August 2025

London Atmospheric Emissions Inventory 2022 Update

Executive Summary

London Atmospheric Emissions Inventory (LAEI) is a London-based system that estimates and reports on emissions of various pollutants from different sources within Greater London. This inventory helps in understanding the impact of human activities on the environment and in developing policies to reduce harmful emissions, as well as monitoring the trends in emissions over time.

The 2022[1] provides an update to the previous LAEI 2019 and a new baseline for 2022. The comprehensive data set is being published in two parts, this document provides an overview of the first release of the LAEI 2022 output results along with the trend seen from previous LAEIs and previously published future projections including:

- Changes in nitrogen oxides (NO_x) and particulate matter (PM_{10} and $PM_{2.5}$) emissions by over time.
- Emissions by pollutant and source, split by London Zone by borough and grid square.

This will be followed in autumn by the addition of the following data:

- Maps of annual mean concentrations for nitrogen dioxide (NO_2), PM_{10} and $PM_{2.5}$; (to follow, autumn 2025).
- 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; (to follow, autumn 2025).
- The number of Londoners, and the number of schools, hospitals and care homes meeting air quality targets for NO_2 and $PM_{2.5}$. (to follow autumn 2025)

All statistics given in this document are for the Greater London area. As per the London Government Act 1963, the area comprising the London boroughs, the City and the Temples shall constitute an administrative area to be known as Greater London.

Given the increasing body of evidence of the health impacts of air pollution, even at levels previously considered to be low, 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

[1] 2022 data is the most up to date available.

The soon to be published (autumn 2025) LAEI 2022 concentration maps and exposure data will enable us to track our progress towards meeting these new WHO air quality guidelines for NO_2 and $PM_{2.5}$.

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. While this LAEI release does not include any new forecasts, the previously published LAEI included concentrations forecasts which showed that meeting the interim targets is possible within the timeframe of the 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 Mayor has commissioned a scientific and technical evaluation of what action would enable London to achieve its existing target of 10 µg/m^3 annual average $PM_{2.5}$ by 2030, and to reach full compliance with the WHO Guidelines.

The relationship between different clean air targets is described in more detail in the main section of this summary.

Key findings are:

The overall findings of this data set show continued progress in the reduction in pollution emissions across London since 2016. While strong progress has been made for NO_x and $PM_{2.5}$, the total emissions for PM_{10} have remained stable, indicating that there is still further work to be done to reduce emissions.

Emissions

- **A sustained and substantial reduction in total emissions has been observed since the introduction of Mayoral air quality policies in 2016, with the most pronounced declines seen in road transport emissions, where NO_x emissions have reduced by over half (52%) by 2022.**
- Total NO_x emissions in Greater London fell by 23% between 2019 and 2022, building on the 19% reduction already achieved between 2016 and 2019. Further reductions of 12% by 2025 and 29% by 2030 (relative to 2022 levels) are forecast.
- NO_x emissions from road transport in Greater London fell by 30% between 2019 and 2022, building on the 31% reduction observed between 2016 and 2019. Road transport NO_x emissions are expected to reduce by a further 38% across London by 2025 and 68% by 2030, compared to 2022. This is primarily influenced by strong Mayoral policies specifically targeting vehicle emissions, such as the Ultra Low Emission Zone (ULEZ).
- Total $PM_{2.5}$ emissions reduced by 6% in Greater London between 2019 and 2022 and are forecast to reduce further by 4% by 2025, and 11% by 2030, from 2022 levels.
- While total PM10 emissions in 2022 remain broadly similar to 2019 levels, a notable decline was seen in emissions from road transport (14%). From 2022 levels, total PM10 emissions are forecast to fall by 7% by 2025 and 12% by 2030.
- The fall in road transport PM10 emissions has been largely offset by rising emissions from construction, particularly in central London, confirming the trend that construction is now the dominant emissions source for PM10.

The substantial reductions in pollution emissions seen are due to a number of different factors including the Mayor's work to improve air quality with schemes such as the 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 above and beyond that of the natural churn of the vehicle fleet which has also helped reduce emissions and concentrations.

Introduction

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

The 2022 LAEI emissions data was published on 13 August 2025. It provides an update to the previous LAEI 2019 and a new baseline for 2022. The concentrations and exposure data for 2022 will be published shortly following the emissions.

The new base year is 2022 and includes the impacts associated with the operation of the central ULEZ, the ULEZ expansion to the North/South Circular Road which took place in October 2021 and the impacts due to the introduction of tougher standards for the London-wide LEZ in March 2021. It does not include the impacts associated with the London-wide ULEZ expansion which launched in August 2023. The LAEI 2022 is for the base year only and does not include new future projections.

The data from the LAEI is publicly available on the London Data Store and is used by the GLA and London boroughs as an evidence base for air quality policy work, as well as for assessing change over time and formal reporting.

The comprehensive data set is being published in two parts; the first release includes:

- Emissions trends
- Emissions by pollutant and source, split by London Zone by borough and grid square

To follow in autumn:

- Concentration maps for 2022, 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
- Bespoke borough packages including borough concentration maps and emissions dashboards

World Health Organization (WHO) recommended air quality guidelines

In 2021, the WHO updated its recommended guidelines for air pollutants[2]. 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. The Mayor has also commissioned a scientific and technical evaluation of what action would enable London to achieve its existing target of 10 µg/m^3 annual average PM2.5 by 2030, and to reach full compliance with the WHO Guidelines.

Table 2 WHO recommended air quality guidelines and UK legal limits

Relationship between WHO guidelines and UK legal limits

The difference between the UK legal limits and the WHO Guidelines is summarised in the table below:

Pollutant	Averaging Time	WHO 2021 Guideline µg/m^3	UK Legal limits µg/m^3
NO_2	Annual	10	40
PM_{10}	Annual	15	40
$PM_{2.5}$	Annual	5	20 (10 by 2040)

Following passage of the Environment Act 2021 the Government introduced two 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).

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

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 demonstrates that this can be achieved.

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 ULEZ and its expansion; the London-wide 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.

Emissions Methodology Updates

It is important to note that a full update of emissions (based on the latest detailed activity data and emission factor database and methodology improvements at the time of compilation of the inventory) has only been carried out for the new baseline year 2022. Emissions estimates from previous baseline years (2016, 2019) and forecast years (2025, 2030), remain as previously reported in the LAEI 2019 except for the following sources, where changes in methodology, revised historical activity data or emission factors were deemed significant enough to warrant a revision of emission estimates previously published for these sources, due to the impact they had on overall trends. These include:

- An increase in road transport emissions, due to the revision of motor vehicle statistics on minor roads across Great Britain published by Department for Transport (DfT), which resulted in increases in overall vehicle-kilometre estimates across London and the LAEI area. The effect of this revision by DfT on traffic volume estimates on London roads was discussed in TfL's Travel in London reports[3]. These changes could not be included at the time the LAEI 2019 was prepared but have now been incorporated in the LAEI 2022. For previous baseline years and forecast years, an overall scaling factor was applied to road transport emissions, to reflect the minor road methodology changes. However, the underlying traffic trends are the same as in the LAEI 2019. Revised forecast of traffic volumes accounting for both the DfT minor road changes and new forecasts for traffic post-pandemic will be incorporated in the next LAEI update.

- An increase in PM aviation emissions, linked to the stationary sources at Heathrow Airport, which saw a significant increase in emissions from the biomass CHP plant. Note that emissions from previous baselines have not been revised; only those for forecast years 2025 and 2030 have been updated by replacing estimated emissions for the stationary sources at Heathrow, (using those reported in the Heathrow Airport emission inventory 2022[4] instead of the previous emissions reported in the LAEI 2019.

- An increase in domestic emissions associated to the combustion of residual fuel (i.e. not natural gas) for heat and power generation, aligned with the latest revision of residual fuel consumption for UK local authorities from DESNZ[5].

These revisions mean that overall, LAEI emission estimates for 2016, 2019 and forecast for 2025 and 2030 are slightly higher than previously reported as part of the LAEI 2019. For example, revised 2019 emissions for London (GLA area) are 4% higher for NO_x, 2.5% higher for PM_{10} and 2% higher for $PM_{2.5}$.

Finally, for PM emissions, previous estimates for commercial cooking have now been split between commercial cooking and domestic cooking, following a revision of the methodology. The previous totals from the LAEI 2019 remain unchanged, but the total has been split equally between these two categories, although the spatial distribution is different (as the commercial part of these emissions is based on the distribution of commercial premises, whilst the domestic part is based on the housing distribution across London). Emissions for previous baseline years 2016 and 2019, and forecast years 2025 and 2030, have been split in a similar way.

Note that these revisions have been carried out at high level, based on overall scaling of previous emissions, and only apply to the above sources. However, forecast emissions for all sources will be fully revised in the next LAEI update. A full methodology document will be published alongside the LAEI 2022 concentrations data.

