

PM_{2.5} concentrations and exposure in London

Introduction

This report contains an introduction to PM_{2.5}, summarises our current understanding of PM_{2.5} concentrations and exposure, discusses the findings of research undertaken by the GLA and TfL into the extent of PM_{2.5} pollution in London, and assesses the potential for meeting World Health Organisation guidelines by 2030. Our analysis found that at present all Londoners are exposed to concentrations higher than WHO air quality guidelines, but, if PM_{2.5} reduction measures within the Mayor's Transport Strategy and London Environment Strategy are accompanied by co-operation on a national and international level, the guideline limit is achievable by 2030.

Background – what is PM_{2.5}?

PM_{2.5}, also known as fine particulate matter, is the blanket term used to refer to solid particles and liquid droplets with a diameter less than 2.5 micrometres across (that's one 400th of a millimetre). Some PM_{2.5} is naturally occurring, such as dust and sea salt, and some is manmade, such as particulates formed in combustion processes.

PM_{2.5} is widely acknowledged as being the air pollutant which has the greatest impact on human health. Both short and long-term exposure to PM_{2.5} increase the risk of mortality from respiratory and cardiovascular diseases as well as increased hospital admissions. Children growing up exposed to PM_{2.5} are more likely to have reduced lung function and develop asthma. The Committee On the Medical Effects of Air Pollution (COMEAP) estimate exposure to PM_{2.5} attributes to 29,000 premature deaths in the UK every year.

The World Health Organisation acknowledges there is no evidence to suggest any threshold value exists below which the adverse health effects associated with PM_{2.5} exposure can be avoided. In other words, the current evidence suggests there is no safe level of PM_{2.5}. However, the WHO set a guideline limit which reflects the levels at which increased mortality from exposure to PM_{2.5} is likely. This recommended guideline limit is an annual mean concentration of 10 micrograms per cubic metre of air ($\mu\text{g m}^{-3}$).

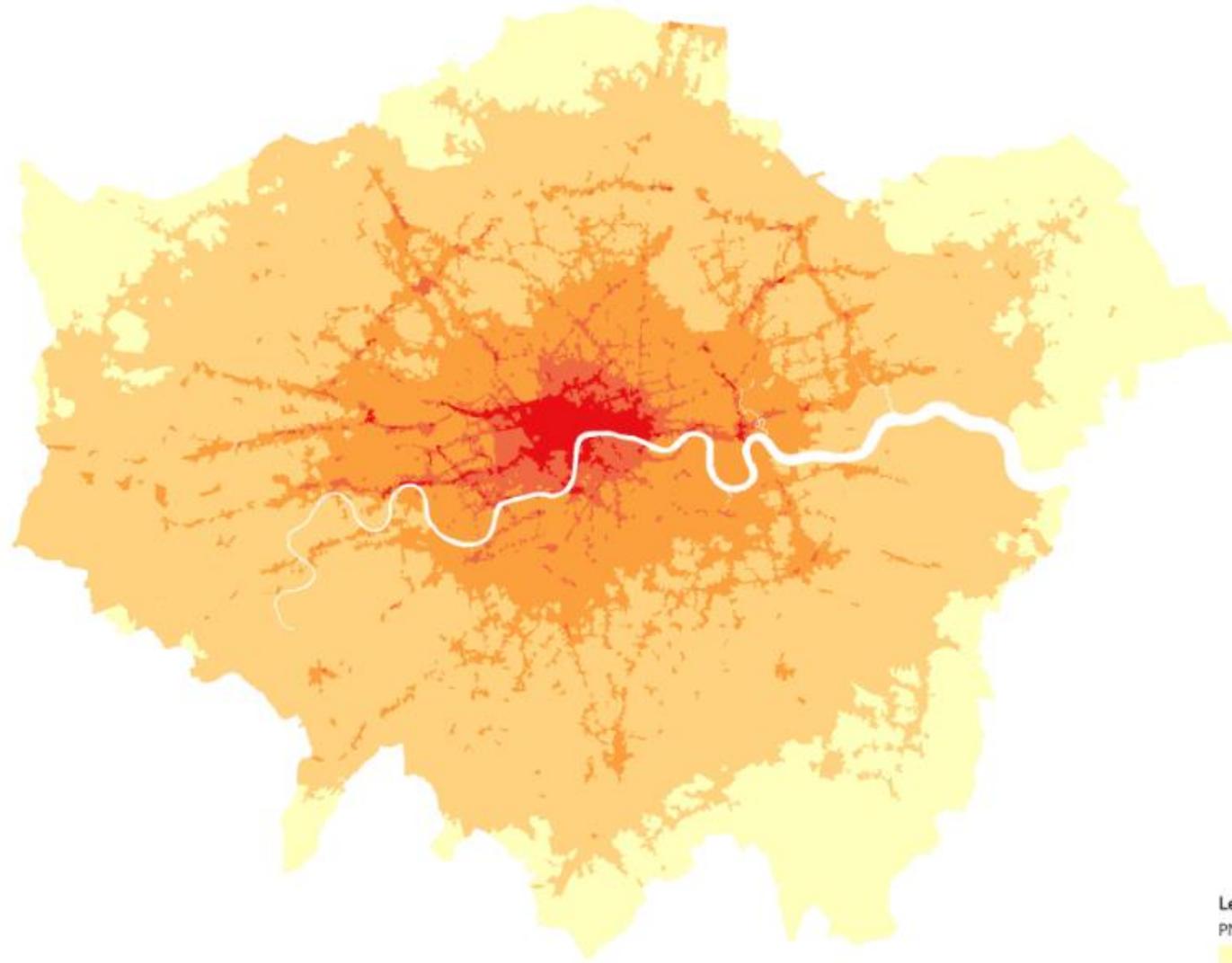
In the European Union, the annual mean air quality limit value (the "legal limit") for PM_{2.5} is 25 $\mu\text{g m}^{-3}$. The Mayor does not think this limit goes far enough for the protection of human health. Many regions containing large urbanised areas that are similar to London, such as California, Scotland and Japan, have already set more ambitious limit values for PM_{2.5}. In the draft London Environment Strategy the Mayor set out the ambition that all of London will have concentrations of PM_{2.5} within the World Health Organisation guideline limit by 2030.

