

AIR QUALITY

Public Health Intelligence

May 2023



Contents

1. Introduction
2. Sources of air pollution
3. Air Quality in Royal Greenwich
4. Impact of air pollution on health: the national picture
5. Impact of air pollution on health: the local picture
6. Policy context for improving air quality
7. Actions to improve air quality and public health
8. What action is Greenwich taking?
9. Recommendations
10. References

Introduction



Controlling air pollution is of global and local importance

Air pollution is a cause of global warming - the results of which are already apparent in changing weather patterns and extreme weather events affecting the environment, food supplies and stability of millions around the world.

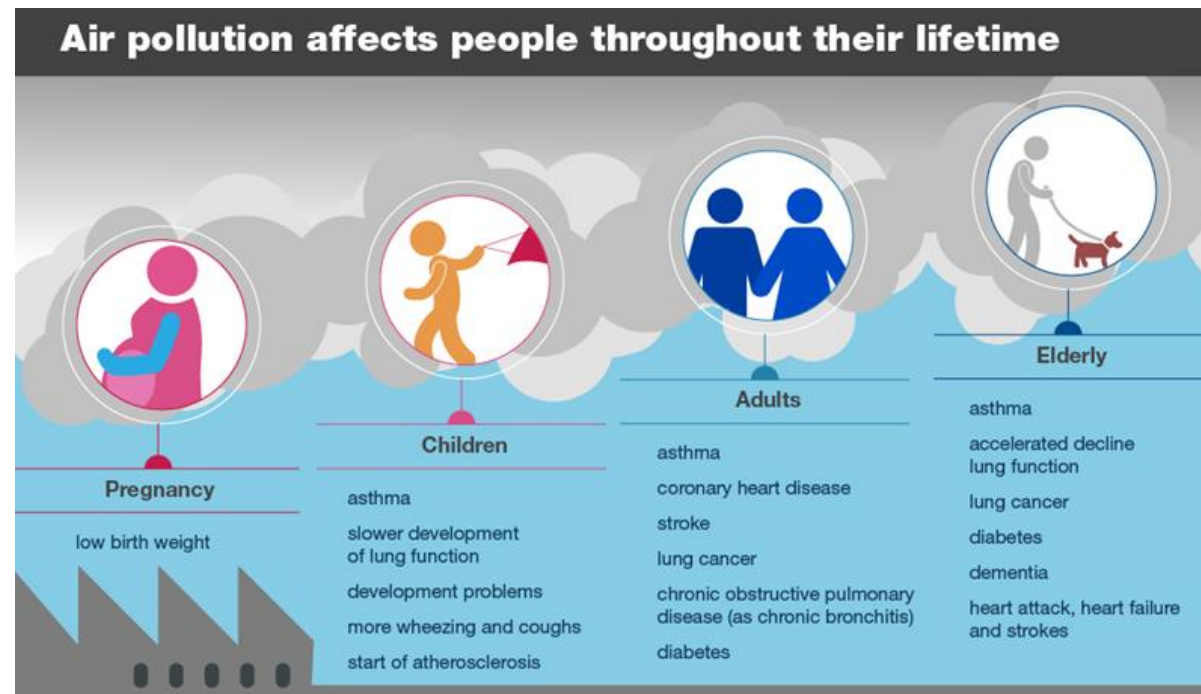
Air pollution also has a direct negative effect on population health, and that is the focus of this chapter of the Royal Greenwich JSNA. Prolonged exposure to poor air contributes to chronic ill-health and disability, and reduced life expectancy of the population. Evidence continues to emerge that air pollution is a factor in a variety of poor health outcomes from conception to old age^{1,2}.

Short-term increases in air pollution can lead to exacerbation of existing illness such as asthma and cardiovascular disease, greater levels of hospital attendance, and in a smaller number of cases early death. A 2020 inquest concluded that the 2013 death of South London resident [Ella Kissi-Debrah](#) was due to asthma contributed to by exposure to excessive air pollution. The first time this was identified as a cause of death in the UK^{2,4}.

Many people are vulnerable to the health impact of air pollution. For example, 14,000 people with asthma were registered with Greenwich GPs in 2022; of these 2,200 were aged 6-19 years old. Thousands more had other health conditions that can be exacerbated by poor air, for example 4400 people were identified as having chronic obstructive pulmonary disease (COPD)⁵. Analysis by Imperial College for the Greater London Authority (GLA) indicated that in 2019 air pollution had led to the equivalent of 3,600 to 4,100 deaths in London, including 113-129 deaths of Greenwich residents².

The economic costs of air pollution due to the need for health and social care, and reduced productivity are estimated to run into billions^{6,7}. In London alone the cost to the economy could be as much as £3.7bn every year^{2,8}.

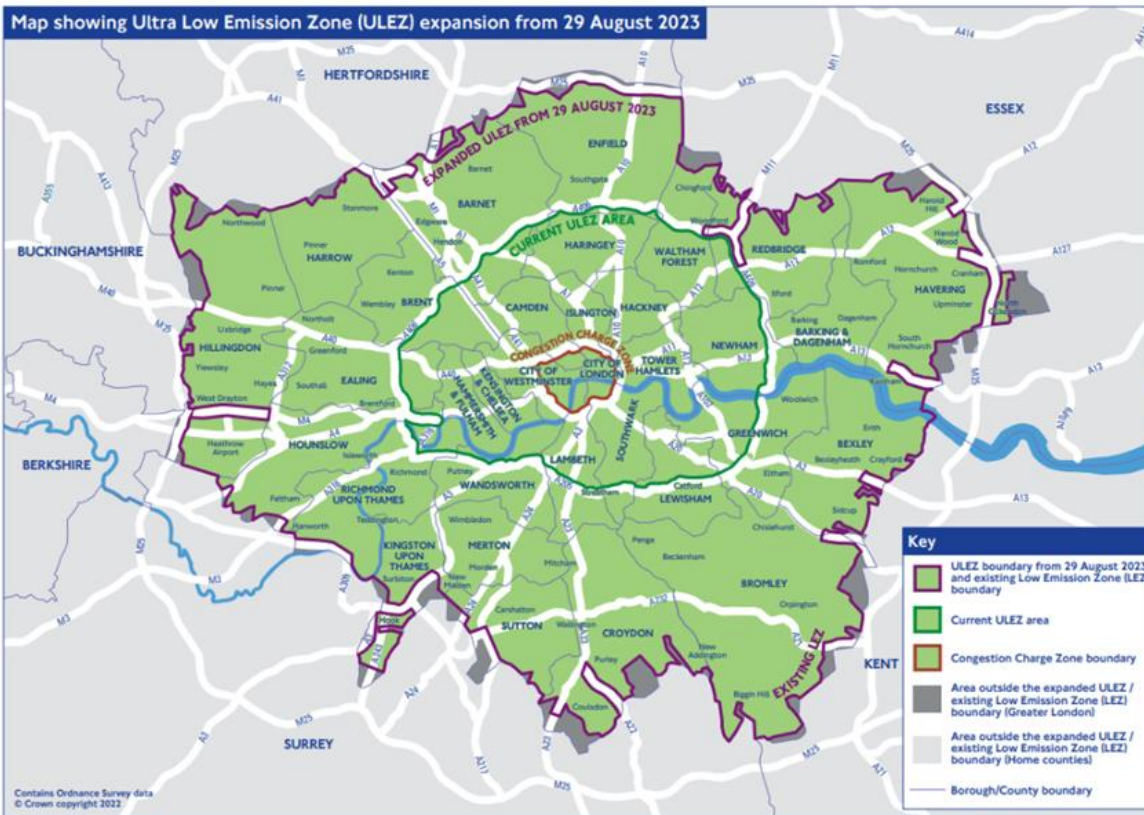
Previous restrictions on pollutants have demonstrated that population health can improve¹, so there is much to be gained, including in Greenwich, where there are relatively high rates of illness due to respiratory and cardiovascular conditions and lower than average life expectancy⁹.



Source: PHE (2018) [Health Matters - Air Pollution](#)³

There has already been some success in reducing air pollution in the UK

Action taken over the last two decades has been primarily driven by obligations under the EU [Directive 2008/50/EC](#)¹⁰ and the [Air Quality Standards Regulations 2010](#)¹¹. Although London and the South-East continues to experience some of the highest levels of air pollution, recent initiatives such as London's Ultra Low Emissions Zone¹² ([ULEZ](#)) have contributed to reductions in these. For example, by 2019, 84% of major roads in London complied with the legal limit for Nitrogen Dioxide (NO₂) emissions compared to only 46% in 2016 and 37% in 2013². Air quality has also improved within Greenwich although targets are not yet being met in all areas of the borough - for example NO₂ levels at the Woolwich Flyover remain above the current UK target¹³. Levels of emissions in London and elsewhere generally exceed the most recent (2021) [WHO recommendations](#)¹⁴ but it is considered possible to meet the interim targets by 2030 as long as commitments made by central and regional government are delivered¹⁵.



There continue to be challenges to meet. As with much of London, Greenwich is an urban area segmented by major roads. It is a busy borough with a growing population and ongoing development (both in Greenwich and within neighbouring boroughs such as [Convoy's Wharf](#) in Lewisham)¹⁶. Transport for London (TfL) have begun work on the [Silvertown Tunnel](#)¹⁷ constructing an additional transport connection between North and South London and there are other large programmes of work nearby such as the construction of Thames Water's '[Supersewer](#)'¹⁸ (which on completion is expected to reduce water pollution across London).

Royal Greenwich continues to take action to improve air quality alongside the GLA, TfL and other partners. In 2021, Greenwich welcomed the expansion of the ULEZ which now covers the northwest of the borough as far as the Woolwich Ferry and the boundary of the South Circular road (although excluding the A205 itself). Recently it was announced that the GLA will extend the ULEZ across Outer London which it is hoped will further reduce the use of older and more polluting vehicles on all Greater London's roads¹⁹. TfL has also substantially extended the network of [cycle lanes](#)²⁰ in London, including in Greenwich.

Royal Greenwich also recently set an ambitious goal of being carbon neutral by 2030

Improving the local environment, infrastructure and the health of people living and working in Royal Greenwich are central to the new corporate plan for 2023 to 2027, '[Our Greenwich](#)'²² Royal Greenwich also recently set an ambitious goal of being [carbon neutral](#) by 2030²³, and the latest [Transport Strategy](#)²⁴ aims to support this as well as delivering a safe and clean transport network which increases opportunities of Greenwich residents and encourages active travel. [The Air Quality Action Plan](#) (AQAN)²⁵ is currently being updated for 2023-27. Further information on these policies can be found [here](#).

These strategies and plans will build on Royal Greenwich's existing assets and achievements¹³ including:

- Substantial areas of parks and woodland, many of which are connected by the London Green Chain, or the Thames Path.
- £1m of investment to enhance parks and the planting of more than 2000 trees in the last four years.
- increasing access to cycleways – the C4 which connects Greenwich to Tower Bridge is being extended to Woolwich, while the Waterlink Way links Greenwich to Beckenham and beyond.
- A growing network of air quality monitors: ten automatic monitoring stations plus 56 diffusion tube monitors in other locations
- continuing to upgrade Royal Greenwich's fleet to lower and zero emission vehicles
- installation of more than 250 electric vehicle charge points across the borough
- delivering four permanent school streets schemes, with several further trials underway
- working with developers to reduce emissions from demolition and

construction, with greater focus on prevention of emissions than remedies for emissions

- nearly 900 low or zero carbon council homes completed or under construction by the award-winning [Greenwich Builds](#) programme. Ten percent of the new homes will be wheelchair accessible²⁶
- installation of heat pumps at the [Ernest Dence Estate](#), alongside other improvements such as loft insulation, and low energy LED lighting. Heat pumps are a low carbon and cost-effective alternative to traditional gas boilers²⁷.

Nationally the UK government strengthened requirements to improve Air Quality in its [Clean Air Strategy](#) (2019)²⁸ and the [Environment Act of 2021](#)²⁹. Since then, the World Health Organisation (WHO) has reduced their [recommended limits](#)¹⁴ for emissions of pollutants following a review of the increasing evidence available demonstrating the link between air pollution and poor health outcomes. It is possible UK limits will be further refreshed in the light of these.

There are a variety of measures recommended to prevent, remove and reduce pollution as well as those which reduce the impact of pollution on population health. The UK Chief Medical Officer's latest report on air quality¹ drew attention to the importance of taking additional action. With greater knowledge and availability of technological means to control air pollution, local and regional plans that go beyond meeting the minimum standards required will prepare the ground for the future and further enhance the environment and future health of our population.

Royal Greenwich also recently set an ambitious goal of being carbon neutral by 2030

As levels of certain outdoor pollutants decrease, it is expected there will be increased focus on sources which have previously received less attention¹ - such as particles emitted from moving parts of vehicles (tyres, brakes) - and locations and sources of indoor air pollution.

From a public health perspective, the best measures to improve air quality are those which offer co-benefits to public health and wellbeing, such as increased physical activity, noise reduction, improved mental health, and greater road safety. For example, a move to electric vehicles is important as this will reduce air pollution (and reduce the impact of air pollution on health) Increases in Active Travel – walking and cycling – will reduce air pollution and also maintain and improve the health of the population¹. The increasing cost of living provides another incentive to promote walking and cycling as free or cheaper forms of transport and exercise¹ and to make these accessible to all³⁰.