[3]Travel in London Report 14, TfL, 2021. Section 7.2 Overall trends for road traffic in London. Available at travel-in-london-report-14.pdf

[4] Heathrow Airport Airfield Emission Inventory 2022, Ricardo Energy & Environment, 2024. Available at Heathrow Airport Airfield Emission Inventory 2022

[5]Available at Sub-national residual fuel consumption data - GOV.UK. Note that DESNZ have also made revisions to non-domestic residual fuel consumption across the UK, but due to issues with aligning these spatially across London, these have not been included in the LAEI 2022, and further work will be required before including these changes in the next LAEI

Key findings

Emissions Trends

Nitrogen Oxides (NO_x)

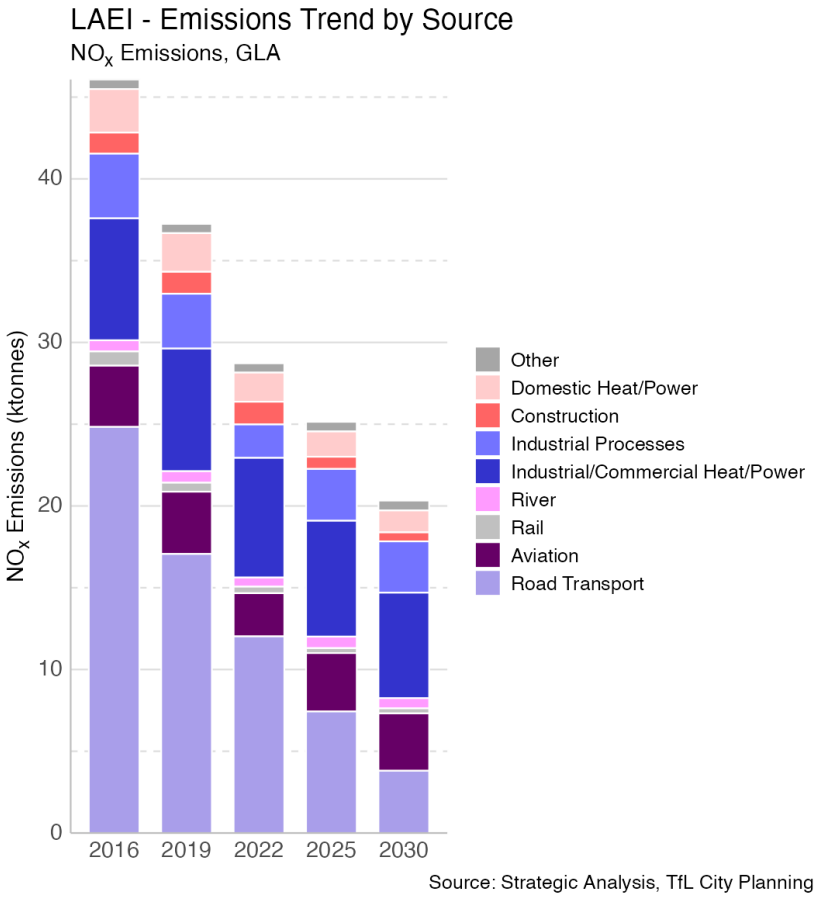
Since 2016, there has been a significant reduction in total NO_x emissions across London. Figure 1 shows the trend in NO_x emissions per source. Compared to 2019, total NO_x emissions reduced by 23% in Greater London in 2022. The largest reduction in (tonnes of) NO_x emissions is from road transport in London, with a decrease of more than 5,000 tonnes. This equates to a reduction of 30% in road transport emissions across London between 2019 and 2022.

Total NO_x emissions across London are forecast to be 12% lower in 2025, and 29% lower in 2030, compared to 2022 emission levels.

The largest reduction in NO_x emissions is forecast to come from road transport in London. Road transport NO_x emissions are expected to reduce by 38% across London by 2025 and 68% by 2030, compared to 2022, as the vehicle fleet continues to become cleaner, accelerated due to schemes such as the ULEZ.

Following the increase in forecast road transport emissions due to the revision of traffic volume statistics from DfT, by 2025 road transport will still be the dominant source of NO_x across London (30% of total NO_x), although closely followed by the industrial and commercial heat and power generation source category (28%, see Figure 7). However, by 2030, it is still expected that the latter will overtake road transport as the main source of NO_x across London (see further details page 10).

Figure 1 - NO_x Emissions Trend by Source in Greater London



Particulate Matter (PM_{10})

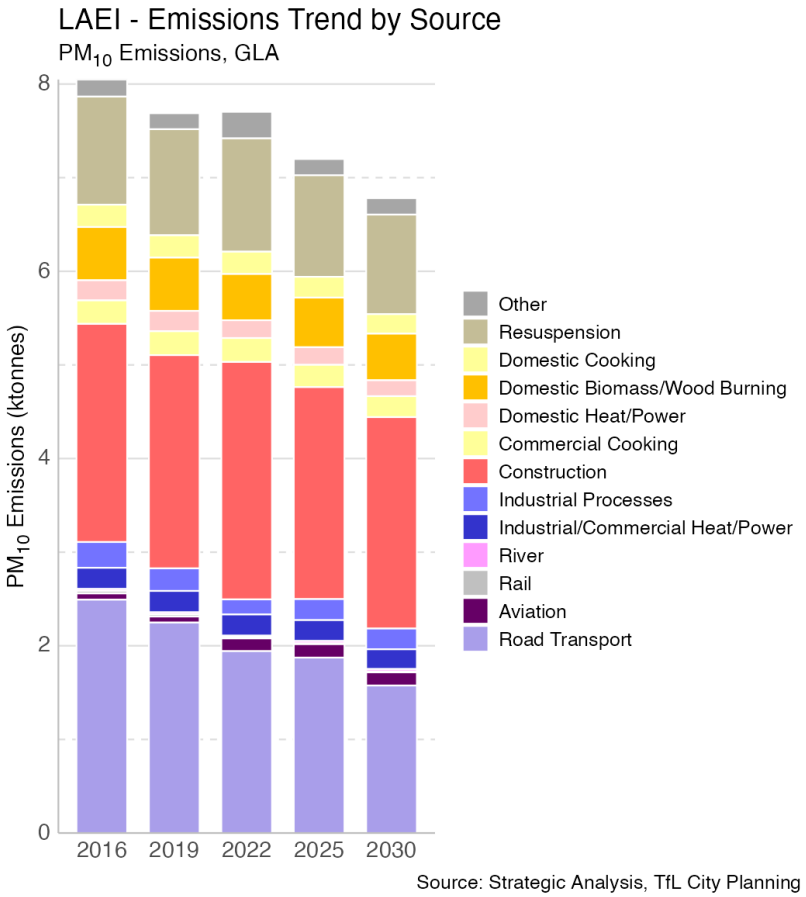
Figure 2 shows the trend in PM_{10} emissions per source. Emissions for 2022 confirm the long-term trend showing a gradual reduction in total PM_{10} over the years. As seen in Figure 11, in 2022 construction emissions contributed the largest single source of PM_{10} accounting for 33% of total emissions in London, followed by road transport at 25% and resuspension at 16%.

In 2022, total PM_{10} emissions in London remain at a similar level as in 2019. Whilst a strong reduction was seen for estimated road transport emissions of 14% in 2022 compared to 2019, this was counterbalanced by an increase in estimated construction dust emissions (11%), due to increased construction activity particularly in central London, although it is important to note that construction emissions estimates are subject to significant uncertainty, inherent to the methodology and data used to calculate emissions.

Despite not being the largest source, the largest reduction in (tonnes of) PM_{10} emissions is from road transport in London, with a decrease of about 300 tonnes, indicating that the Mayoral policies targeted at reducing emissions from road vehicles have had a strong impact.

Total PM_{10} emissions across London are forecast to be 7% lower in 2025, and 12% lower in 2030, compared to 2022 emission levels.

Figure 2 - PM_{10} Emissions Trend by Source in Greater London



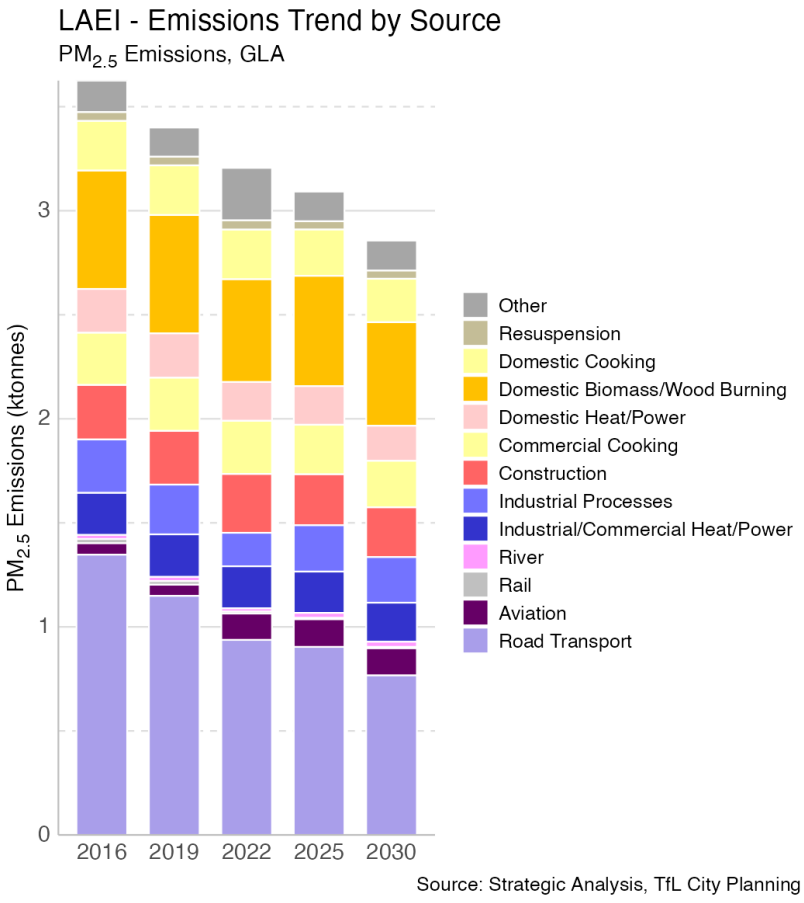
Particulate Matter ($PM_{2.5}$)

Figure 3 shows the trend in $PM_{2.5}$ emissions per source. Emissions for 2022 confirm the long-term trend showing a continuing reduction in total $PM_{2.5}$ over the years. As seen in Figure 16, in 2022 road transport emissions contributed the largest single source of $PM_{2.5}$ accounting for 29% of total emissions in London, followed by domestic wood burning at 15%.