Concentrations of PM_{2.5} in London

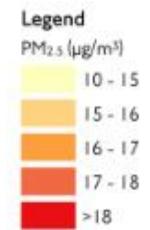
The map on the following page was produced using the updated London Atmospheric Emissions Inventory (LAEI). The LAEI produces a bottom up inventory of emissions across London, including all the major sources such as; transport, construction and industry. These local London emissions are then modelled and dispersed over the background concentration from regional contributions.

The map shows that in 2013 there were no areas in London within the WHO guideline limit.

The first concentration band is light yellow, which is used to colour areas with concentrations of PM_{2.5} between 10 – 15 $\mu\text{g m}^{-3}$, this covers a small area at the very outskirts of the city which is home to only 6.2 percent of the population.



2013 LAEI Update - Annual mean PM_{2.5} concentrations based on average within Output Areas



The other parts of the map (in dark yellow, orange and red) are home to the remaining population of London, meaning the vast majority of Londoners live in an area at least 50 percent higher than the World Health Organisation guideline limit. 7.9 million Londoners – nearly 95 percent of the capital’s population – live in areas of London that exceed the guideline limit by 50 percent or more.

Sources of PM_{2.5} in London

A big component of PM_{2.5} in London comes from regional, and often transboundary (non-UK) sources. In 2013 the background concentration for PM_{2.5} was 12 µg m⁻³, meaning in 2013 the external contribution to London’s PM_{2.5} levels alone were above the WHO guideline of 10 µg m⁻³. Much of the background emissions come from areas outside of the Mayor’s jurisdiction. This highlights one of the key messages of this report, that London needs national and international support to tackle this issue.