Narrowing health inequalities is also important. Some individuals and communities are more likely to experience air pollution and to be negatively impacted when they do. They have the most to gain from cleaner air or measures to restrict pollution. This includes children, older people, and those with pre-existing conditions who are more vulnerable. People on low incomes and who are from ethnic minorities are also more likely to be affected partly because they often live in areas with poor air quality^{1,2,3}.

The Royal Greenwich Public Health team recommend these areas for further action which will support the missions of the Royal Greenwich Corporate Plan for 2023-27:

1. Keep on doing what we are doing!
2. Improving monitoring of Air Quality
3. Public Engagement and Inclusion
4. Communicating benefits of action to be taken and offer tangible examples

5. Providing additional support to people at risk
6. Improving health and reducing health inequalities
7. Indoor Pollution
8. Considering using contracting and purchasing power to influence change, showcase innovation and make less polluting investments

Sources of air pollution



Identifying and finding solutions to problems of air pollution will be an ongoing process

Air pollutants are a mix of particles and gases which are emitted from a range of human-made or natural sources. Some air pollutants are emitted directly from their source into the air (primary sources), while others are formed in the atmosphere through complex chemical reactions (secondary sources)^{1,3}.

Some of the air pollutants of most concern currently include:

- Particulate Matter (PM) – PM₁₀ particles are generally less 10µm (microns) in diameter. PM_{2.5} are smaller at less than 2.5µm. Human-made sources of PM include vehicle exhausts and burning solid fuels.
- Nitrogen Dioxide (NO₂) - a toxic gas produced during combustion processes, such as those found in car engines.
- Ozone (O₃) - ground level ozone is formed by photochemical reactions when NO_x (from internal combustion engines) and volatile organic compounds (VOCs) combine.
- Volatile Organic Compounds (VOCs) – compounds emitted from a wide range of products and processes, including household products.

PM_{2.5} is thought to have the greatest impact on health. It can travel further into the body, including the bloodstream. There is no recognised safe level and the more PM_{2.5} can be reduced the greater the expected health benefit. More information about these and other pollutants can be found in the Annex, Item A.

Much of the air pollution in London and Greenwich is produced by road transport, construction, heating, and burning of solid fuels. Transport sources include exhaust fumes, but also particles from moving parts such as brakes, tyres, and resuspension of particles from road surfaces. The GLA's [London Atmospheric Emissions Inventory](#) (LAEI)³¹ found that in 2019:

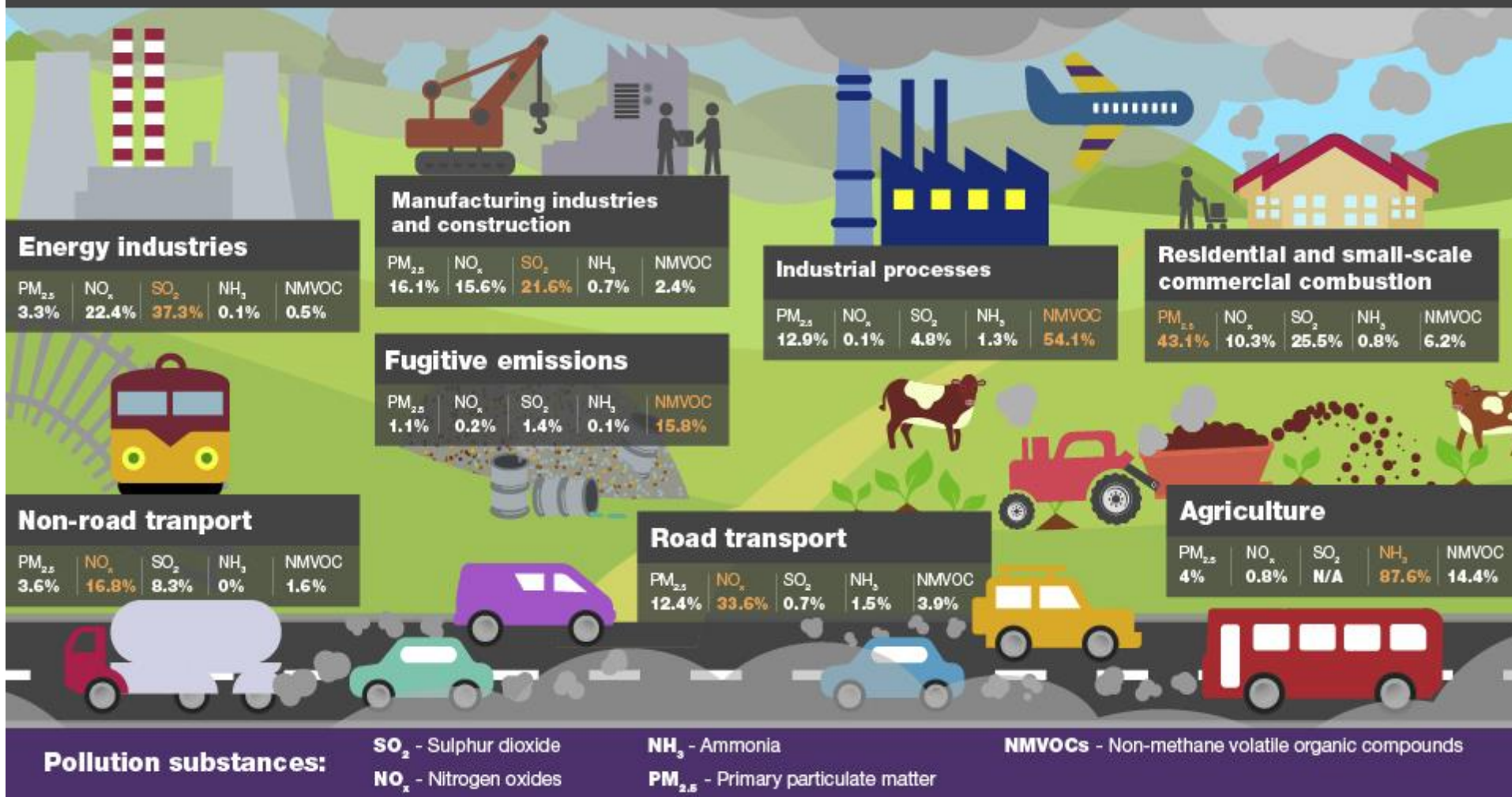
- Over 40% of NO₂ emissions in London came from road transport with the highest concentrations recorded at busy roadside locations.

- Around a third of the PM_{2.5} emissions were also from road transport. A further 40% came from construction (dust, soil, emissions from machinery), as well as wood burning, and commercial cooking.
- Road transport also accounted for around a quarter of PM₁₀ emitted.

Air pollutants can be carried long distances and London's air also contains pollutants from neighbouring regions and further afield. For these reasons improving air quality is a national and international responsibility. For example, PM₁₀ from agriculture is known to travel hundreds of miles. The UK has benefitted from increased regulation of agricultural emissions within Europe, and more could be done to control this within the UK¹.

Identifying and finding solutions to problems of air pollution will be an ongoing process¹. As some types of outdoor air pollutants reduce, there can be a greater focus on those which remain and indoor air pollution, as well as emerging pollutants or changed patterns of pollution: for example, emissions from wildfires might increase in the UK (and Europe) if there continue to be hotter summers and dryer winters.

Sources of air pollution



Indoor Air Pollution

There is increasing awareness of indoor air pollution^{1,2,32}. Where people live, work, and learn, and the conditions of the buildings in which they do can influence exposure to air pollution. Some indoor air pollutants are created inside buildings and pollutant levels can build up if there is inadequate ventilation. Outdoor air pollutants can also enter the indoor environment. Many indoor spaces are communal or public spaces (for example, hospitals) where individuals have little or no control over air quality and improvements must be delivered at a communal level.

A proportion of outdoor pollution also originates from inside buildings, and the activities of people in those buildings. Domestic appliances such as boilers, heaters, fires, stoves and ovens are one source. Domestic burning accounted for 25% of the UK's total primary PM_{2.5} emissions in 2020, with wood alone accounting for 17% of these. Changes such as increased home working could lead to more suburban emissions from home heating if appropriate action is not taken.

Wood burning stoves are increasingly popular, but even the most compliant models emit large amounts of pollutants compared to other forms of heating. There is also some evidence that indoor exposure to solid fuels is associated with an increased risk of lung cancer and COPD in adults, and some limited evidence that exposure to indoor wood burning is associated with asthma and respiratory infections in children.

Most VOCs are not directly harmful to health at low concentrations. At higher concentrations, for example, in a poorly ventilated space, VOCs can cause irritation of the eyes and respiratory tract, allergies, and asthma, as well as possibility of central nervous system symptoms, liver and kidney damage, and cancer risks.

VOCs can be emitted from personal care products, building materials and household consumer products such as paints, carpets, laminate furniture, air fresheners, cleaning and polishing products, environmental tobacco smoke (ETS) also known as [second-hand smoke](#) (SHS)³³. The use of compressed aerosol spray canisters (such as deodorants and room sprays) emit more VOC into air than

are released from all UK road transport combined.

Other sources of indoor air pollution include mould, pet dander, condensation, and asbestos, and radon gas.

Maximising ventilation is important in reducing indoor air pollution. This allows pollutants to disperse and reduces humidity which can contribute to the growth of moulds. It is also important in high-occupancy settings to prevent the build-up of carbon dioxide (CO₂) which may affect cognition and mental performance.

Carbon monoxide (CO) is another indoor pollutant generated by everyday activities such as cooking³⁴, heating when using poorly maintained fuel-burning appliances without adequate ventilation. Nearly 700 cases of CO poisoning were reported to the National Poisons Information Service in 2020¹ – most were due to poorly maintained or faulty boilers at home. The phasing out of gas appliances due to decarbonisation plans will remove a major source of CO, although PM_{2.5} and NO₂ can still be emitted from other sources of combustion including solid fuel combustion using stoves.

Emissions of some VOCs (or other organic chemicals such as phthalates and per/poly-fluorinated substances) are already regulated or have guidelines for their use in place. Further regulation may be needed to reformulate products or heighten awareness of products and appliances that are used indoors and the home. The Clean Air Strategy suggested that product labelling could be improved, but there are currently no plans to require this.

Areas in which it has been suggested there might be more research include examining personal and total exposures as people commute and spend time in a mixture of indoor and outdoor environments, and the impact of commercial kitchens close to places where people live and work. The Chief Medical Officers Report also identified the emergence of lower-cost sensors as a means to support individuals and building owners identify areas with poor ventilation, such as CO₂ sensors.

The National Institute for Health and Care Excellence (NICE) has recently provided [guidance](#)³⁵ on improving indoor air quality following the publication of their guidance on outdoor air quality in 2019³⁶.

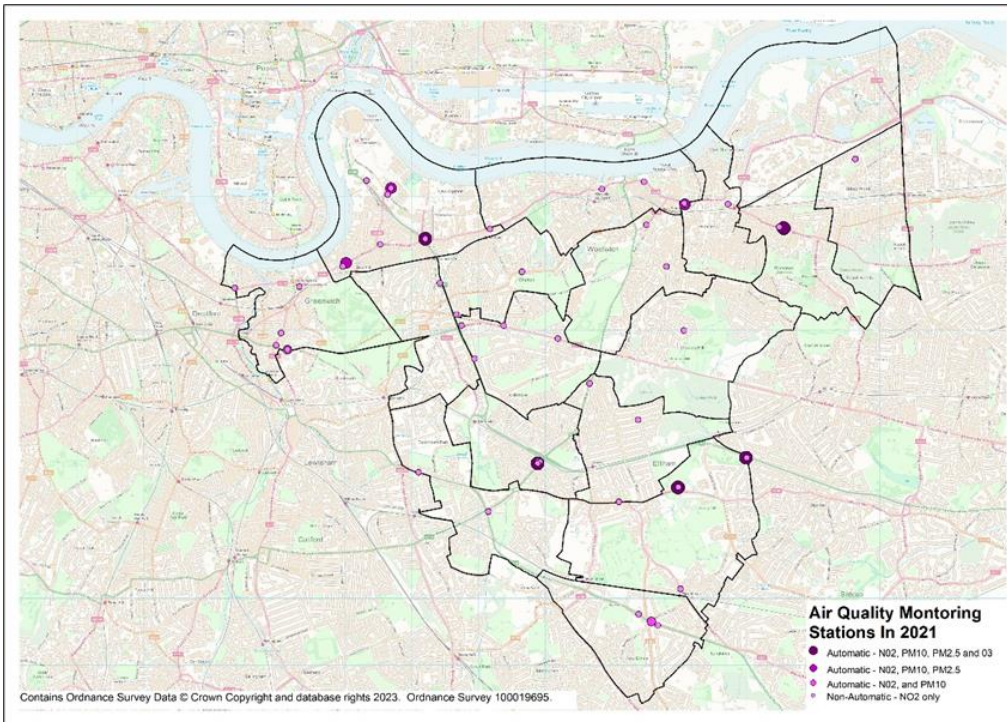
Air quality in Royal Greenwich



Greenwich was designated an Air Quality Management Area (AQMA) in 2001

Greenwich was designated an [Air Quality Management Area \(AQMA\)](#) in 2001 due to the high levels of NO₂ emissions at that time and the expectation that this would continue without further action being taken³⁷. Since then, Royal Greenwich has developed an extensive network of Air Quality Monitoring Stations to identify where action is needed. The network currently consists of ten automatic monitoring stations measuring several key pollutants supplemented by fifty-six NO₂ diffusion tube monitors located across the borough.

