%	0%	17%	99%
Newham	0%	0%	2%	76%
Redbridge	0%	0%	21%	96%
Richmond	0%	0%	23%	98%
Southwark	0%	0%	8%	51%
Sutton	0%	0%	44%	100%
Tower Hamlets	0%	0%	0%	25%
Waltham Forest	0%	0%	11%	86%
Wandsworth	0%	0%	4%	92%

Appendix 2

Following passage of the Environment Act 2021 the Government has introduced two new legally binding limits for fine particulate matter ($PM_{2.5}$):

- An annual mean concentration target ('concentration target') - a maximum concentration of 10 $\mu g/m^3$, to be met across England by 2040, and
- A population exposure reduction target ('exposure target') - a 35% reduction in population exposure by 2040 (compared to a base year of 2018).

Existing legal limits, including those for the NO_2 annual and hourly means, remain in place, and include: an annual average of 40$\mu g/m^3$ and an hourly average of 200$\mu g/m^3$, not to be exceeded more than 18 times per year.

The Mayor has long made the case for UK air pollution limits for all air pollutants to be aligned with the WHO recommended air quality guidelines, which are based on the best available health evidence. In the London Environment Strategy, the Mayor committed to achieving annual mean concentrations of 10 $\mu g/m^3$ of $PM_{2.5}$ by 2030, a full decade before the new UK legal limits, the data demonstrated that this can be achieved.

This appendix reports on the annual mean concentrations for NO_2 compared to the UK legal limit.

For $PM_{2.5}$ data compared to UK legal limit, to avoid repetition please see main reporting within the summary note as compared with WHO interim target of 10 $\mu g/m^3$

Nitrogen Dioxide (NO_2)

The proportion of major road lengths[11] exceeding the NO_2 national legal limit (40 $\mu g/m^3$) have been assessed and results are provided in Table 12. This is estimated based on analysis of concentrations along the edge of roads at approximately 4m distance.[12]

- In 2019, 84% of major road lengths in London met the NO_2 annual mean legal limit of 40 $\mu g/m^3$. This is compared to 46% of major roads lengths in 2016. 100% of major roads are expected to meet this limit in 2025 and 2030.
- In central London, no major road lengths met the NO_2 annual mean legal limit of 40 $\mu g/m^3$ in 2016. This has improved substantially, and it is estimated that 27% of major road lengths met the legal limit in 2019. This proportion is expected to go up to 94 % in 2025 and 100% of the major roads in 2030.

[11] Major roads are road links in the LAEI which are assigned traffic flows based on TfL strategic transport models and exclude minor roads and most smaller residential roads across London where there is much lower risk of exceeding the legal limits for NO_2 concentrations.

[12] This provides a similar approach to the national assessment of compliance. Moreover, it can be replicated when new LAEI concentrations become available providing a consistent way of indicating the changes in modelled roadside concentrations.

Table 12 – Proportion of Major Roads Network Length Below / Over the NO_2 Annual Mean UK Legal Limit of 40 µg/m³

UK legal limit 40 µg/m³ NO_2 annual average	Exceeding Central	Meeting Central	Exceeding Inner Zone	Meeting Inner Zone	Exceeding Outer Zone	Meeting Outer Zone	Exceeding GLA	Meeting GLA
2016	100%	0%	88%	12%	36%	64%	54%	46%
2019	74%	27%	26%	74%	8%	92%	16%	84%
2025	4%	96%	1%	99%	0%	100%	0%	100%
2030	0%	100%	0%	100%	0%	100%	0%	100%