Of the local London PM_{2.5} sources the biggest contributor by far is road transport, accounting for over half of local contributions. While these emissions are mainly related to non-exhaust emissions (including road wear, resuspension of particles and tyre and brake wear) the introduction of the T-charge this month, the Ultra Low Emission Zone and cleaning up the bus and taxi fleets are expected to reduce PM_{2.5} emissions coming from road transport. The next biggest local London source is Non-Road Mobile Machinery, which is also being addressed by the world’s first Non-Road Mobile Machinery Low Emission Zone. The Mayor has made the case to Government for additional powers to tackle other non-transport sources of pollution.

Looking to 2030

Detailed modelling of a raft of PM_{2.5} reduction measures found that a PM_{2.5} target concentration of 10 µg m⁻³ is achievable by 2030 as long as this included local, regional, national and international action. In addition, our analysis also identified a range of potential co-benefits from the PM_{2.5} reduction measures, including large reductions in NO_x, CO₂ and black carbon emissions. Many of the measures to tackle air pollution from PM_{2.5} will also tackle climate change.

As the number of zero emissions vehicles increases and exhaust emissions fall, the proportion of transport emissions that come from road, tyre and brake wear increases. By 2030, an estimated 90 percent of PM emissions from road transport will be from tyre and brake wear. The draft London Environment Strategy includes plans for reducing emissions from tyre and brake wear which include working with industry and other partners. However, the most effective reduction of tyre and brake emissions is to reduce the vehicle kilometres being driven. This will be one of the many co-benefits of the Mayor’s Healthy Streets approach and the huge investments being made in walking, cycling and public transport. The Mayor’s Transport Strategy sets out an objective that by 2041 the proportion of trips undertaken by bike, foot and public transport will have increased to 80 per cent from 64 per cent today.

Wood burning in urban areas and construction can contribute significantly to local pollution. That is why the Mayor is calling on the government to devolve powers to him to allow City Hall to tackle emissions from construction sites and wood burning. The Mayor is also clear that he wants to reduce emissions from wood burning through improved education about the types of fuel that should be used and when they should be used. He also wants a stricter set of emission standards on future sales of wood burning stoves to tackle this source of pollution.

The Stove Industry Alliance and Woodsure, the UK’s wood fuel accreditation scheme, have recently launched their voluntary “ecodesign ready” and “Ready to Burn” labels for stoves and

fuels to help consumers make the right choice in London and other smoke control areas. The Mayor believes that more should be done to empower consumers to make the right choice, including better information at the point of sale and mandatory labelling of products that are legal to use in smoke control areas.

Expected reductions in PM_{2.5} (London sources)

The Mayor expects PM_{2.5} emissions to reduce by approximately 26 percent by 2020 compared to 2013. Going forward a 34 percent reduction is expected by 2025, and a 41 percent reduction by 2030.

The need for additional national and international action

A key finding of our research is national and international co-operation will be essential in meeting this target. Our analysis found the extension of the EU National Emissions Ceiling Directive will be integral in London achieving the World Health Organisation target by 2030.

The National Emission Ceiling Directive is the mechanism by which the European Union sets a legal limit to the amount of pollution in tonnes member states can emit per year. Under the new extension the UK will be legally bound to reduce PM_{2.5} emissions by 46 percent in 2030 (relative to 2005), with similar commitments made by our neighbouring countries.

**Greater London Authority
Transport for London**

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Appendix A: Calculating PM_{2.5} exposure

Sources:

- 2013 PM_{2.5} annual mean concentrations ($\mu\text{g m}^{-3}$) - LAEI 2013 Update
- 2011 Output Area (OA) London - Office for National Statistics, ONS Geography Customer Services
- 2013 London Population (same year as PM_{2.5}) - Population figures are TfL population forecasts, based on GLA borough forecasts and then disaggregated to lower geographical levels (OA)

Method:

- Figures for LAEI years have been calculated using interpolation method
- OA in London have been overlaid using GIS with 2013 PM_{2.5} annual average concentration and, with the aid of a GIS tool called Zonal Statistics, PM_{2.5} mean/average in each OA has been calculated. OAs shown in red in the map attached have a mean PM_{2.5} concentration of over $18 \mu\text{g m}^{-3}$

Results:

- The sum of the population in OAs exceeding $15 \mu\text{g m}^{-3}$ for PM_{2.5} in 2013 gives us the 7.9 million people - roughly 94 percent of the total population.