The locations of the air quality monitoring stations in 2021 are shown in the following map:



UK targets for emissions have been less strict than recommended by WHO, although they are being updated and strengthened, particularly in the light of latest WHO standards. The 2023 [Environmental Improvement Plan](#)³⁸ now states that the target for population exposure to PM_{2.5} will be reduced by 35% in 2040 compared to 2018 levels, with a new interim target to reduce this by 22% by the end of 2028. The target for annual mean concentration of PM_{2.5} will be 10µg/m³ (micrograms per cubic metre) by 2040, with a new interim target of 12/m³ by the end of January 2028

The current and recommended targets for emissions of NO₂, PM₁₀ and PM_{2.5} are shown in the table below.

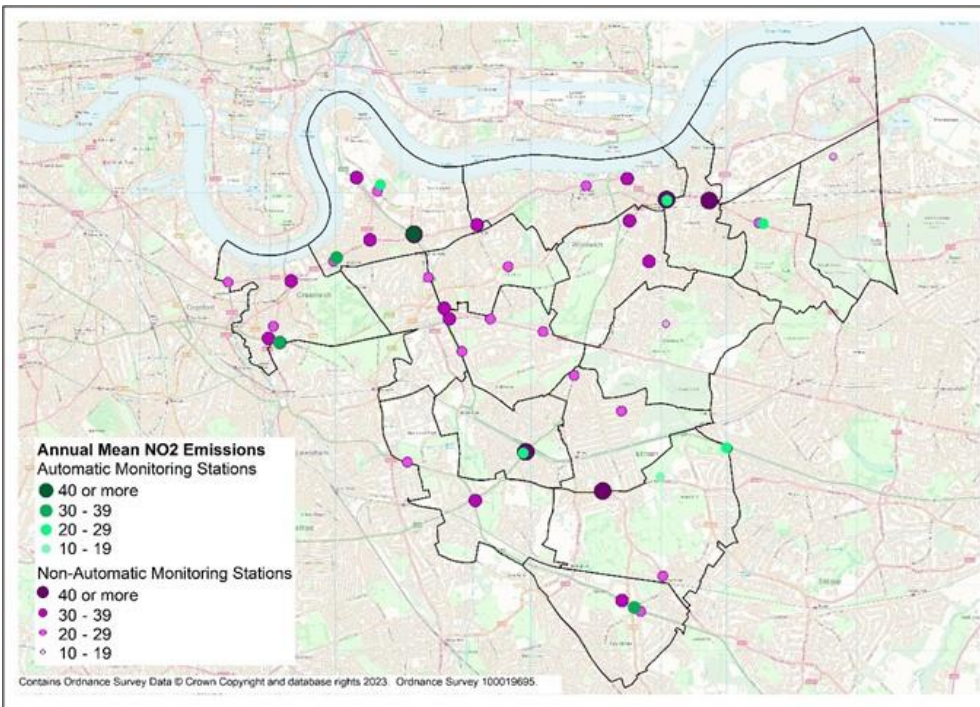
Pollutant	Concentration measured as	Old WHO Guideline	New WHO guideline	Current UK Objective	Proposed UK Objective
NO ₂	1-hour mean	200 µg/m ³		200 µg/m ³ not to be exceeded more than 18 times a year	
	Annual mean	40 µg/m ³	10 µg/m ³	40 µg/m ³	
	24-hour mean		45 µg/m ³		
PM ₁₀	24-hour mean	50 µg/m ³ not to be exceeded more than 35 times a year	45 µg/m ³ not to be exceeded more than 35 times a year	50 µg/m ³ not to be exceeded more than 35 times a year	
	Annual mean	20 µg/m ³	15 µg/m ³	40 µg/m ³	
	24-hour mean	25 µg/m ³	15 µg/m ³		
PM _{2.5}	Annual mean	10 µg/m ³	5 µg/m ³	20 µg/m ³	12 µg/m ³ by 2028 and 10 µg/m ³ by 2040
	3-year mean				35% reduction in population exposure in 2040 compared to 2018 (with interim of 22% by 2028)

Source: Environmental Action Plan 2023 (DEFRA)³⁸

Air quality in Greenwich has improved, but targets are not yet achieved consistently.

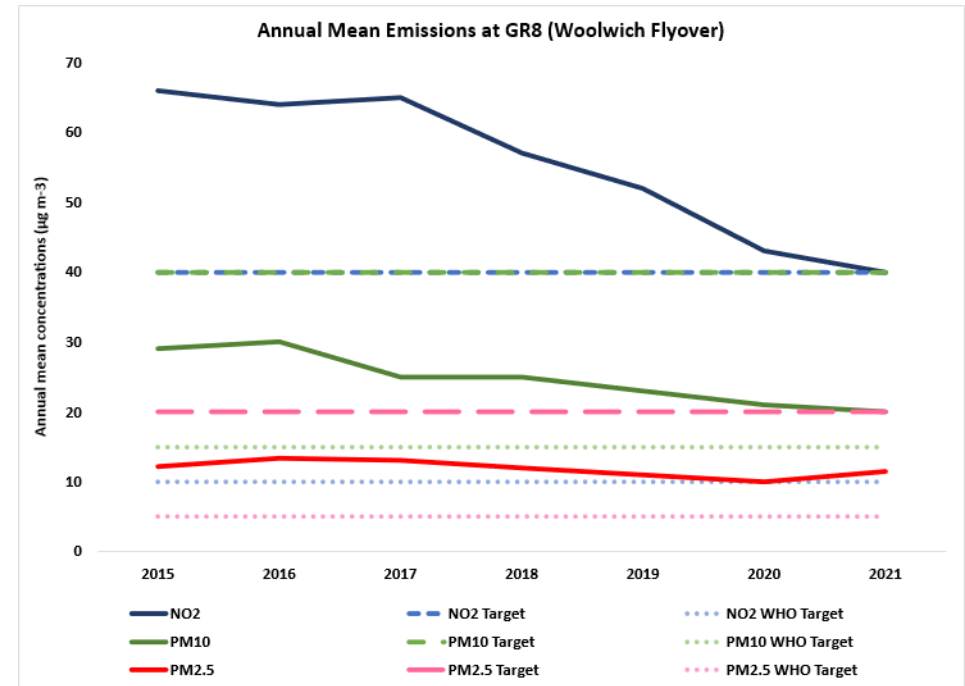
Air pollutant levels recorded by [Greenwich monitoring stations](#)¹³ indicate that air quality has improved, and that in many Greenwich neighbourhoods, concentration levels are within the current national limits. However, there are areas where targets are not yet achieved consistently. This includes levels of NO₂ at the Woolwich Flyover.

Mean NO₂ measured by monitoring sites in 2021 are shown in the map below:



Source: Royal Borough of Greenwich (2022) Air Quality Annual Status Report for 2021¹³

The chart below shows the trends for annual mean emissions of NO₂, PM₁₀ and PM_{2.5} at the Woolwich Flyover compared to UK and WHO targets. There has been a large drop in NO₂ emissions recorded at this site (continuous blue line) despite not yet meeting the current national target. It is also clear how much more progress would be needed to move towards WHO's new target shown as a blue dotted line. (Results for each of the automatic monitoring stations can be found in the Annex, Section B).



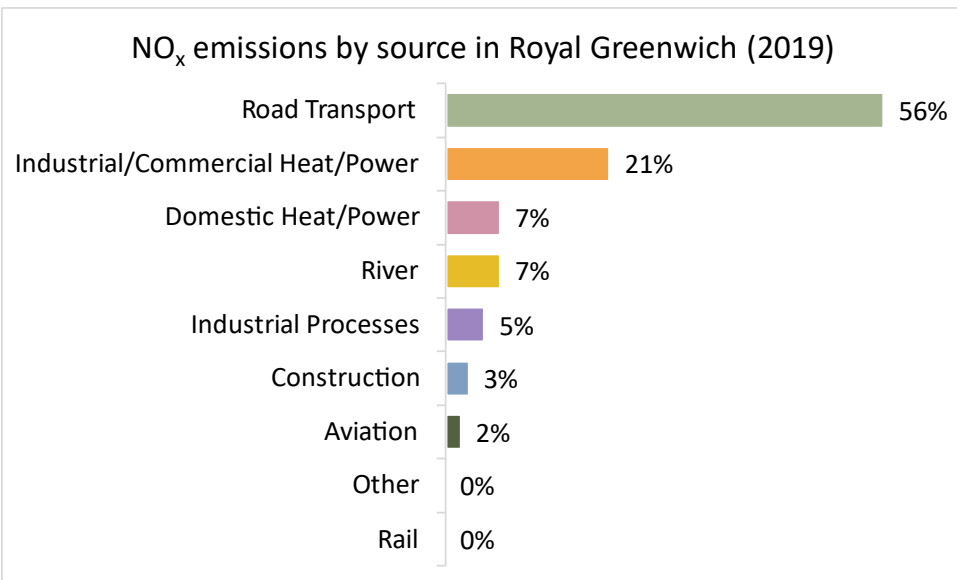
Source: Royal Borough of Greenwich (2022) Air Quality Annual Status Report for 2021¹³

Much of the air pollution originating in Greenwich is from transport, construction, heating and burning of solid fuels

As with London as a whole, most air pollution originating in Greenwich is from transport, construction, heating and burning of solid fuels³¹.

Road transport is calculated to account for more than half of local emissions of NO_x . Followed by industrial/commercial heat and power generation at more than a fifth. Emissions from domestic heat and power, industrial processes, river related combustion, and use of non-road mobile machinery (NRMM) in construction constitute most of the remaining emissions.

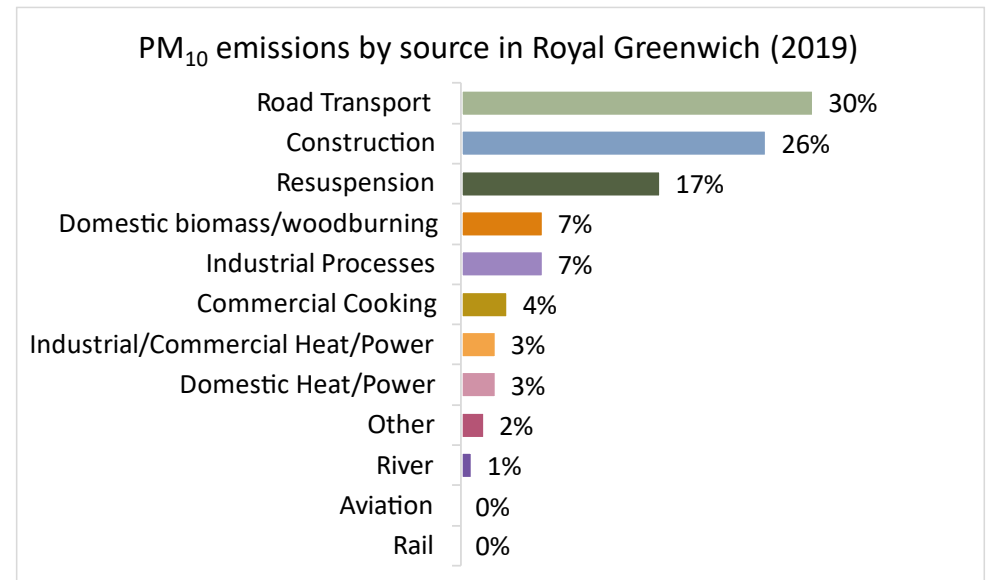
NO_x Emissions by Source in Greenwich (2019)



Source: GLA LAEI 2019³¹

Road transport and construction activity account for more than half of local emissions of PM_{10} . This is generated by the driving of diesel and petrol engine vehicles, NRMM, as well as dust from construction site activities. 'Non-exhaust emissions' (NEE) contribute over 10%. NEE includes particles created by wear to brakes, tyres, and road surfaces, as well as resuspended road dust. Biomass burning (including domestic woodburning), and industrial processes are the next largest sources at 7% each.