In 2022, total $PM_{2.5}$ emissions in London reduced by 6% compared to 2019, building upon the reduction of 6% that was observed between 2016 to 2019. The largest reduction in (tonnes of) $PM_{2.5}$ emissions is from road transport in London, with a decrease of more than 200 tonnes.

Total $PM_{2.5}$ eissions across London are forecast to be 4% lower in 2025, and 11% lower in 2030, compared to 2022 emission levels.

Figure 3 - $PM_{2.5}$ Emissions Trend by Source in Greater London



Source: Strategic Analysis, TfL City Planning

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 2022, the largest contributing source for NO_x and $PM_{2.5}$ emissions was from road transport at 42% and 29% respectively.

For $PM_{10,}$ in 2022, the largest contributing source is construction dust at 33%, a small increase in proportion from 30% 2019, followed by road transport at 25%. Figure 16 also shows that domestic biomass/wood burning is a significant contributor at 15% of total $PM_{2.5}$ emissions.

The contribution by source from 2016 is also provided for comparison. For NO_x, it shows a similar source apportionment compared to 2022, although the road transport NO_x contribution reduced notably (54% in 2016 vs. 42% in 2022), whilst the contribution of industrial/commercial heat and power combustion sources increased (from 16% in 2016 to 25% in 2022). Over time the road transport contribution is becoming less dominant, with similar levels to industrial/commercial heat in 2025 (30% and 28% respectively) and by 2030 it is expected to no longer be the main source of NO_x.

Similarly for PM, the road transport contribution reduced from 31% in 2016 to 25% in 2022 (PM_{10}) with construction emissions increasing in proportion, and for $PM_{2.5}$ the road transport contribution reduced from 37% in 2016 to 29% in 2022 ($PM_{2.5}$).