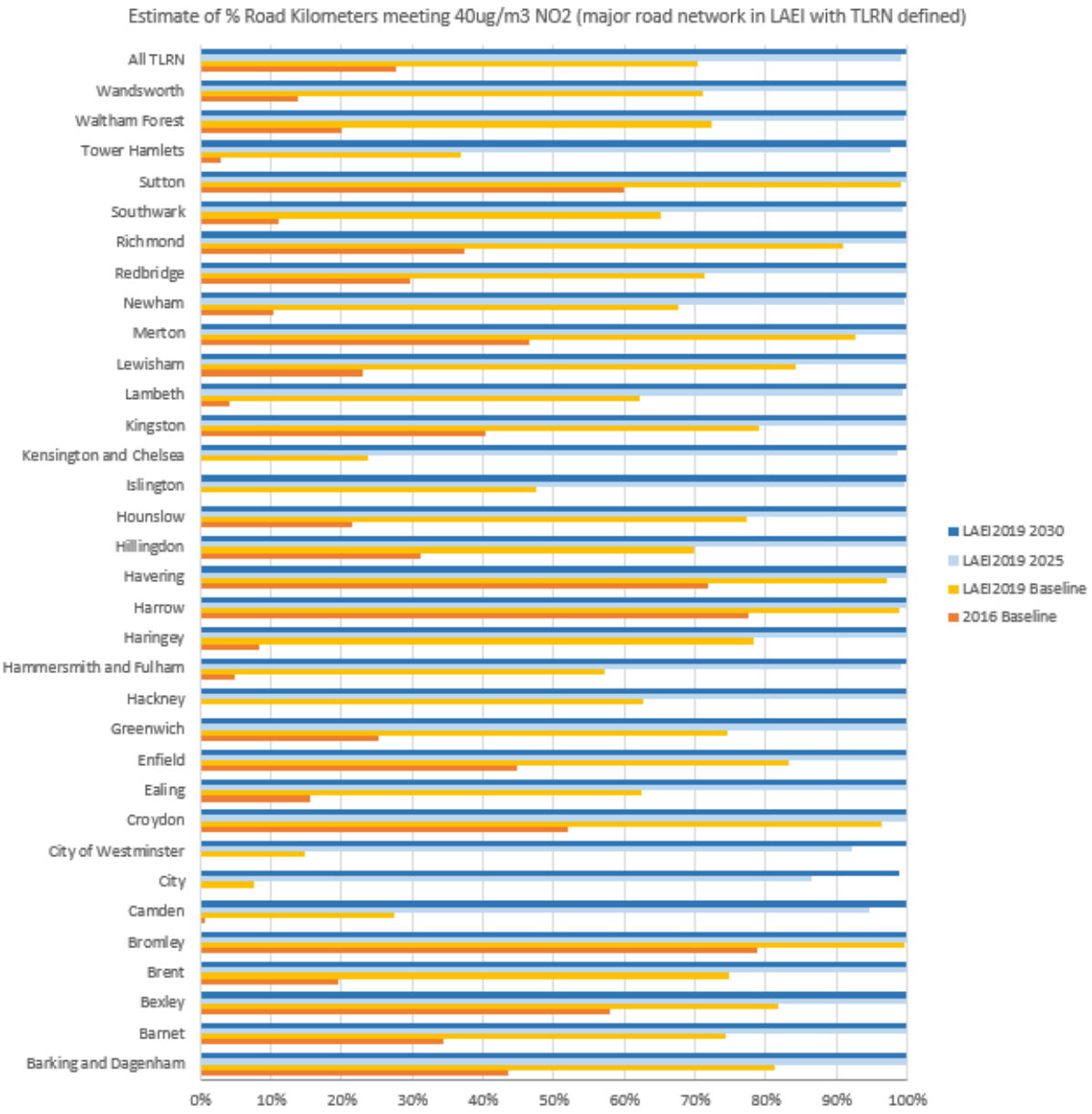
Transport for London Road Network (TLRN) or London's 'Red Routes'

London's red routes form a network of major roads that only make up 5% of the roads, however it represents up to 30% of the city's traffic.

- In 2016, it was estimated that 28% of the TLRN met the UK annual mean legal limit of 40 µg/m³ for NO_2, based on average concentrations at 4 m distance. Based on the LAEI 2019, this has increased to 70% in 2019, and in 2030 100% of the TLRN is expected to meet this limit.

Figure 28 shows the estimated proportion of TLRN, by borough, exceeding the NO_2 annual mean limit value of 40 µg/m³.

Figure 28 – Proportion of TLRN Meeting the NO_2 Annual Mean Limit Value of 40 µg/m³



Population exposure

The population exposure data shows that there have been significant reductions in the number of Londoners living in areas of high pollution.

- Over 2 million Londoners were living in areas exceeding the UK annual mean legal limit of 40 µg/m³ for NO_2 in 2016. This reduced to 161,000 in 2019 and is forecast to be 600 in 2025 and none in 2030.

- Over a quarter of those living in central London were still living in areas exceeding the UK legal limit of 40 µg/m³ for NO_2 in 2019, but overall levels are reduced, and no Londoners are expected to exceed this limit in central London in 2030.

Schools

Analysis on concentration data allows us to determine the number of each type of educational facility located in areas exceeding the NO_2 annual mean UK legal limit (40 µg/m^3) in 2019, 2025 and 2030. The concentration figures have been calculated as an average within a 150m buffer of each educational establishment.