PM_{10} Emissions by Source in Greenwich (2019)

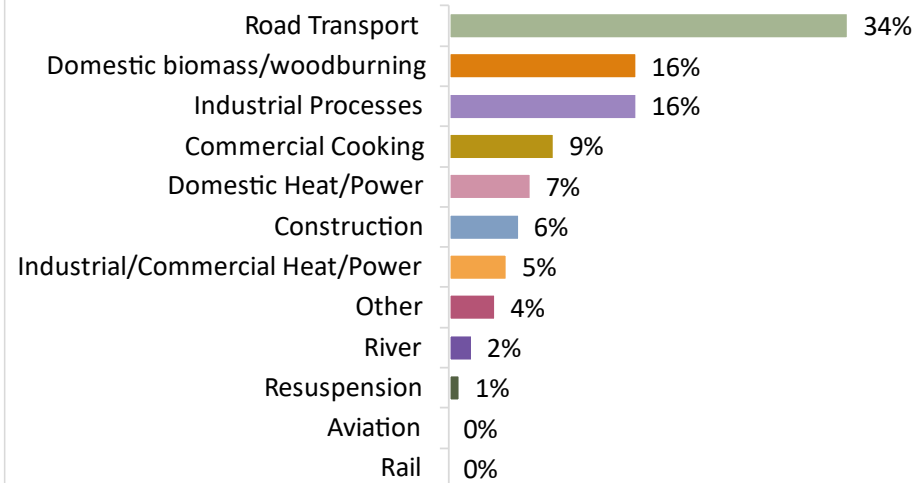


Source: GLA LAEI 2019³¹

Greenwich residents' exposure to PM_{2.5} is similar to the London average

PM_{2.5} Emissions by Source in Greenwich (2019)

PM₁₀ emissions by source in Royal Greenwich (2019)



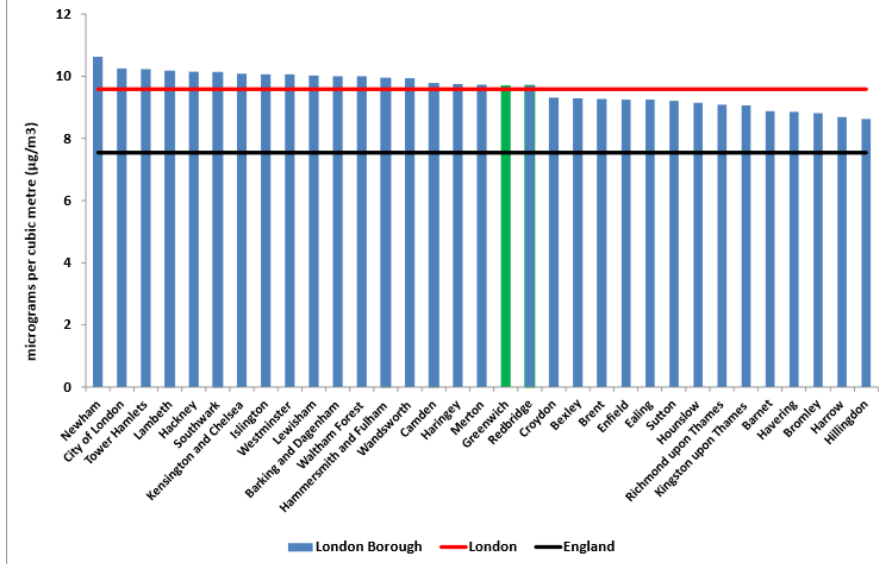
Source: GLA LAEI 2019³¹

Road transport is again the largest contributor to local emissions of PM_{2.5} in Royal Greenwich – at around 34%. Domestic biomass burning (often wood burning stoves) and industrial processes also account for around a third of these emissions. Commercial cooking, domestic and commercial heat and power, and construction NRMM make up most of the remaining third.

Modelled annual mean concentrations of pollutants

Results from monitoring stations can be used to model pollutant concentrations across wider areas. The results indicate that Greenwich residents' exposure to PM_{2.5} was similar to the London average (although levels in London are the highest in England)³⁹.

Annual mean concentration of fine particulate matter (PM 2.5) at an area level in 2020, (adjusted to account for population exposure).

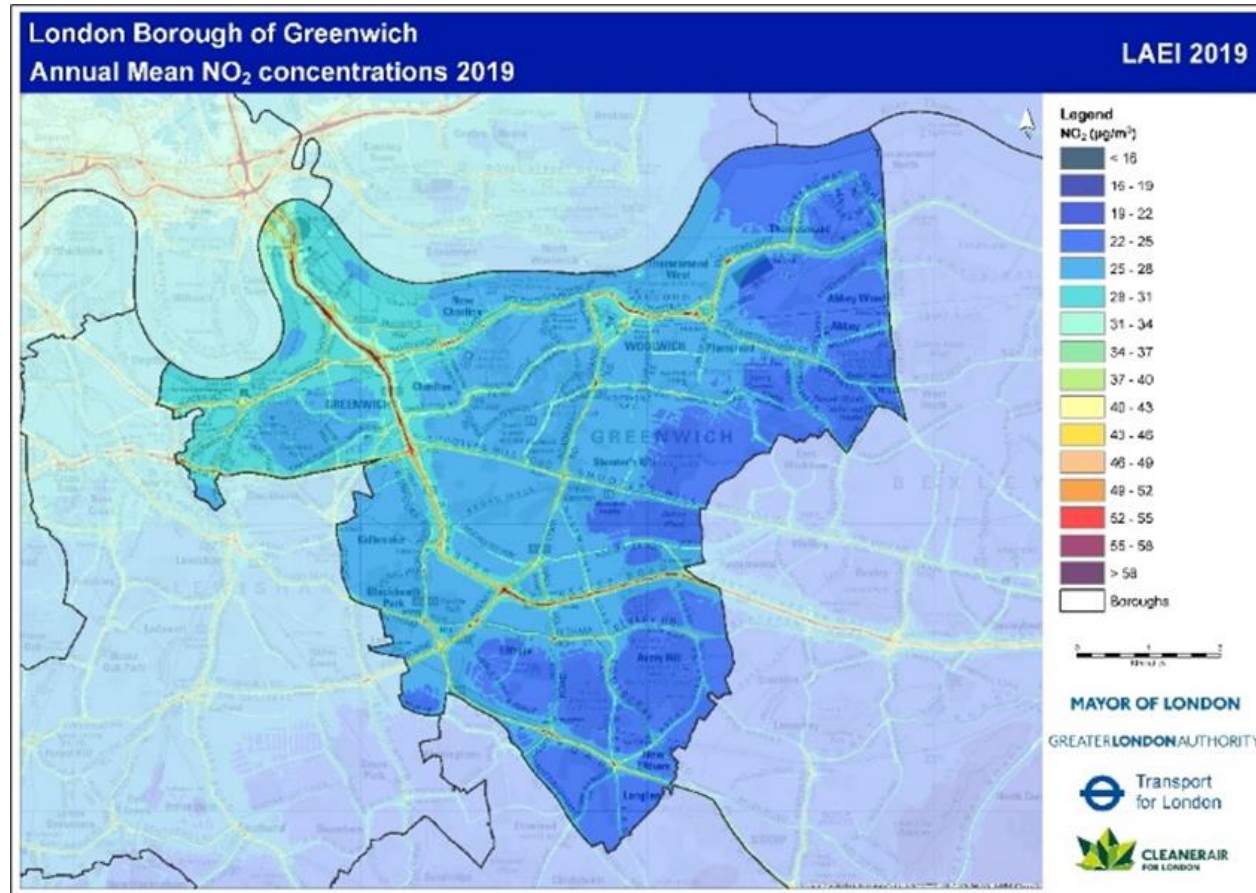


Source: Indicator 93687 [OHID Fingertips \(March 2023\)](#)³⁹

Modelled estimates can also indicate changing levels of exposure in smaller neighbourhood areas. Compared to [LAEI 2013](#)⁴⁰ (reported in our previous Air Quality JSNA⁴¹), results from LAEI 2019³¹ show lower average annual concentrations across much of the borough. Concentrations continue to be higher along the busiest roads in the north and west of Greenwich - including the A2 from the Blackwall Tunnel (southern approach) to East Rochester Way, the A206 from Deptford to Plumstead, the A205 from Horn Park to Woolwich, the A207 Shooter Hill Road, and A20 Sidcup Road. Pollutant levels will drop off rapidly within a relatively short distance from these roads, but areas immediately adjacent to them will experience high levels of pollution.

Modelled annual mean NO₂ concentrations (LAEI 2019)

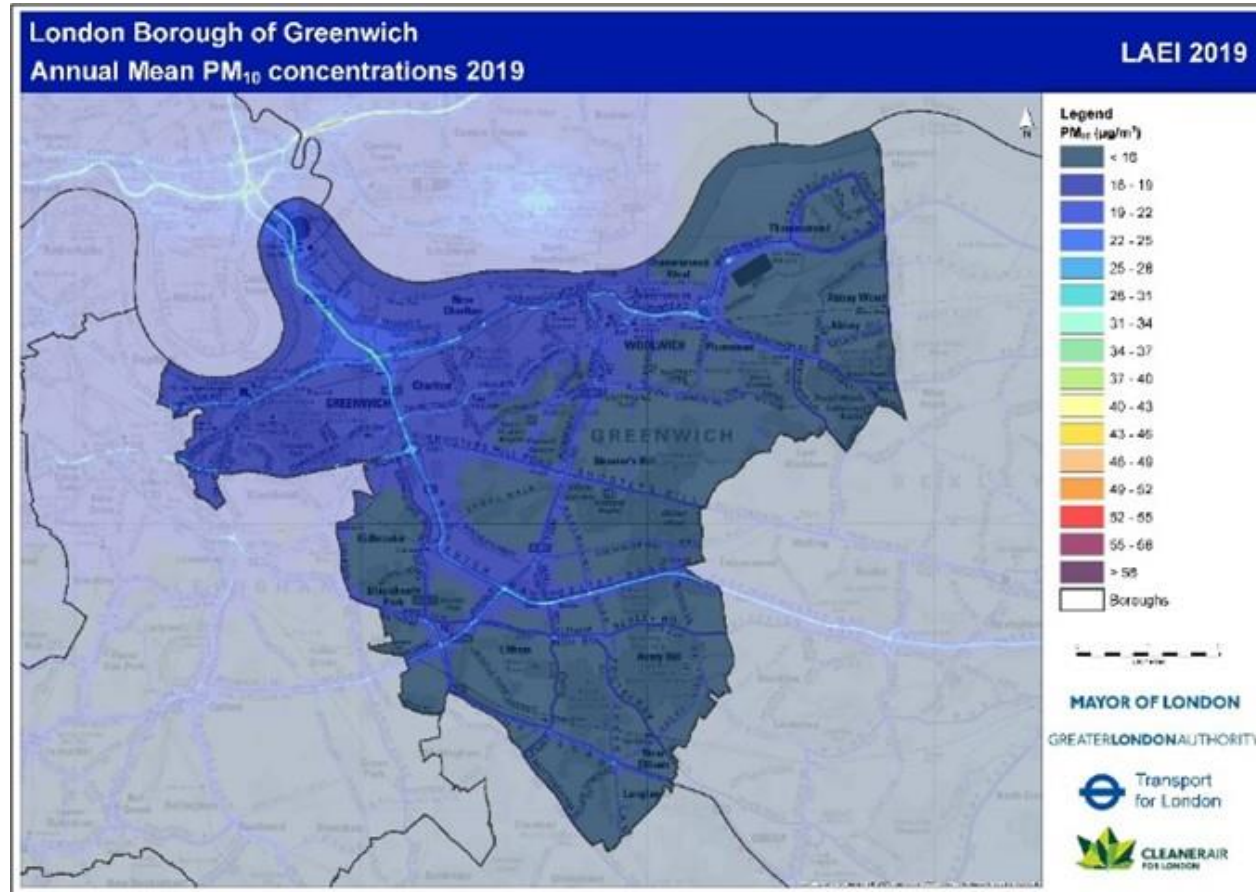
In 2019, much of the east and south of Greenwich has an annual mean emission of less than 28 (as shown in the map below) except for areas immediately bordering main roads. This is an improvement from 2013 when LAEI indicated all the areas in Greenwich had an annual mean emission of 28 or more.



Source: GLA LAEI 2019³¹

Modelled mean annual PM_{10} (LAEI 2019)

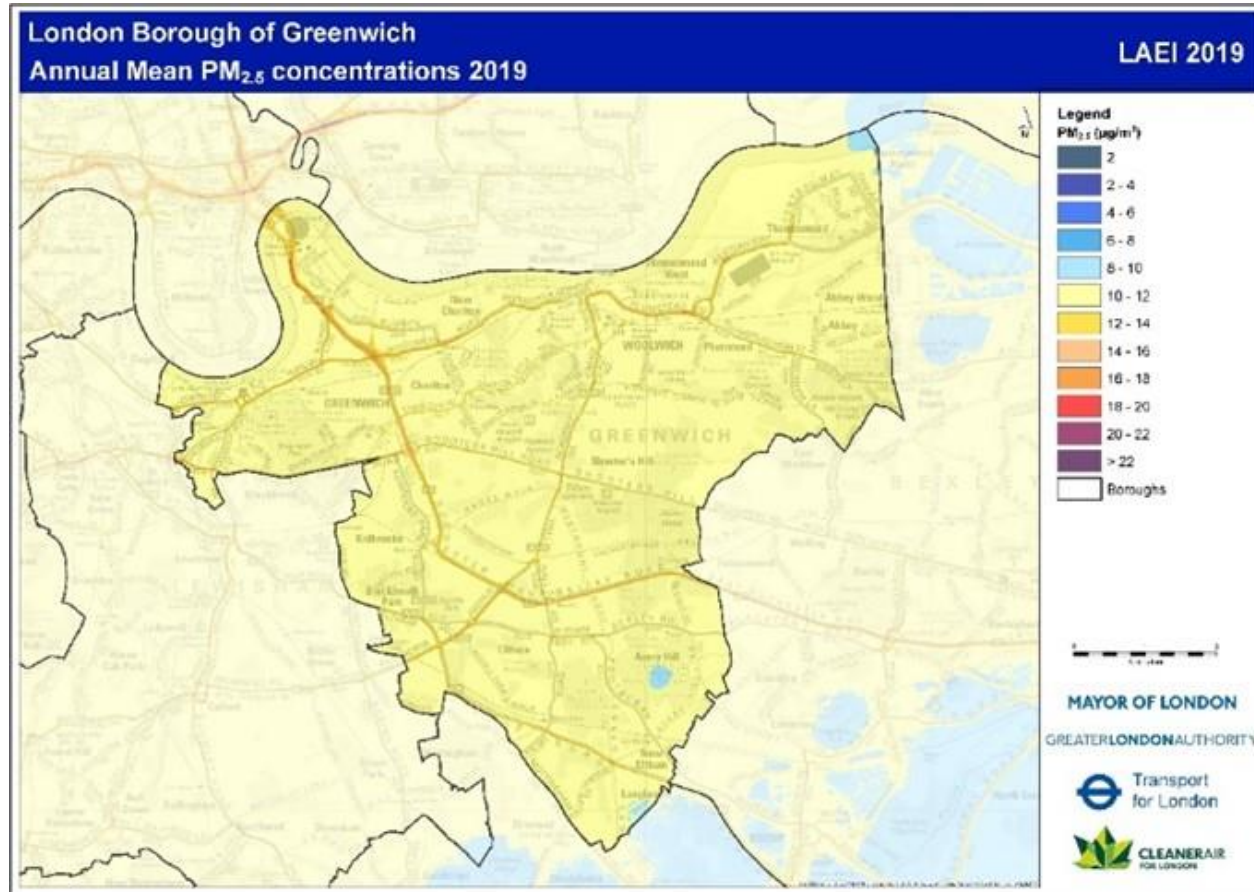
Improvements are indicated across the borough. In 2013 most areas had annual mean emission levels up to 28. In 2019, much of Greenwich experienced annual means of less than 22 (as shown in the map below).