Figure 4 - 2016 NO_x Emissions by Source in Greater London

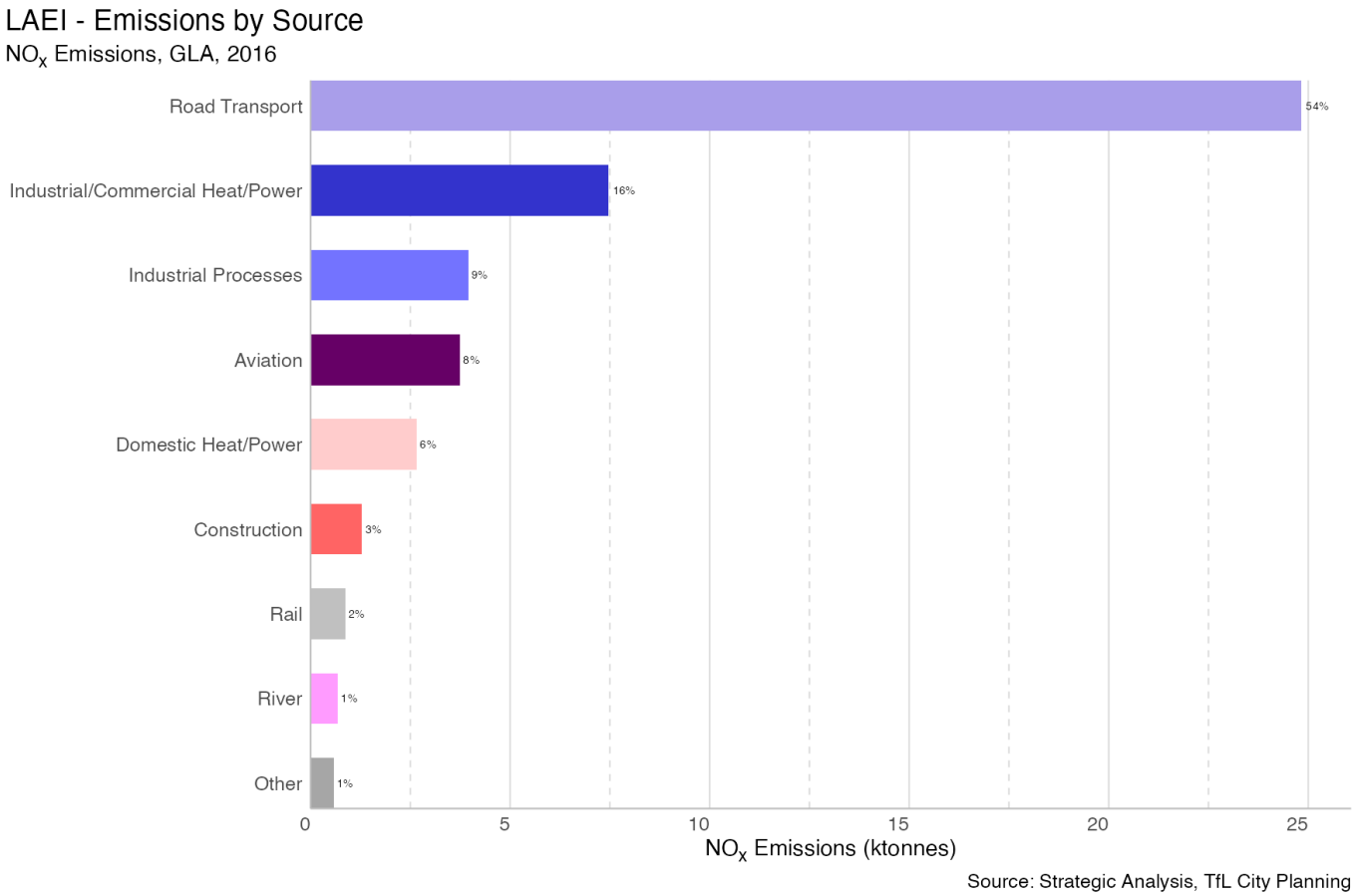


Figure 5 – 2019 NO_x Emissions by Source in Greater London

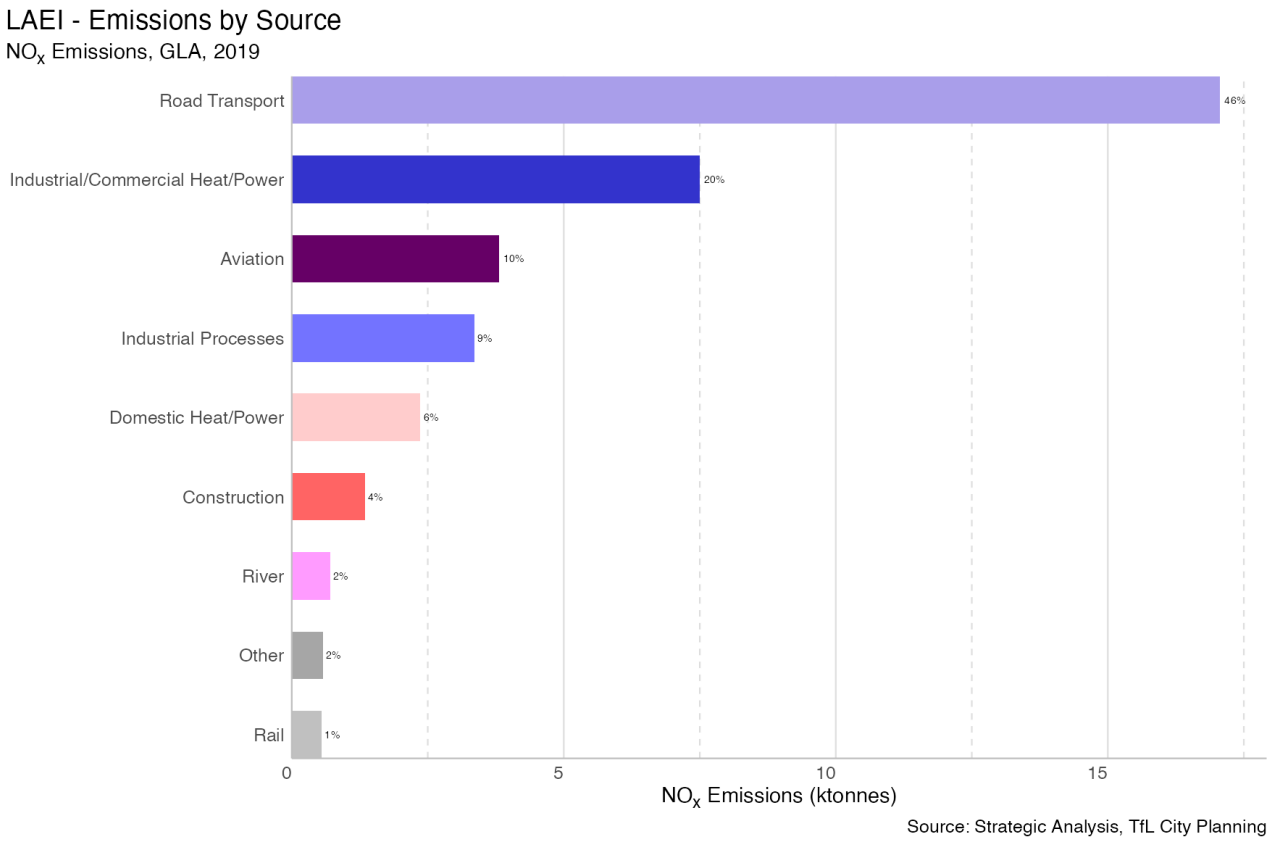


Figure 6 – 2022 NO_x Emissions by Source in Greater London