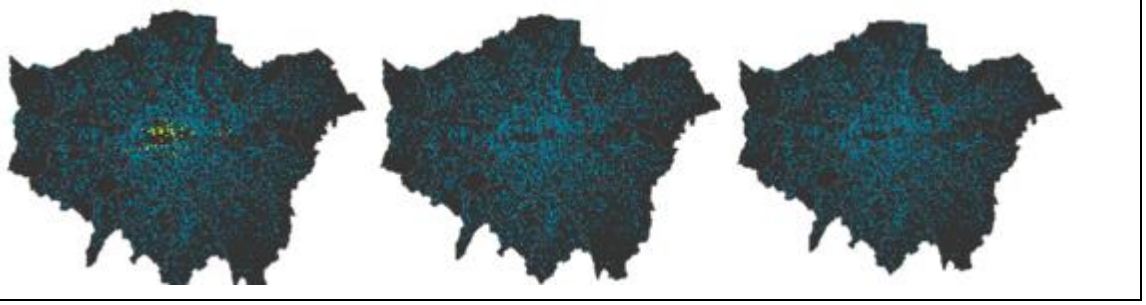
As shown in Table 13*, of 3,255 educational establishments assessed, 50 (1.5%) were in areas exceeding the UK legal limit annual* mean of 40 µg/m3 for NO_2 in 2019. Out of a total of 2,262 state primary and secondary schools, 19 (0.8%) were in areas exceeding this limit in 2019. No educational establishments are expected to exceed the limit in 2025 and 2030.

Please note that earlier analysis for 2019 baseline suggested slightly different numbers than these now reported. The variation is due to an updated version of the school database (Edubase from the Department of Education) being used in this analysis.

Table 13 – Schools exceeding the NO_2 Annual Mean UK Legal Limit of 40 µg/m^3

		NO_2 Annual Mean UK Legal Limit 40 µg/m^3					
		2019 baseline		**2025**		**2030**	
Establishment Type	**Total Number**	**Number Exceeding**	**% Exceeding**	**Number Exceeding**	**% Exceeding**	**Number Exceeding**	**% Exceeding**
Nursery	79	0	0.0%	0	0.0%	0	0.0%
Primary	1803	14	0.8%	0	0.0%	0	0.0%
Secondary	459	5	1.1%	0	0.0%	0	0.0%
16 plus	46	2	4.3%	0	0.0%	0	0.0%
Community Special School	81	0	0.0%	0	0.0%	0	0.0%
Higher Education Institutions	36	8	22.2%	0	0.0%	0	0.0%
Other Independent School	475	17	3.6%	0	0.0%	0	0.0%
Other Independent Special School	52	1	1.9%	0	0.0%	0	0.0%
Pupil Referral Unit	36	0	0.0%	0	0.0%	0	0.0%
Other	188	3	1.6%	0	0.0%	0	0.0%
Total	3255	50	1.5%	0	0.0%	0	0.0%

Figure 29 - Schools Meeting / Exceeding the NO_2 Annual Mean UK Legal Limit

	2019	2025	2030
UK Legal Limit 40 µg/m³			

Hospitals

Of 284 hospitals, it is estimated that 25 (9%) of these are in locations areas that were exceeding the NO_2 annual mean UK legal limit (40 µg/m³) in 2019, whilst none are expected to exceed this limit in 2025 or 2030.

Table 14 - Hospitals exceeding the NO_2 Annual Mean UK Legal Limit

Hospitals		Total Number	2019 baseline		2025		2030	
			Number Exceeding	% Exceeding	Number exceeding	% Exceeding	Number Exceeding	% Exceeding
NO_2 Annual Mean	UK Legal Limit (40 µg/m³)	**284**	25	9%	0	0%	0	0%

Care Homes

Of an estimated 525 care homes, none were in locations where the annual average NO_2 concentration was above the UK legal limit of 40 µg/m³ in 2019 or future modelled years.

Table 15 – Care Homes exceeding the NO_2 Annual Mean UK Legal Limit

Care Homes		Total Number	2019 baseline		2025		2030	
			Number Exceeding	% Exceeding	Number Exceeding	% Exceeding	Number Exceeding	% Exceeding
NO_2 Annual Mean	UK Legal Limit (40 µg/m³)	**525**	0	0%	0	0%	0	0%