Source: GLA LAEI 2019³¹

Modelled mean annual $PM_{2.5}$ (LAEI 2019)

There has been a reduction in $PM_{2.5}$ measured across the borough. In 2013, most areas in Greenwich saw annual mean emission of around 15-17. In 2019, this had reduced to around 10-12, as shown below.



Source: GLA LAEI 2019³¹

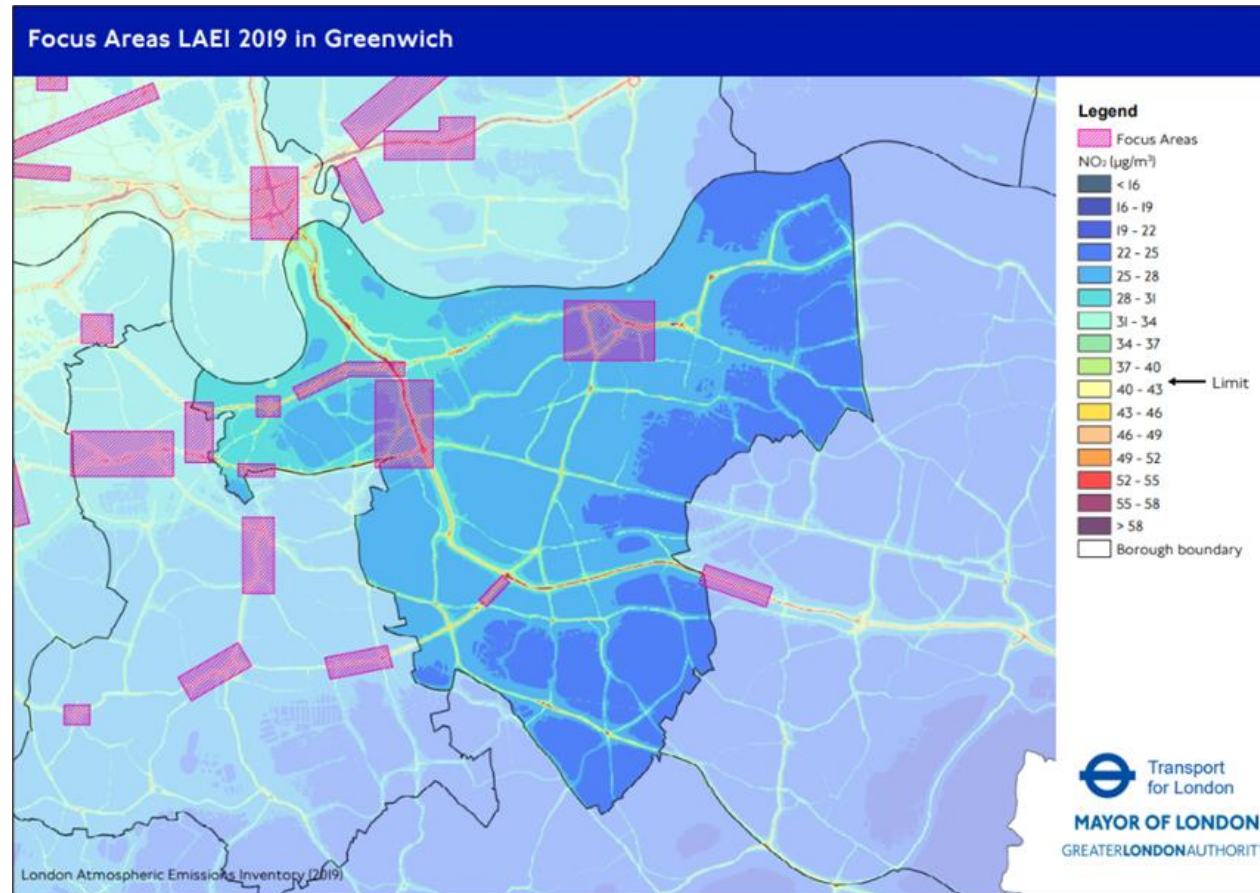
Air Quality Focus Areas

[Air Quality Focus Areas](#)⁴² (AQFA) are selected where the annual mean limit for NO₂ (40µg/m³) has been exceeded (excluding road carriageways), and there are particularly high levels of population exposure. Additional measures should be taken in these areas to reduce and prevent air pollution.

London's AQFAs were reviewed in 2022 using the LAEI 2019 and reduced in number from 186 to 160⁴³. In Greenwich there are now 6 AQFAs compared to 8 previously (following removal of Plumstead and Eltham High Streets). These are:

- Westthorne Avenue A205
- Greenwich Centre
- Sun-in-the-Sands junction A102/A2 Shooters Hill and Charlton Road Roundabout
- Woolwich and Woolwich Arsenal A205 Woolwich Rd/A206 Plumstead Road
- Greenwich South St/Lewisham High St Junction and Blackheath Hill
- Greenwich Trafalgar Road (A206) and Woolwich Road

Air Quality Focus Areas in the Royal Borough of Greenwich (LAEI 2019)



Source: GLA LAEI 2019³¹

Impact of air pollution on health: the national picture

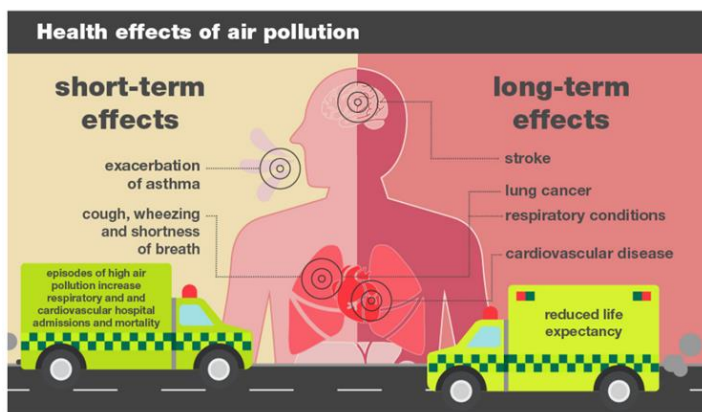


Air pollution can contribute to chronic ill-health and disability, and reduced life expectancy

Over time air pollution can contribute to chronic ill-health and disability, and reduced life expectancy of the population. In addition to well-understood links to cardiovascular and respiratory conditions and cancer, evidence continues to emerge that air pollution is a factor in a variety of poor health outcomes from conception to old age^{1,3}, including:

- premature birth and low birth weight (both risk factors for poor outcomes in infancy and childhood, as well as later in adult life).
- poor growth of lungs in children and development of asthma.
- accelerated decline of lung function in adults
- type 2 Diabetes, dementia, and cognitive decline.

Damage to the body can be gradual and might not be apparent for many years.



Source: PHE (2018) Health Matters – Air Pollution³

Short-term increases in air pollution can exacerbate symptoms of existing illness such as asthma and cardiovascular disease, increase hospital attendance, and in a smaller number of cases lead to early death. A 2020 inquest concluded that the 2013 death of South London resident Ella Kissi

-Debrah was due to asthma contributed to by exposure to excessive air pollution. The first time this was identified as a cause of death in the UK^{2,4}.

People with pre-existing conditions are most vulnerable from short-term exposure to air pollution. People who are generally well are on balance better able to manage the impact by maintaining their health and fitness through regular moderate exercise and eating a healthy diet¹.

Pyramid Model of health



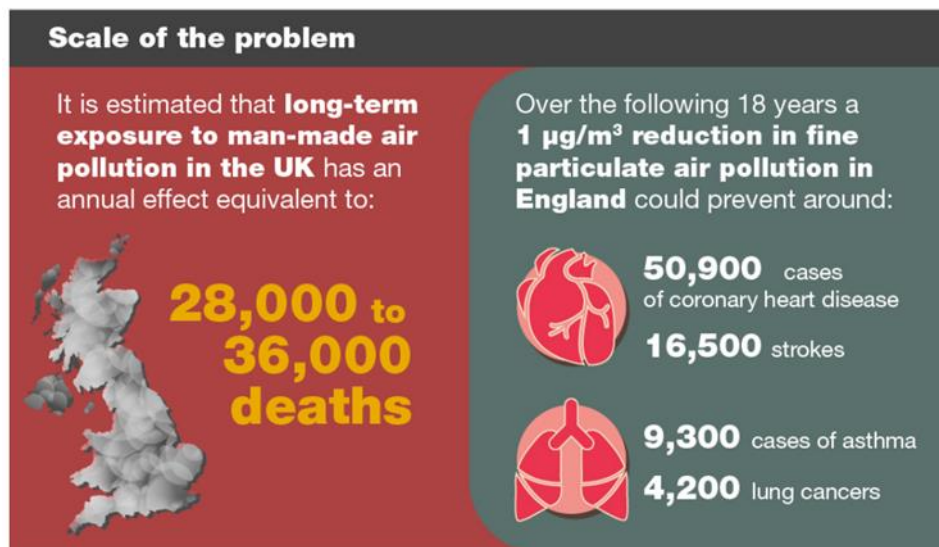
Source: WHO (2005) in RBG Air Quality JSNA (2016)⁴¹

The Pyramid Model of population health⁴¹ illustrates the impacts well. At the top there are a smaller number of people who die prematurely, and below this a larger group of people who are increasingly unwell, less able to take part in everyday life, and in need of support from health and social care. At the base of the pyramid, there are many people who are experiencing physiological change which can still be addressed and slowed.

It is estimated that 28,000 to 36,000 deaths in the UK each year were attributable to human-made air pollution.

Analysis commissioned by Public Health England (PHE) identified that air pollution is expected to cause 2.4 million new cases of disease in England between 2017 and 2035, with PM_{2.5} alone responsible for around 350,000 cases of coronary heart disease and 44,000 cases of lung cancer in England in that time.

It was also estimated that 28,000 to 36,000 deaths in the UK each year were attributable to human-made air pollution⁶. A separate analysis by Imperial College estimated that in 2019 the equivalent of 3,600 to 4,100 deaths in Greater London were attributable to human made PM_{2.5} and NO₂ (61,800 to 70,200 life years lost)².



Source: PHE (2018) Health Matters - Air Pollution³

Previous restrictions on pollutants appear to have improved health. For example, a study found long-term reductions in PM and NO₂ in California

were associated with measurable improvements in the development in the lung function of children between the ages of 11 and 15, compared with those growing up in earlier years when pollution levels were higher¹. An earlier example reported a 6% decrease in all-cause mortality in the 3 years following a ban on coal burning in Dublin in 1990: the largest decline found to be, as expected, in respiratory and cardiovascular deaths⁴⁴.

Action taken now is expected to reduce the numbers of new cases of serious and chronic illness, as well as support the health of people already living with these conditions. The modelling for PHE also estimated that a 1 µg/m³ reduction in fine particulate air pollution in England could prevent around 50,900 cases of coronary heart disease, 16,500 strokes, 9,300 cases of asthma and 4,200 lung cancers over an 18-year period⁶. The model assumes that 30% of the reduction in risk of mortality occurs in the first year after pollution reduction; 50% occurs across years 2 to 5 (cardiovascular illness); and the remaining 20% of the risk reduction is distributed across years 6 to 20 (lung cancers).

The COVID lockdown provided a more recent example, hospital admissions due to asthma fell rapidly during the pandemic but as lockdown ended and traffic returned, they began to increase again. In London admissions of children due to asthma increased by 64% in 2021-22 compared to 2020-21⁴⁵.

People from lower socio-economic groups are more likely to be exposed to air pollution

Health Inequalities

Some individuals and communities are more at risk of experiencing poor air quality, and at greater risk from harm when they do^{1,3}. This includes:

- people with existing health conditions (especially respiratory and cardiovascular disease)
- infants and young children – their lungs and other organs are still developing, and children breathe more rapidly than adults⁴⁶
- older people - are more likely to have pre-existing respiratory and cardiovascular health issues
- people from Black and Minority Ethnic communities^{45,47}
- people who live or work close to a source of pollution - housing in polluted areas may be more affordable
- people experiencing poverty.