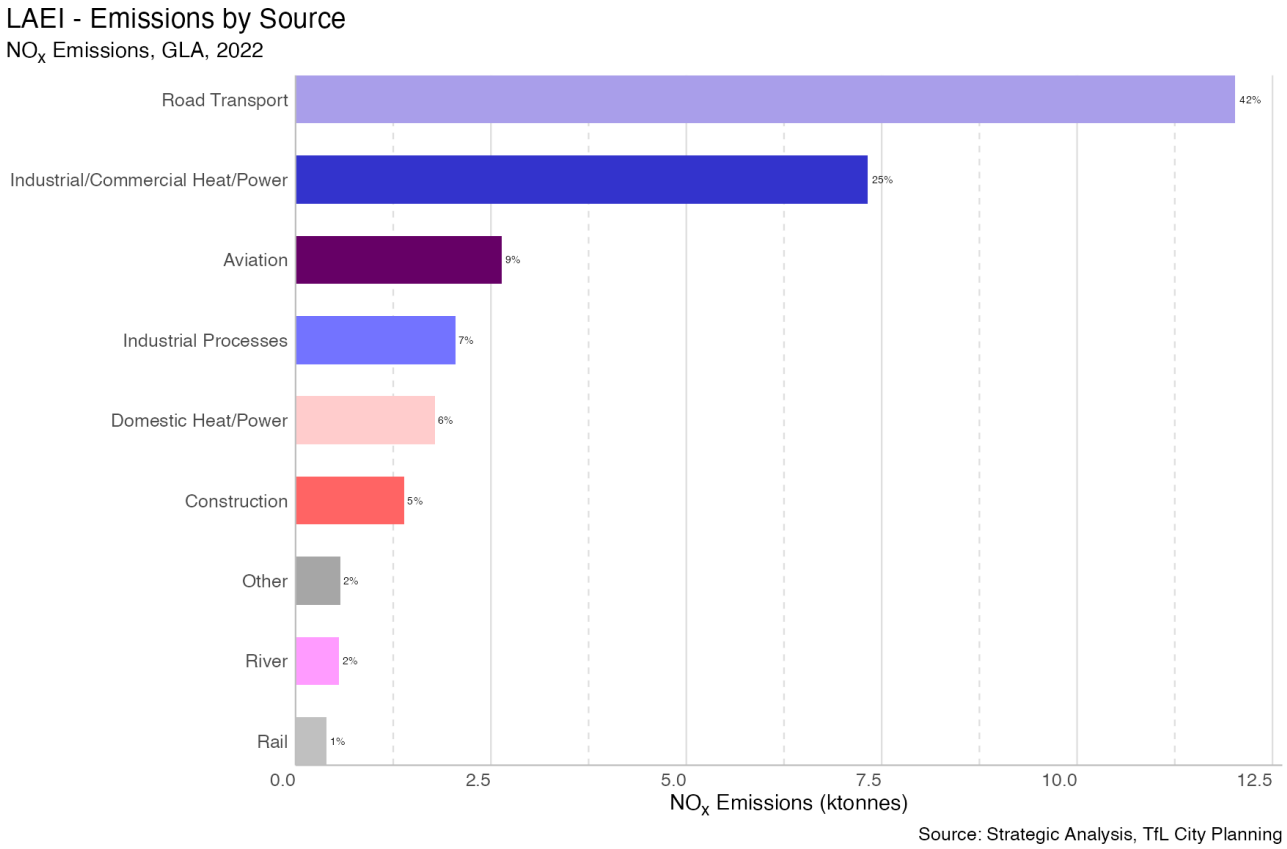


Figure 7 - 2025 NO_x Emissions by Source in Greater London

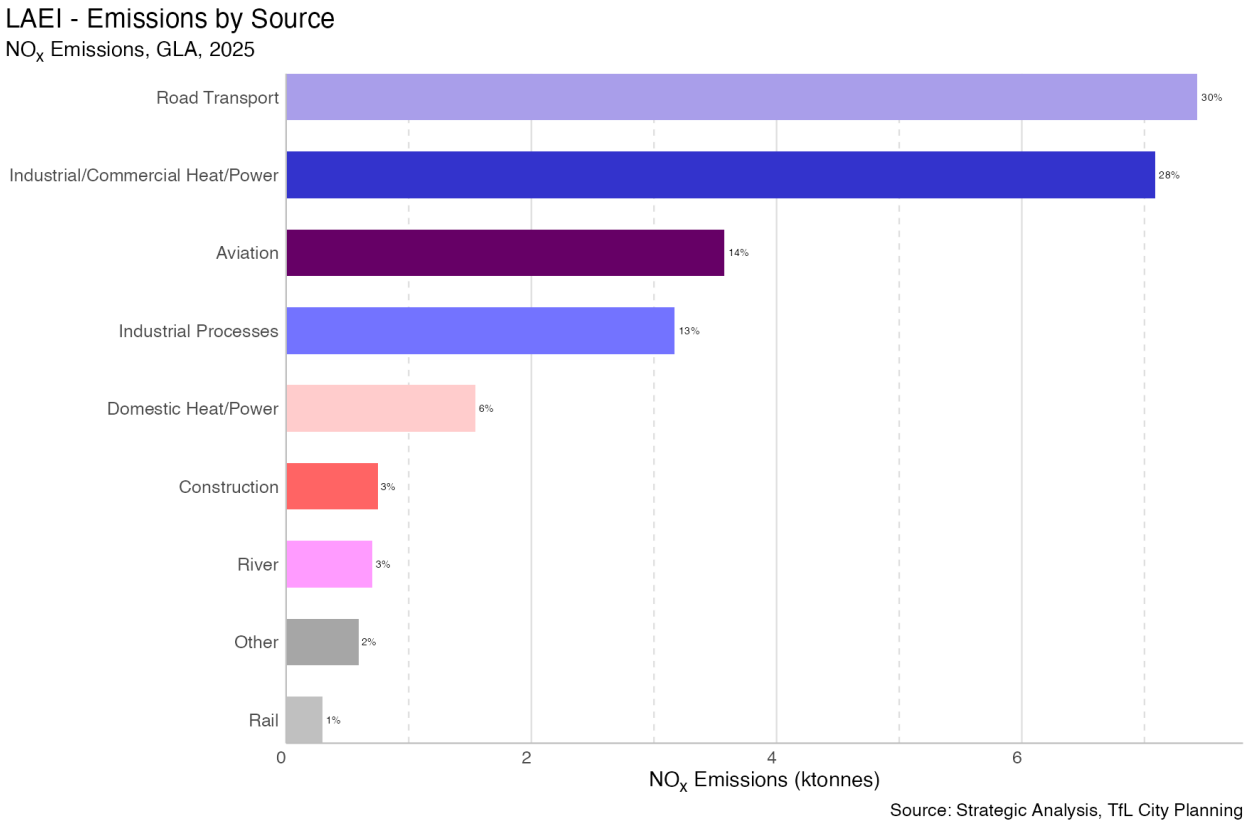


Figure 8 - 2030 NO_x Emissions by Source in Greater London

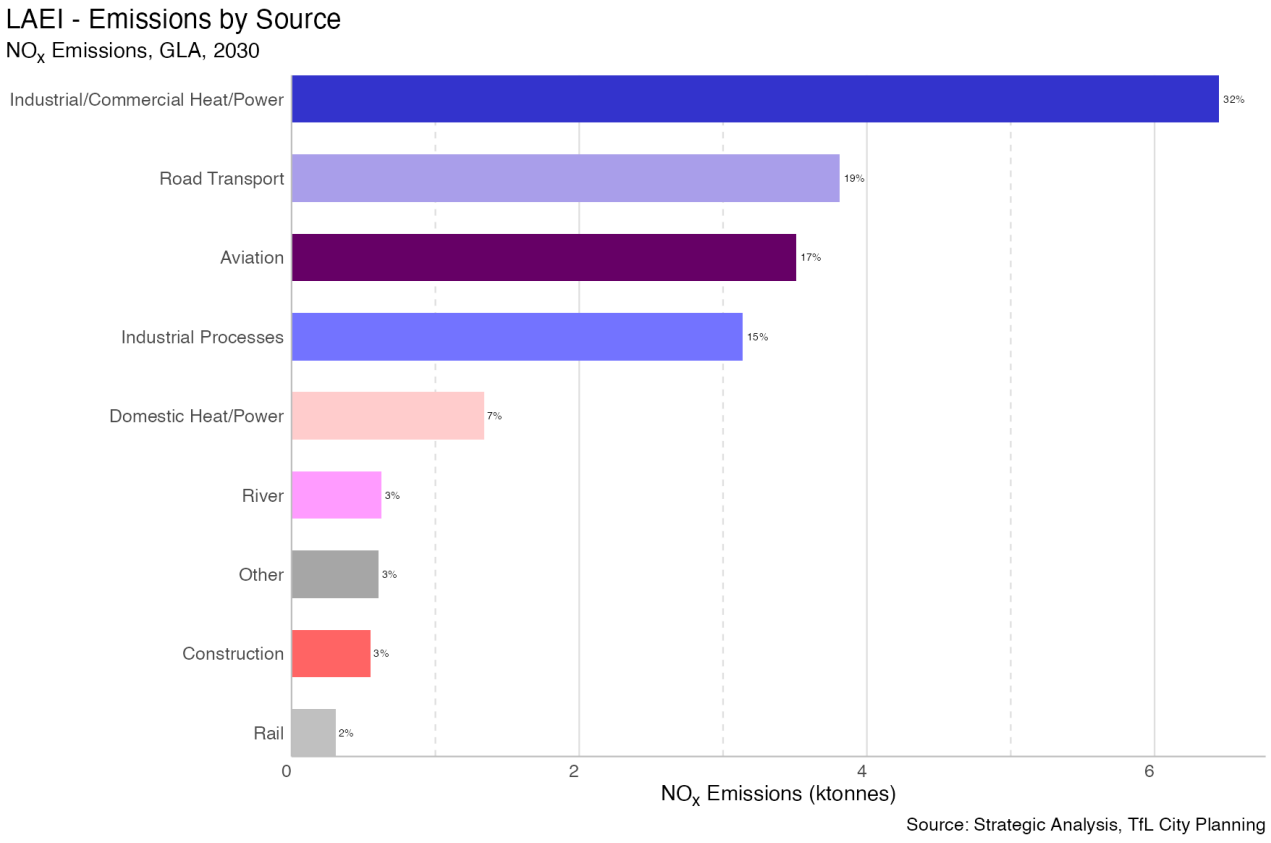