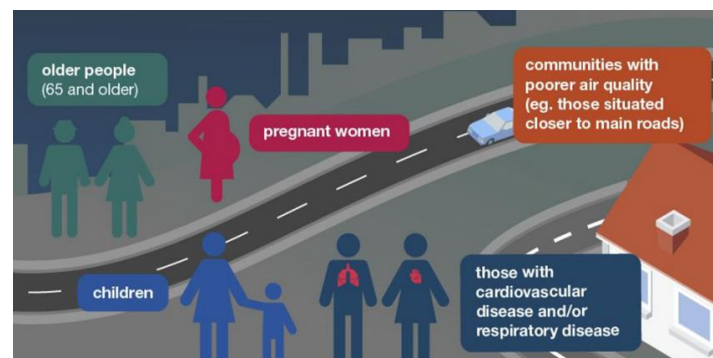
For example, people from lower socio-economic groups are more likely to be exposed to air pollution^{1,3,47} and to be less protected when they are exposed to it. They are:

- more likely to have existing medical conditions including asthma or COPD,
- more likely to have grown up and to live in areas with poor indoor and outdoor environments – near busy roads or industry
- schools and children's play areas may be in more polluted locations
- less likely to live in areas with green space
- less likely to be able to access decent housing and a healthy diet
- higher levels of occupancy and overcrowding

Although many people can be impacted by one of these factors, people from lower socio-economic backgrounds are more likely to experience them in

combination which multiplies the impact.

Identifying ways that will reduce air pollution and also reduce health inequalities is not always straightforward. For example, living close to a road tends to be associated with greater levels of deprivation, but this is not universal. Results from LAEI in 2019³¹ indicated that there were higher levels of pollution in more deprived neighbourhoods compared to less deprived neighbourhoods: annual average concentrations of NO₂ were 13% higher and PM_{2.5} were 6% higher. However, studies¹ comparing specific postcode level neighbourhoods sometimes found the reverse could be true.



Source: PHE (2018) Health Matters – Air Pollution³

The [Index of Multiple Deprivation](#) (IMD)⁴⁸ is widely used to compare neighbourhoods, but these LSOA areas are still relatively large and can contain pockets of greater or lesser deprivation. Residents might also experience varying levels of air quality – an LSOA might border a major road on one side, and open green space on the other⁴⁷.

Actions which reduce emissions or increase resilience are likely to be especially beneficial when targeted at individuals and communities who experience greater inequalities, and this should be considered and investigated when planning interventions and changes to infrastructure.

Economic costs of air pollution are estimated to run into billions

Indoor air pollution and health inequalities

Individuals and households can influence their exposure to some extent – but there are constraints to this. This might depend on factors such as their level of knowledge, their ability to buy or use fewer polluting products, or to increase levels of ventilation. For example, some individuals living in poorly maintained rental properties with inadequate ventilation have reported their landlords are unwilling to make necessary repairs or improvements.

As with air pollution in general, health inequalities mean that some people and communities are more likely to experience the impacts of indoor air pollution^{1,3}:

- they may be more likely to live, work and learn in polluted areas (close to busy roads or industry)
- they may live in areas where noise or security risks mean they avoid opening windows for ventilation
- the cost of heating, and trying to maintain adequate warmth, is a barrier to using ventilation
- the physical infrastructure of their home (such as small room size, poor layout, inadequate ventilation, and the orientation of the building) is more likely to trap air pollution
- standard of housing and maintenance (treatment of damp and mould, physical disrepair including flood damage or poorly maintained fuel-burning appliances)
- overcrowding – multiple occupants can lead to increased moisture, and greater resuspension of particles
- greater likelihood of environmental tobacco smoke⁴⁹
- type and quality of building materials used (including for home building and decorating projects)

- type and quality of flooring, carpeting and furniture
- type and quality of cleaning and personal care products used

People who are older, unwell or disabled may be less able to leave their homes, and more susceptible to the cold, so designs that balances ventilation with maintaining a comfortable level of heat can be important¹.

The economic cost of air pollution

As well as the impact on people and communities, the economic costs of air pollution are estimated to run into billions. This is due to the need for health and social care, as well as reduced productivity^{2,3}.

It has been estimated that the health and social care costs of air pollution (PM_{2.5} and NO₂) in England could reach at least £5.3 billion by 2035⁶. This was for those diseases most associated with Air Quality such as coronary heart disease; stroke; lung cancer; and childhood asthma. When other health issues were included, the costs could reach £18.6bn by 2035. These included chronic obstructive pulmonary disease (COPD); diabetes; low birth weight; and dementia.

The Confederation of British Industry (CBI) estimates that improved health and fewer working days lost could benefit the UK's economy by £1.6bn each year due to: £500m in London⁷, while a study by Kings College in 2015 estimated this might be as much as £3.7bn every year⁸.

Impact of air pollution on health: the local picture



Average life expectancy in Royal Greenwich is amongst the lowest in London

Royal Greenwich has lower life expectancy than the average for London and England, and rates of premature mortality due to respiratory illness and cancers are amongst the highest in London. There continue to be high rates of emergency admissions of children compared to comparators and until the recent past this has included admissions due to respiratory illness⁹.

Air pollution is one of several 'wider determinants of health'³⁹ which contribute to the development of chronic illness and reduced life expectancy. Other factors that contribute to poor health and early death include health behaviours, such as smoking^{33,49}. (Smoking is itself strongly linked to respiratory illness and lung cancer and will be examined in greater detail in a later section of the JSNA).

Improving air quality will contribute to improvements in the health of the Royal Greenwich population. The results below indicate the number of people who have conditions which air pollution is linked to, or exacerbated by and who would benefit from cleaner air.

Life Expectancy

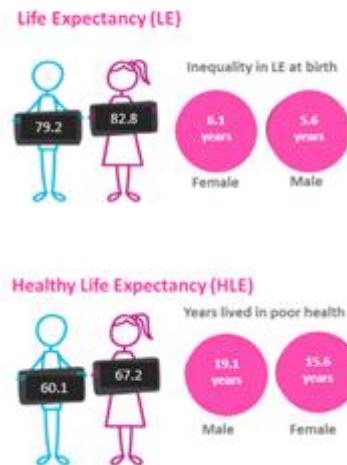
In 2018-20, average life expectancy at birth for both men and women in Royal Greenwich was lower than England, and amongst the lowest in London⁹:

- 79.2 years for men (6th lowest rate out of all London boroughs)
- 82.8 years for women (2nd lowest out of all London boroughs).

There was also a wide gap in the life expectancy of residents within Royal Greenwich, with lower average life expectancy in areas of greater deprivation. In the period 2016-20, life expectancy for MSOA neighbourhoods ranged from 74 to 84 years for men and from 77 to 87 years for women⁵⁰. (See maps in Section C of the Annex).

People with lower life expectancy also often spend more of their life in poor health. Healthy life expectancy (HLE) indicates the number of years a person can expect to live in good health. In 2018-20, HLE for Greenwich men was 60.1 years on average (the 3rd lowest of all London boroughs). In contrast HLE has continued to improve for Greenwich women: at 67.2 years in 2018-20, this was the 9th highest in London.

Health Inequalities- LE and HLE



Source: OHID [Wider Determinants of Health](#)³⁹

...and the causes



Many people are vulnerable to air pollution because of existing long-term health conditions.

Primary Care

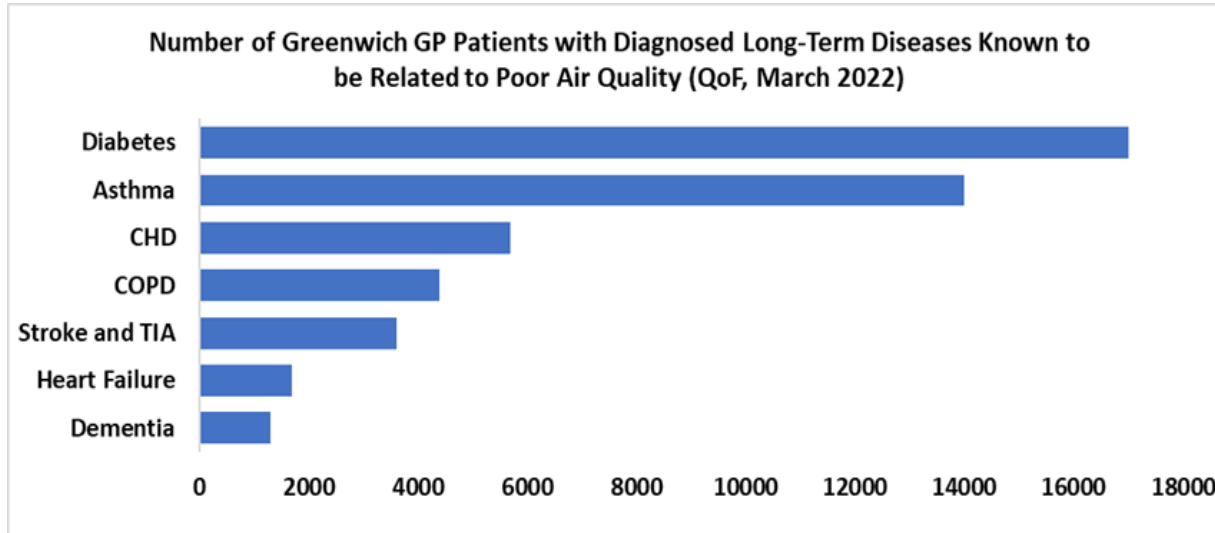
Many people are more vulnerable to air pollution because they have existing long-term health conditions. Data from Greenwich GP practices in 2021-22⁵ identified that:

- Around 14,000 people aged 6 or more who were registered with a Greenwich GP had a diagnosis of asthma recorded on the practice register: 2,200 were aged 6-19 years old.
- Around 17,000 people aged 17 or more had a diagnosis of diabetes recorded on the register.
- Around 5,700 people (all ages) had a diagnosis of CHD recorded and 4,400 a diagnosis of Chronic Obstructive Pulmonary Disease (COPD) recorded.

Maternity and Birth

Some infants are especially vulnerable as they are premature or have a lower birth weight⁹:

- In 2018-20, nearly 1,000 infants were born prematurely in Greenwich. This was the 8th highest rate of premature births out of all London boroughs.
- Around 300 Greenwich infants have a low birth weight each year (<2.5kg). In 2021, 295 infants had a low birth weight (at 7.6% - this is a similar proportion to the London average).
- Around 100 Greenwich infants each year have a low birth weight even though they were carried to term. In 2021, there were 137 cases, the highest number for several years (placing Greenwich 6th highest out of all London boroughs).



Source: NHS Digital (2022) [Quality and Outcomes Framework 2021-22](#)⁵

Note: TIA = Transient Ischaemic Attack (or 'mini-stroke')

Admissions of children and young people due to respiratory illness and asthma fell in 2020-21

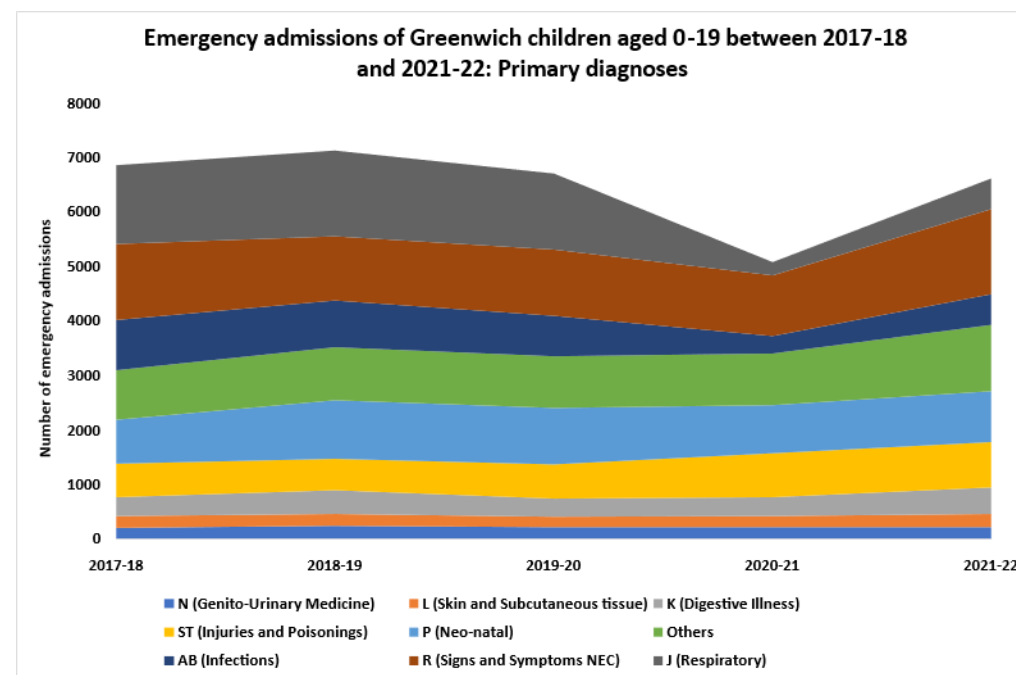
Children's Health

Rates of attendance at A&E and admissions of under 18s have been high for several years⁹. Greenwich had:

- the 7th highest rate of A&E attendance for under 18s amongst London boroughs in 2019-20 (532 per 1000 children under 18 compared to 475.2 in London and 415.6 in England)
- the 5th highest rate of A&E attendance for under 5s amongst London boroughs in 2019-20 (935.4 per 1000 children under 18 compared to 787.7 in London and 659.8 in England)
- the highest rate of emergency admissions for under 18s out of London boroughs in 2020-21 (68.6 per 1000 under 18s compared to 34.9 in London and 46.7 in England).
- the highest rate of emergency admissions for under 5s out of London boroughs in 2020-21 (133.0 per 1000 under 18s compared to 62.7 in London and 91.2 in England)
- the 4th highest rate of emergency admissions due to lower respiratory tract infections amongst infants aged under 1 out of London boroughs in 2019-20 (616.8 per 10,000 compared to 433.6 in London)

By 2019-20, admissions of children and young people due to asthma had already been falling. This accelerated during the pandemic. The chart (to the right) shows how emergency admissions of Greenwich children and young people changed in 2020-21 compared to preceding years⁵¹.

Between 2017/18 and 2019-2020, respiratory illness was the largest cause of emergency admissions of under 20s in Greenwich (4,398 of 20,672 emergency admissions, 21%). In the two years, 2020-22 these diagnoses made up only 800 cases out of 11,691 cases (7%). Emergency admissions due to other causes changed less and some types increased – for example the number of emergency admissions due to 'injuries and poisonings' increased from around 600 a year to 800 in 2020-21



Source: RBG PHWB Analysis of NHS Digital Hospital Episode Statistics⁵¹ (March 2023)

There are high rates of mortality due to COPD and lung cancers in Royal Greenwich

Admissions and Mortality (All Causes)⁹

The standardised admission ratio for emergency hospital admissions (all causes) indicates that emergency hospital admissions in Greenwich were significantly greater than England in 2016/17- 2019/20, with 6.2% more admissions per 100 people than in England.

- The rate of all-age all-cause mortality in Greenwich was the 3rd highest out of London boroughs in 2018-20. There were 978.0 deaths per 100,000 people compared to 880.0 in London.
- The rate of premature mortality (deaths before the age of 75) due to all causes was the 4th highest out of London boroughs in 2018-20. There were 376.1 deaths per 100,000 people compared to 316.1 in London. The rate was also significantly greater than England. (deaths of 2071 Greenwich residents aged under 75 were registered in these three years).

Cardiovascular Disease (CVD)⁹

- The rate of emergency admissions due to stroke (all-ages) was 7th highest out of London boroughs in 2020-21. There were 198.9 admissions per 100,000 people compared to 161.8 in London. The rate was also significantly greater than the England average.
- The rate of under 75 mortality due to preventable cardiovascular disease was the 10th highest out of London boroughs in 2021. There were 33.9 deaths per 100,000 people compared to 29.5 in London and 30.2 in England.

Lung Cancers⁹

- Greenwich had the 4th highest rate of lung cancer registrations out of all London boroughs in 2017-19 at 98.8 per 100,000 people compared to 74.8 in London. This was also significantly greater than England.
- The rate of mortality due to lung cancers was also 4th highest out of

London boroughs in 2017-19. There were 65.6 deaths per 100,000 people compared to 48.0 in London. This was also significantly greater than England. (322 deaths of Greenwich residents due to lung cancer were registered in this period).

- Historically there have been high levels of smoking in Greenwich, although this has reduced in recent years. The ONS Annual Population Survey suggests that 11.5% of adults in Greenwich were current smokers in 2021. Some population groups are more likely to smoke - 21.8% of Greenwich residents in routine and manual occupations were identified as smokers in the 2020 survey

Respiratory Illness and COPD⁹

- The rate of emergency admissions due to COPD (all-ages) was 7th highest out of London boroughs in 2019-20. There were 472 admissions per 100,000 people compared to 358 in London. The rate was also significantly greater than England.
- The rate of u75 mortality due to respiratory illness was the 8th highest out of London boroughs in 2017-19. There were 36.4 deaths per 100,000 people compared to 29.4 in London.
- The rate of u75 mortality due to preventable respiratory illness was the 4th highest out of London boroughs in 2021. There were 22.6 deaths per 100,000 people compared to 12.1 in London and 15.6 in England.
- The rate of mortality due to COPD (all-ages) was 4th highest out of London boroughs in 2017-19 at 63.7 deaths per 100,000 people compared to 47.2 in London. It was also significantly greater than England. (303 deaths of Greenwich residents due to COPD were registered in this period).

Rate of emergency admissions due to respiratory illness has reduced

Mapping Emergency Admissions to Hospital due to Respiratory Illness

There has been a small reduction in the number of emergency admissions due to respiratory illness when comparing two recent 5-year periods: 2013-18 and 2017-22⁵¹. This is the case even though the Greenwich population has increased. The reduction in admissions was not consistent across all age groups with the decrease largely amongst under 20s and especially amongst children under the age of 5. There was a small increase in the number of admissions for older age groups. (More details are available in the Annex, Item D).

Numbers of admissions decreased during the COVID lockdown especially, and this decrease might not be sustained, but by 2021-22 numbers of admissions remained relatively low although had increased a little.

It is difficult to calculate reliable rates of admission until refreshed mid-year population estimates are released by the Office for National Statistics, especially for smaller neighbourhoods. These results will need to be examined again once population estimates are available and there are additional results post COVID lockdown.

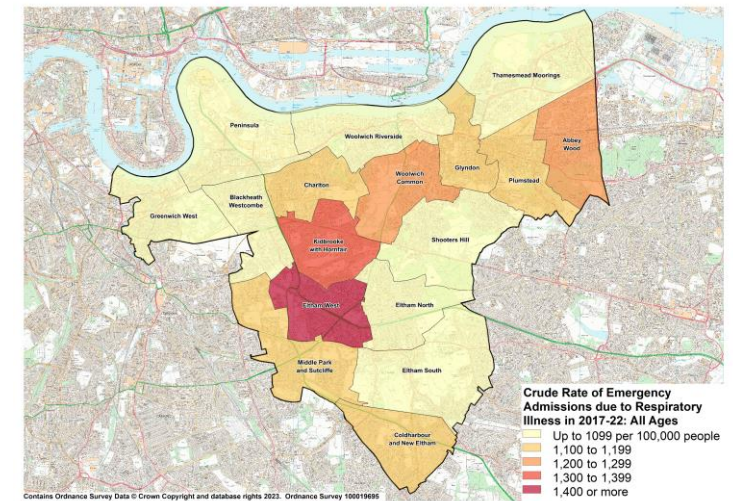
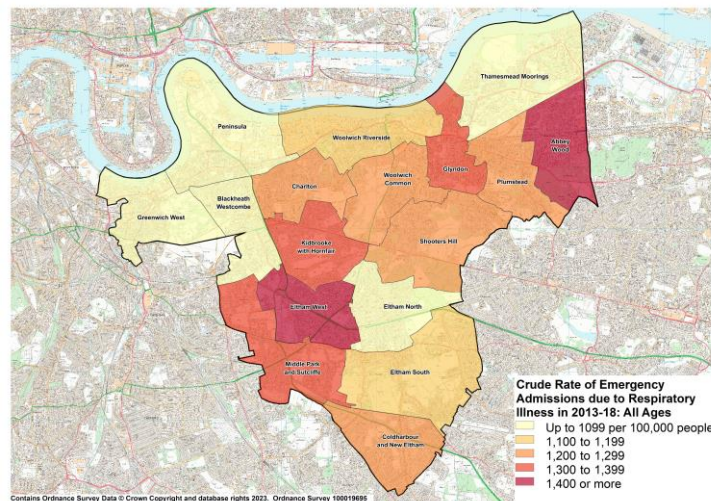
Using a 2020 ward level [GLA population projection](#)⁵² suggests rates of emergency admissions due to respiratory illness (all ages) in Royal Greenwich reduced from an average of 1,193 per 100,000 people to 1,090 per 100,000 people⁵¹. These results also indicate that rates of emergency admissions due to respiratory illness decreased in nearly all wards within Royal Greenwich. Kidbrooke with Hornfair and Eltham West wards had some of the highest rates in both periods.

Emergency Admissions to Hospital due to Respiratory Illness (J00-J99)

Age Group	2013-18	2017-22
0-4	5,393	3,983
5+	10,948	11,652
All Ages	16,341	15,635

Source: RBG PHWB Analysis of NHS Digital Hospital Episode Statistics⁵¹ (March 2023)

Crude rate of Emergency Admissions due to Respiratory Illness: All ages in 2013-18 and 2017-22

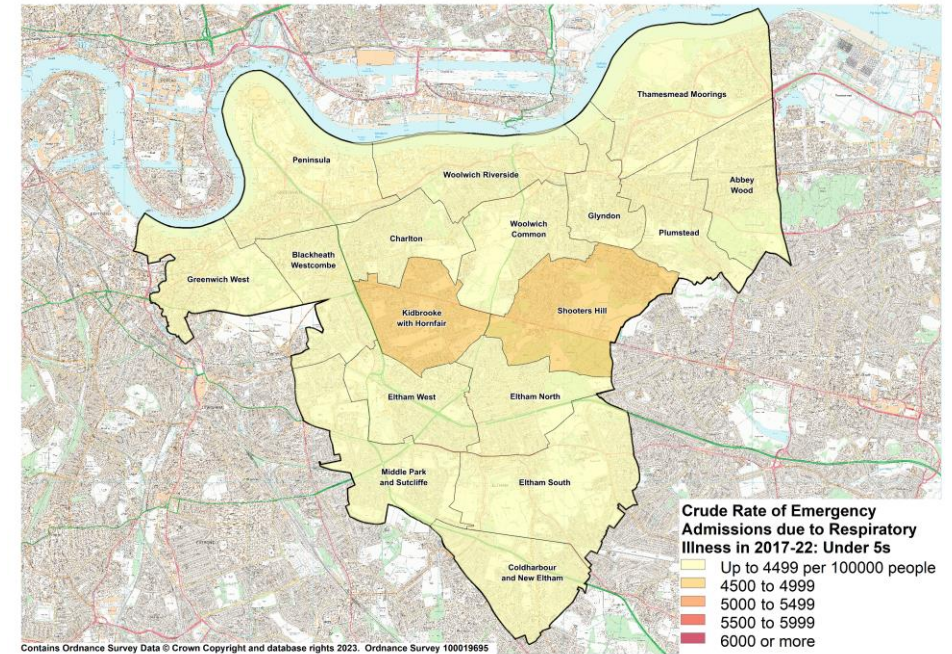
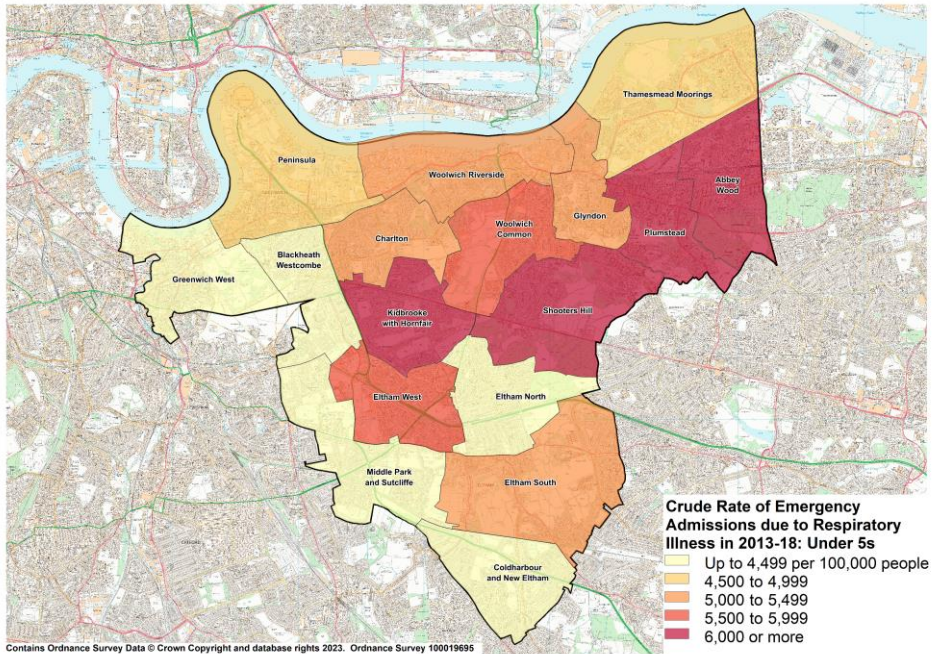


Emergency admissions due to respiratory illness in ages 0-4 fell by at least 25% in most wards

Crude Rate of Emergency Admissions due to Respiratory Illness: Ages 0-4

The number of emergency admissions due to respiratory illness amongst children aged under 5 fell by 5,393 in 2013-18 to 3,983 in 2017-22. Numbers of admissions fell by at least 25% in most wards.

The estimated rates of admissions also fell from an average of 5,107 emergency admissions per 100,000 children under 5 in 2013-18 to 3,934 in 2017-22. There was a decrease in the rate in most wards, although the lowest ward rates remained at around 3,000 emergency admissions per 100,000 children in each period. (An additional map showing variation between wards in 2017-22 is available in the Annex, Item D).