Figure 9 - 2016 PM_{10} Emissions by Source in Greater London

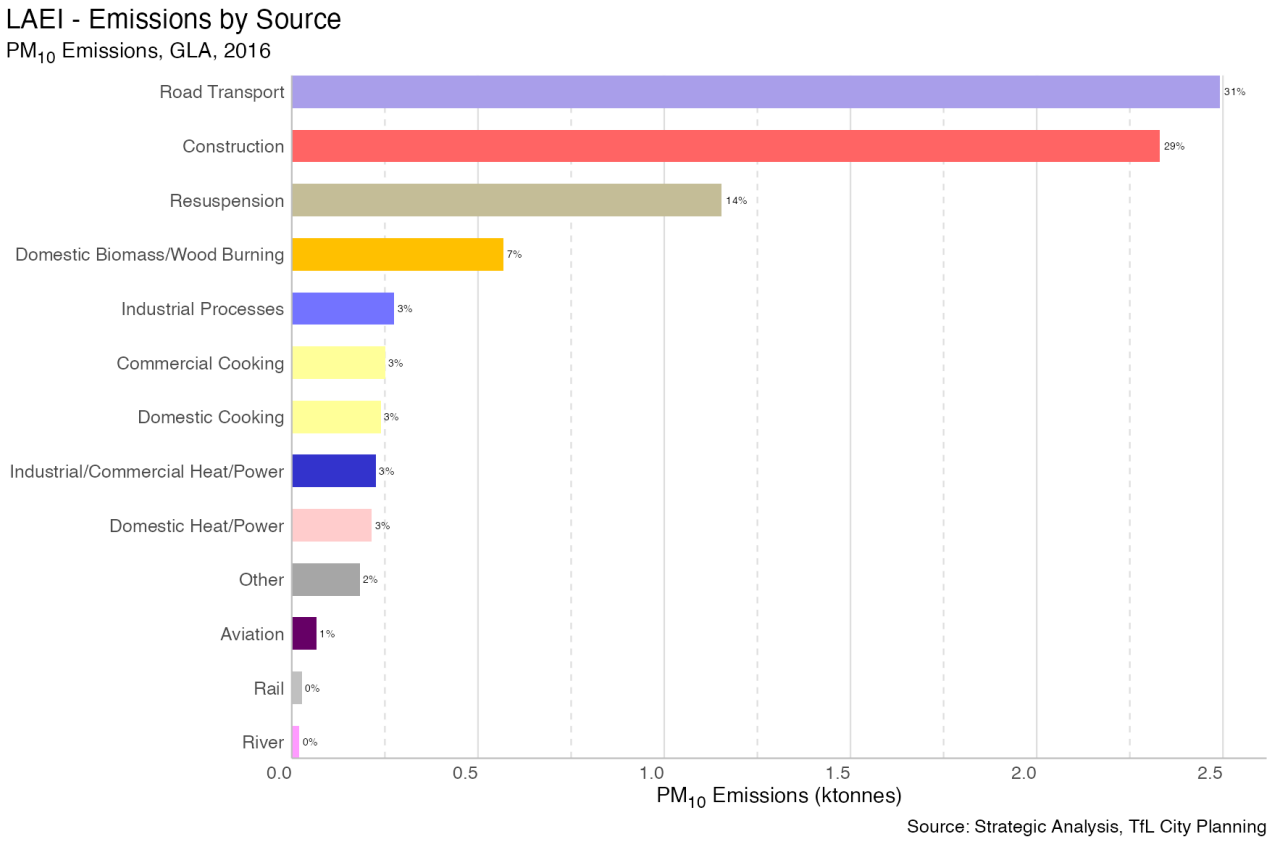


Figure 10 - 2019 PM_{10} Emissions by Source in Greater London

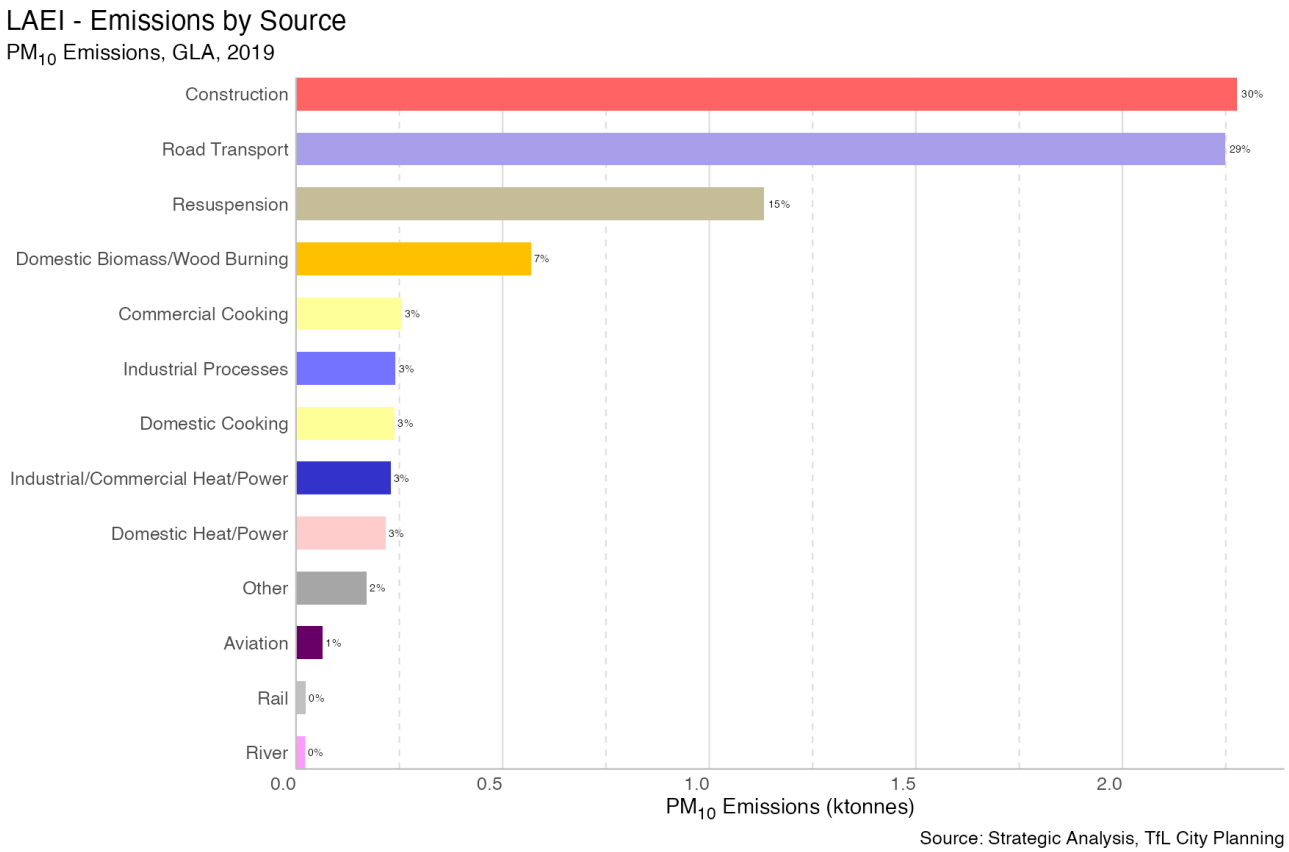
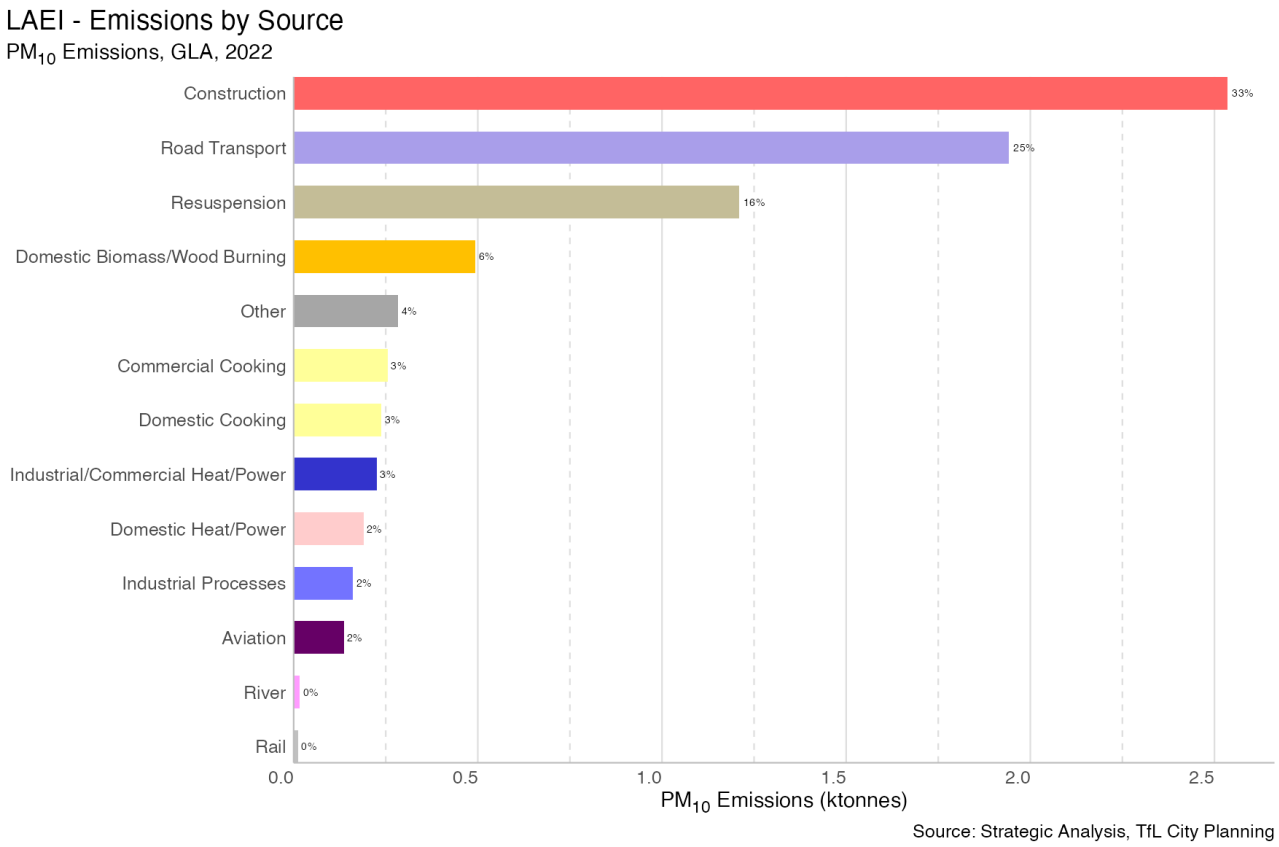
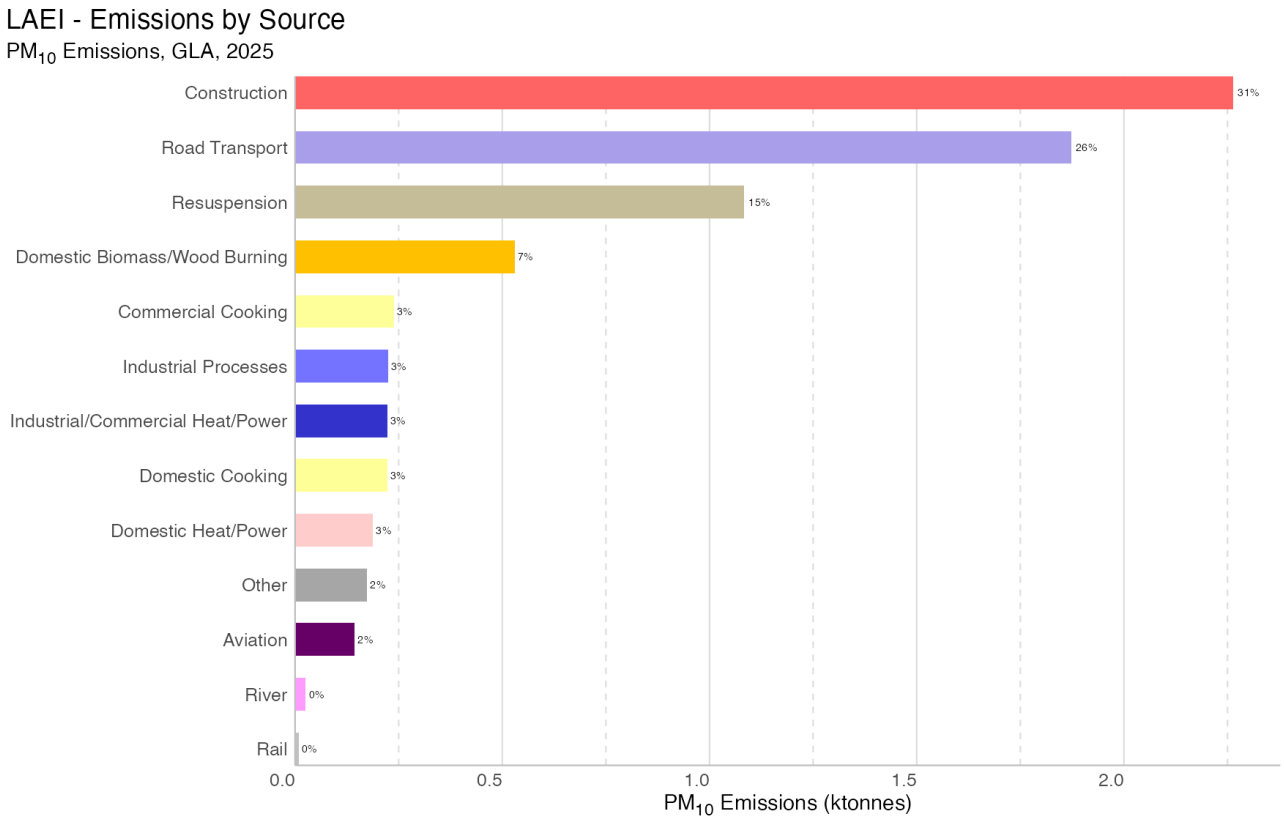


Figure 11 – 2022 PM_{10} Emissions by Source in Greater London



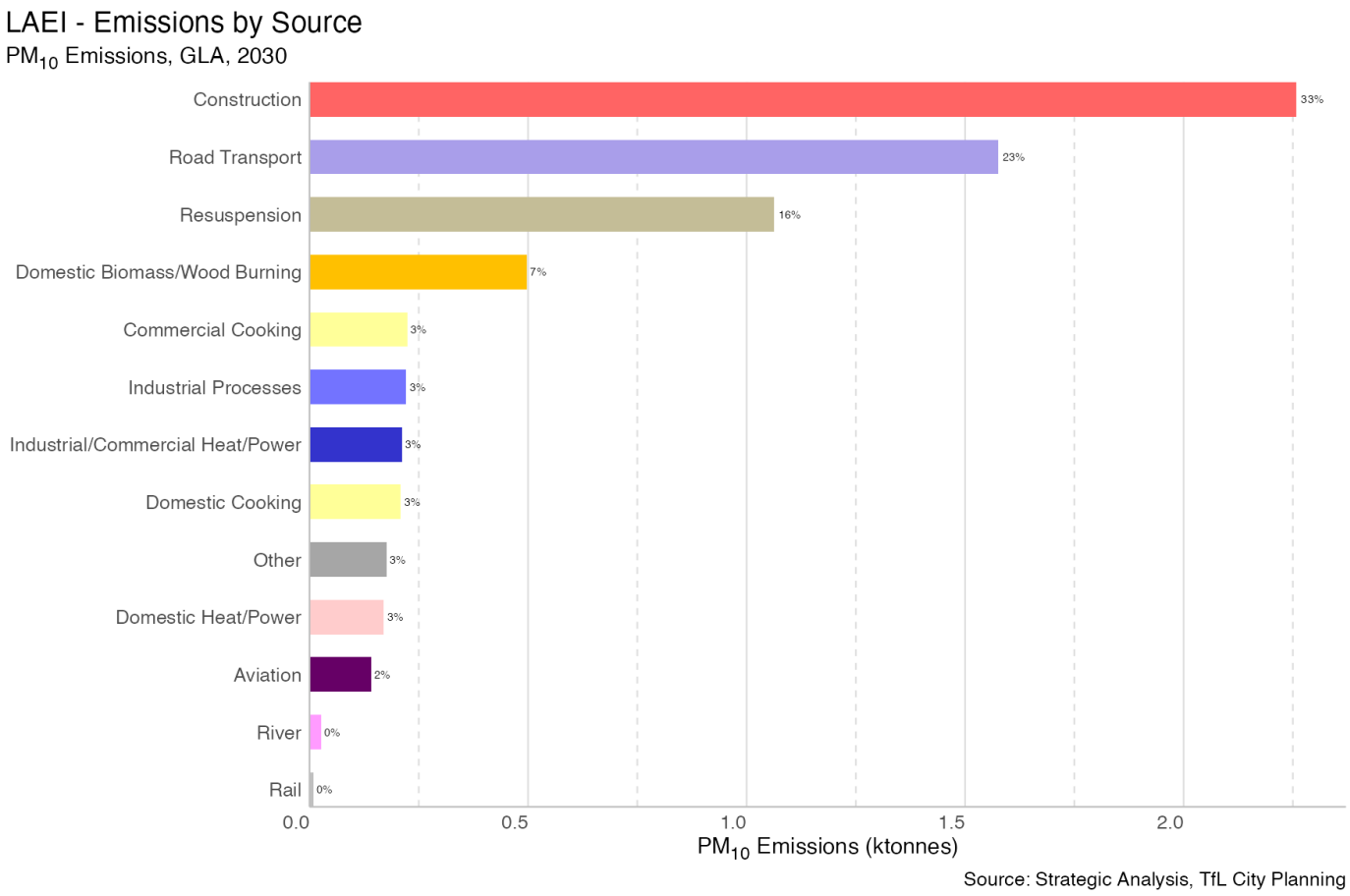
Source: Strategic Analysis, TfL City Planning

Figure 12 – 2025 PM_{10} Emissions by Source in Greater London



Source: Strategic Analysis, TfL City Planning

Figure 13 – 2030 PM_{10} Emissions by Source in Greater London



Source: Strategic Analysis, TfL City Planning

Figure 14 – 2016 $PM_{2.5}$ Emissions by Source in Greater London

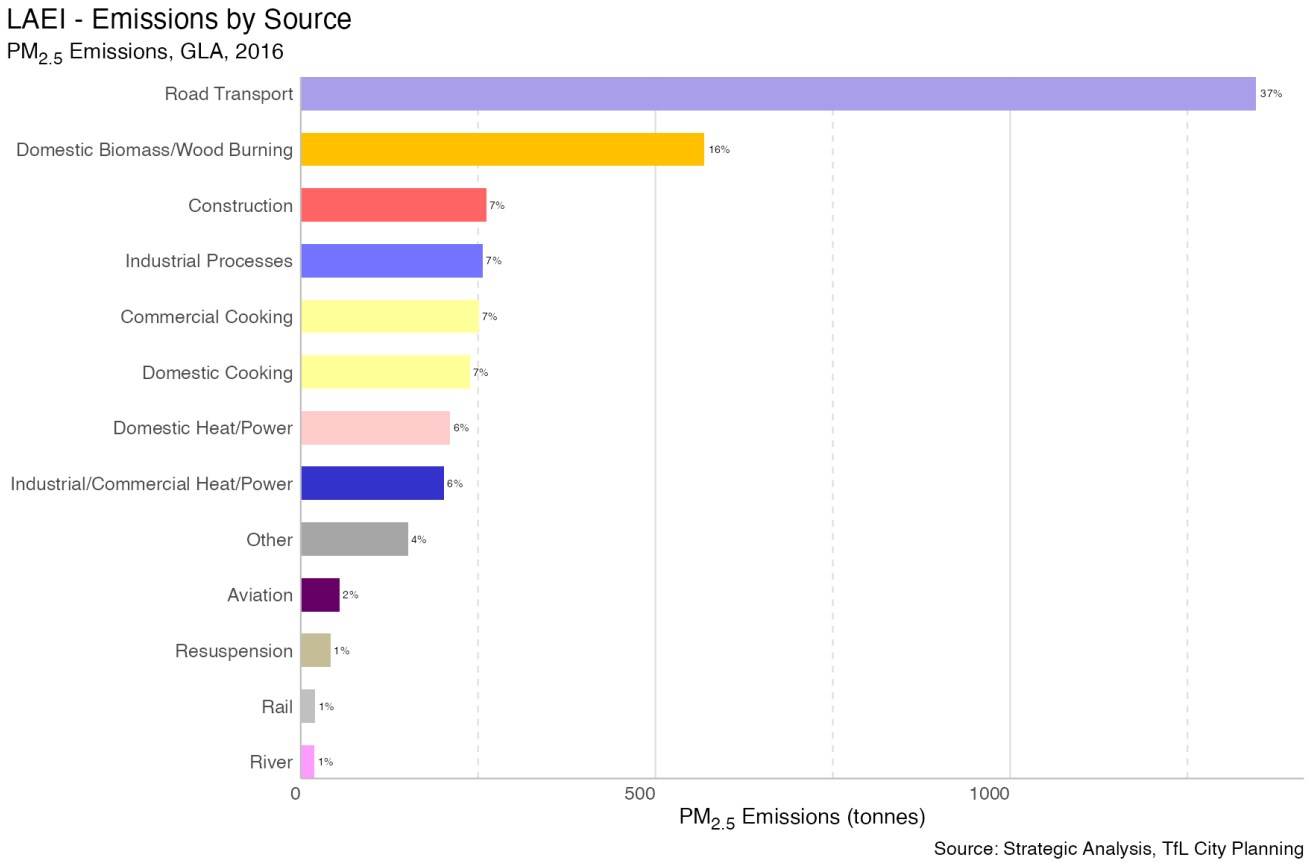


Figure 15 – 2019 $PM_{2.5}$ Emissions by Source in Greater London

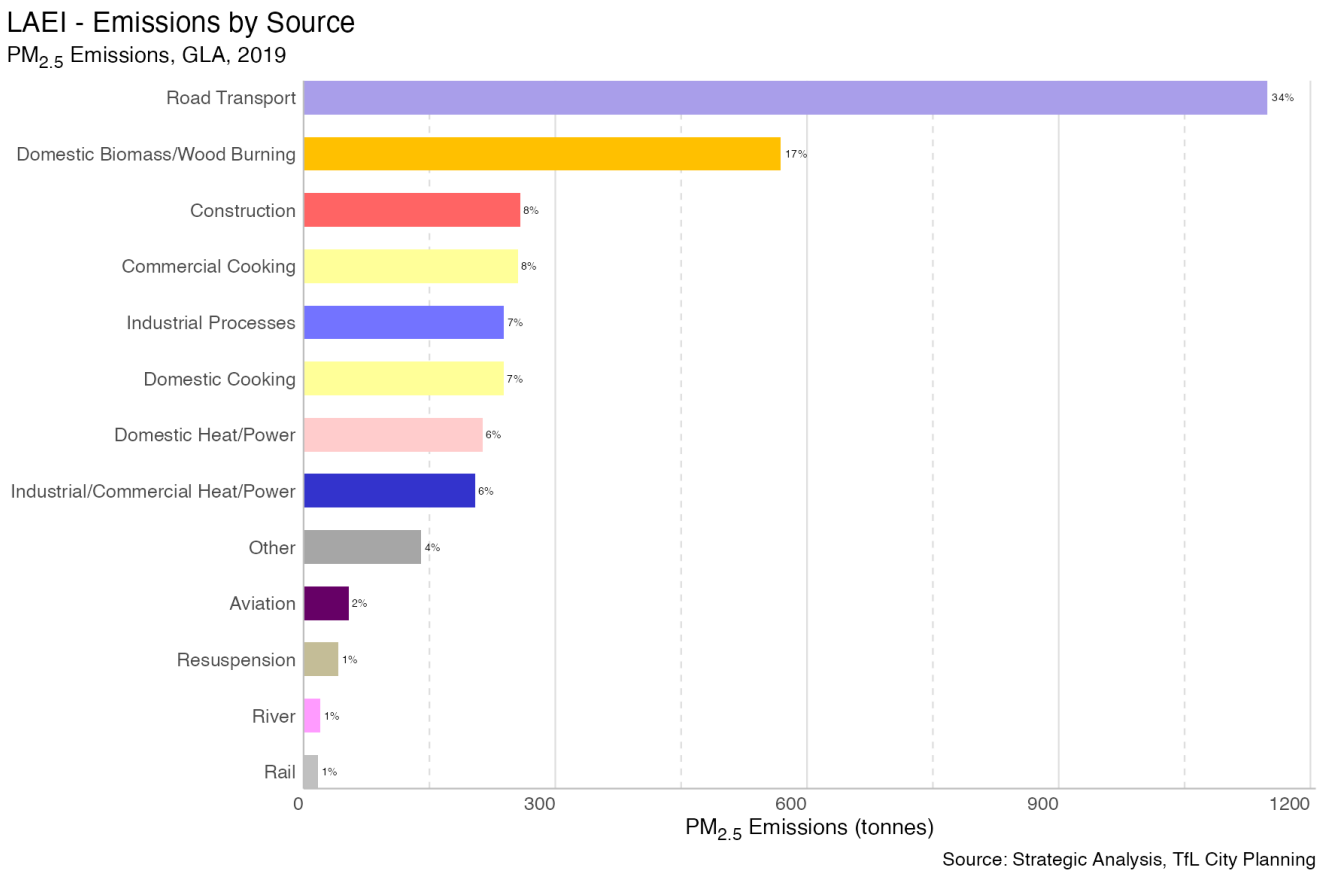


Figure 16 – 2022 $PM_{2.5}$ Emissions by Source in Greater London

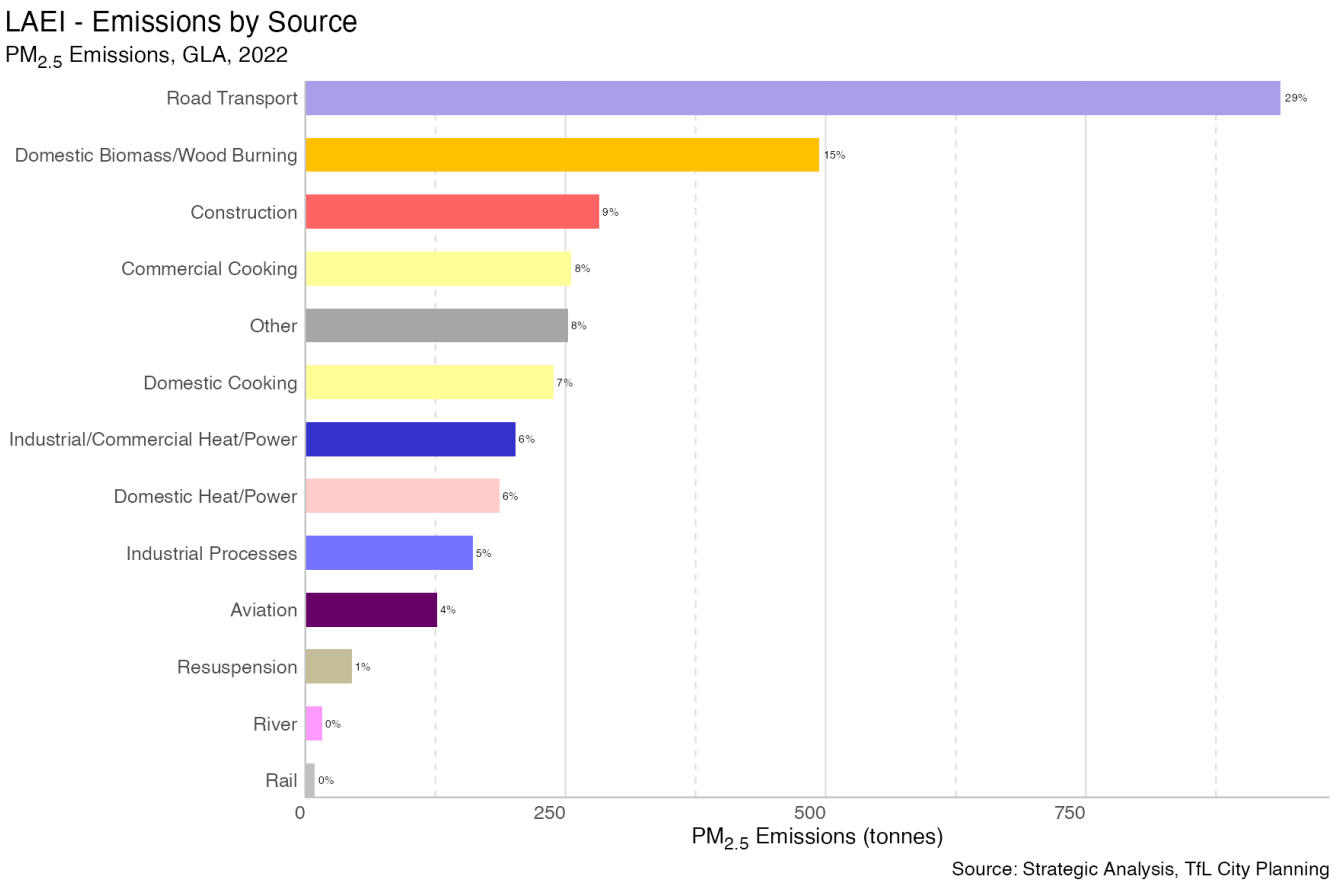


Figure 17 – 2025 $PM_{2.5}$ Emissions by Source in Greater London

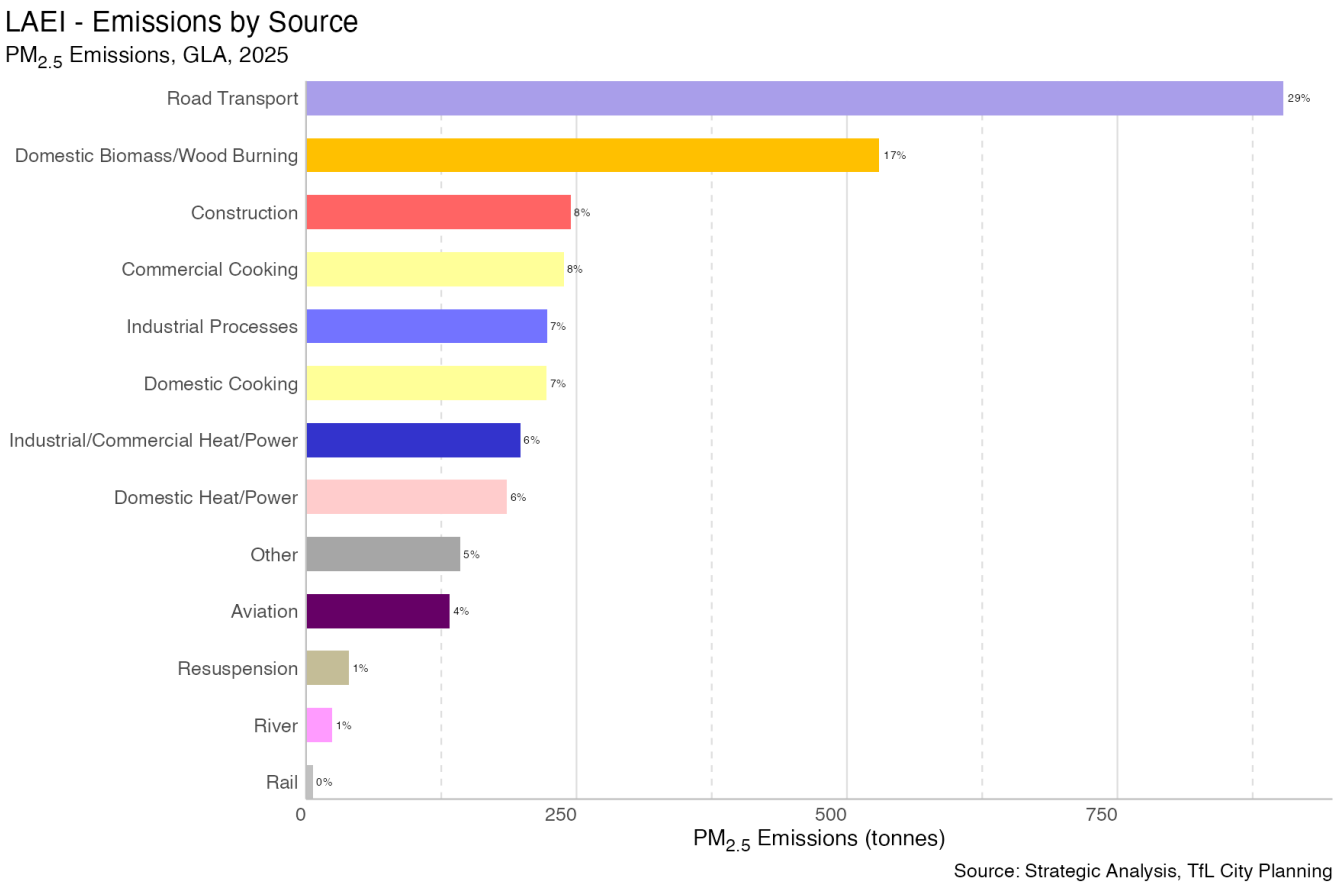
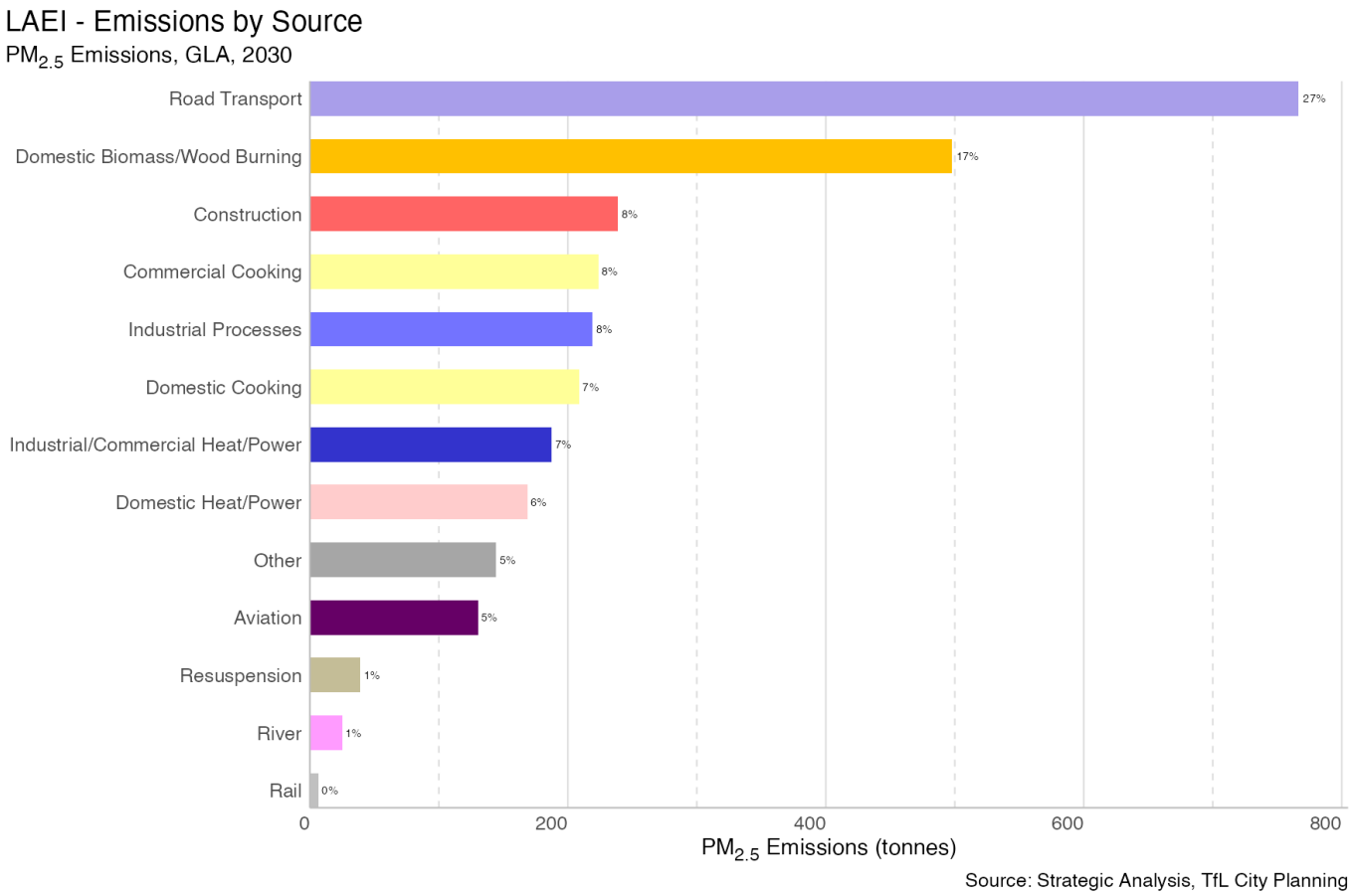


Figure 18 – 2030 $PM_{2.5}$ Emissions by Source in Greater London



Data still to come:

The following datasets will be published shortly with the second release for the LAEI 2022. This document will be updated to provide the summary of the additional data along with the narrative of how the datasets have changed over time and how the concentration and exposure data relates to both the WHO Guidelines and the UK legal limits.

- Concentration Maps
- Major roads meeting air quality targets
- Population exposure
- Schools, Hospitals and Care homes exposure
- Transport for London Road Network (TLRN) or London's 'Red Routes'