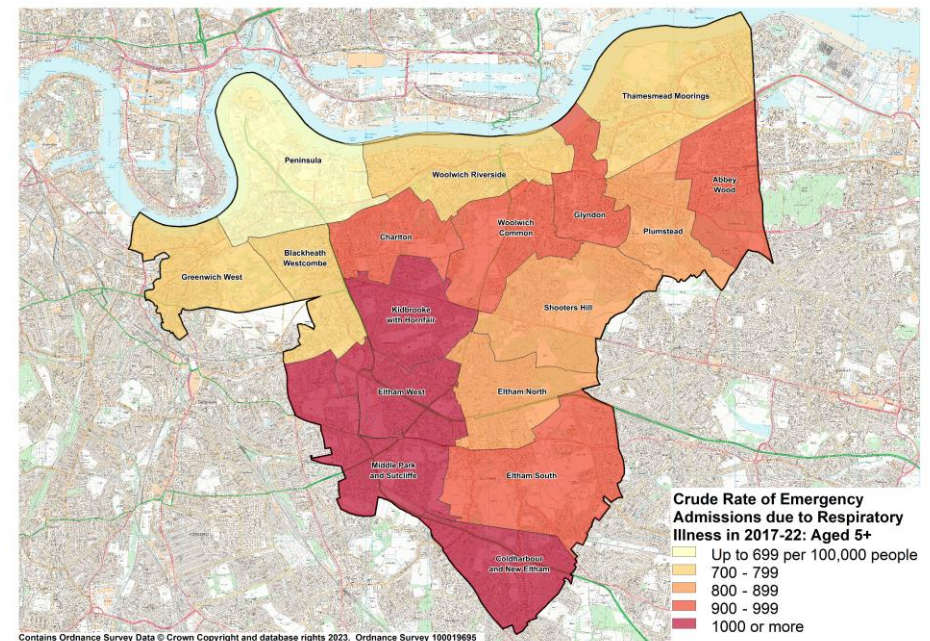
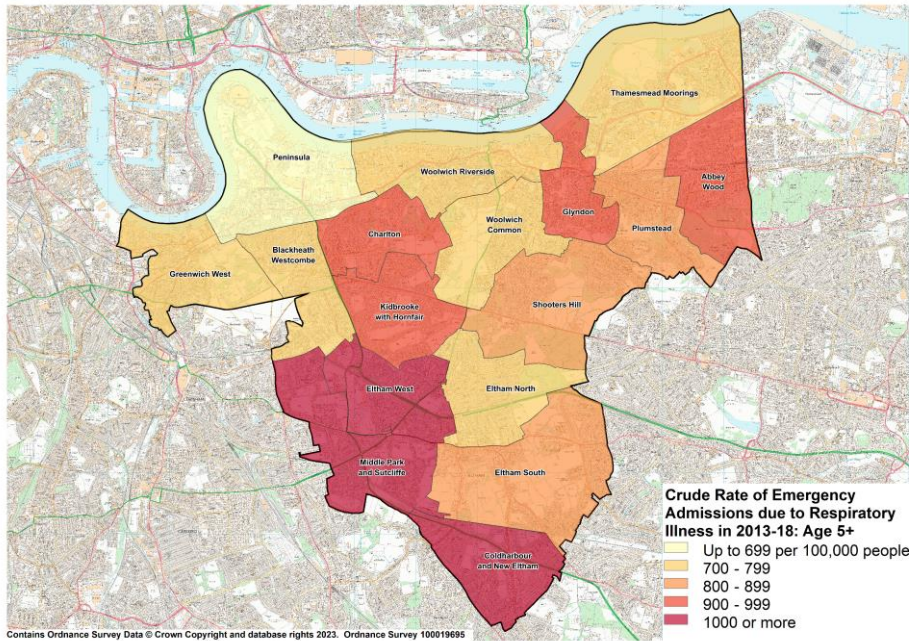


Source: RBG PHWB Analysis of NHS Digital Hospital Episode Statistics⁵¹ (November 2022 and March 2023)

There has been a slight increase in emergency admissions due to respiratory illness in ages 5+

Crude Rate of Emergency Admissions due to Respiratory Illness: Ages 5+

The number of emergency admissions due to respiratory illness amongst children and adults aged 5 or more increased a little between 2017-22 and 2013-18. The rates of admission also increased slightly – up from an average of 866 per 100,000 people aged 5 or more to 874. At ward level the largest increase in rate was in Woolwich Common ward (from 783.2 per 100,000 up to 934). The ward with the largest rate in both 2013-18 and 2017-22 was Eltham West. The largest decrease was in Middle Park ward: down from 1,124 to 1,031, although this remained one of the highest ward rates. (Further details of numbers and rates of admissions can be found in the Annex: Item D)



Source: RBG PHWB Analysis of NHS Digital Hospital Episode Statistics⁵¹ (November 2022 and March 2023)

Changing Diagnoses:

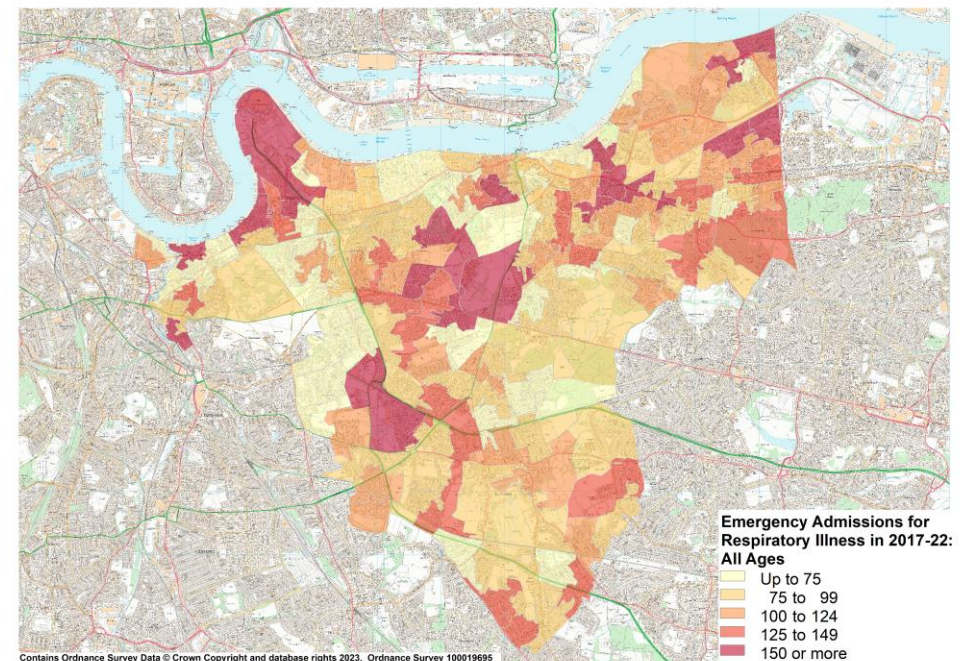
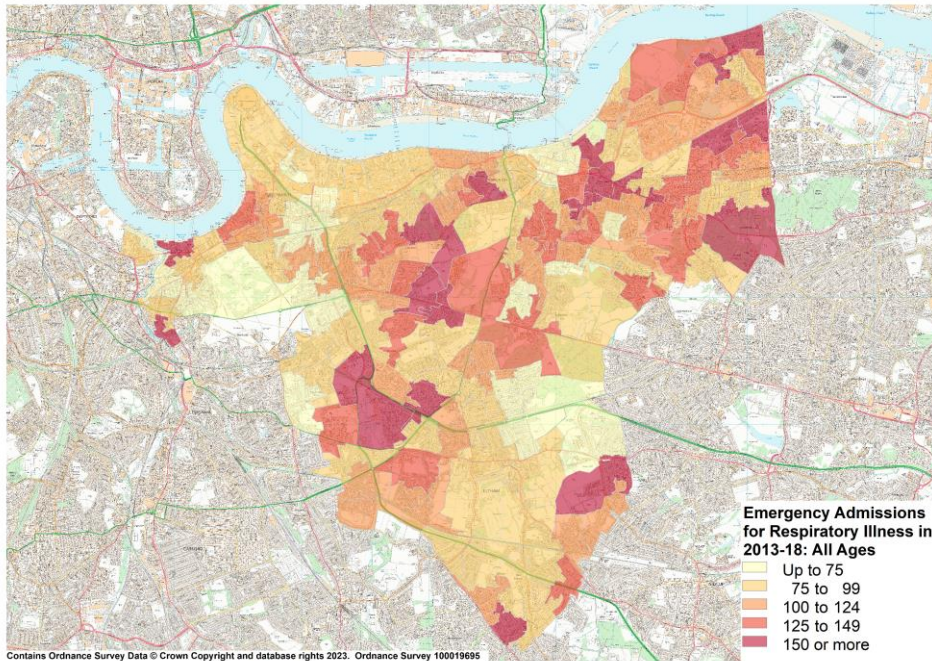
When comparing the two periods, it was found that emergency admissions due to asthma, acute tonsillitis, acute upper respiratory infections, acute bronchiolitis decreased in Greenwich. Emergency admissions due to pneumonia, COPD, and pneumonitis increased⁵¹.

Fewer admissions in the east of the borough

Rates for LSOA neighbourhoods

In the previous air quality JSNA, there appeared to be greater rates of emergency admissions due to respiratory illness in LSOA areas close to main roads. Results for the most recent 5-year period suggest there continue to be higher numbers of admissions in some of these areas⁵¹, but the Greenwich population has also grown substantially in some of the same areas. For example, there appears to be an increase in admissions in Peninsula, but around a third of the 35,000 additional residents recorded in the [2021 census](#)⁵³ live in this area. The estimated ward level rates on the previous slides do not indicate an increased rate in the Peninsula area. Admission rates for LSOA neighbourhoods cannot be reliably calculated until refreshed mid-year population estimates are released by the Office for National Statistics.

Number of Emergency Admissions due to Respiratory Illness per LSOA Neighbourhood: All Ages



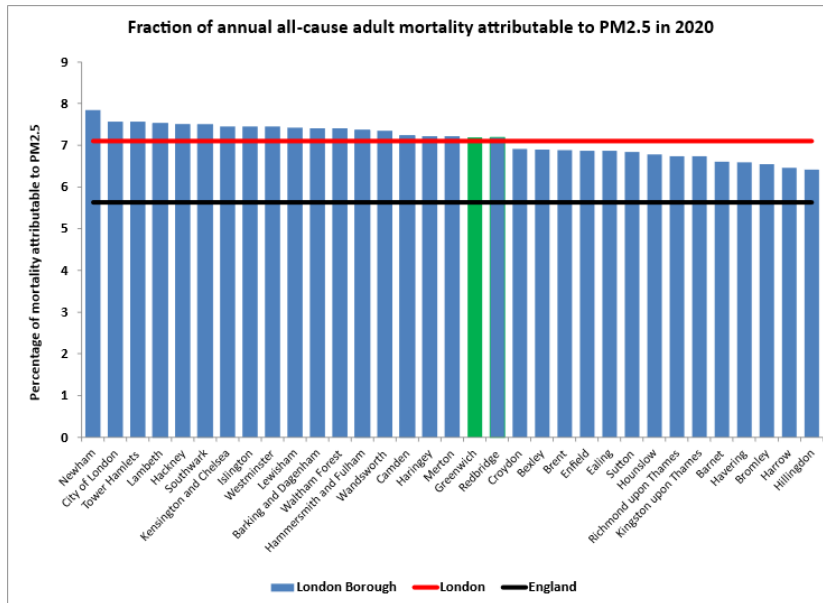
Source: RBG PHWB Analysis of NHS Digital Hospital Episode Statistics⁵¹ (November 2022 and March 2023)

In 2020, 7.2% of deaths in Greenwich were attributable to pollution from PM_{2.5}

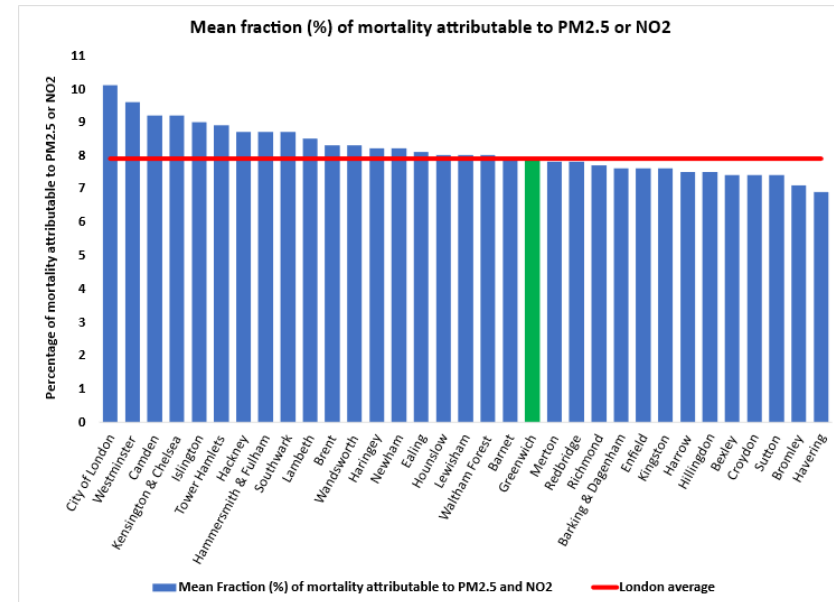
Mortality Attributable to Air Pollution

The fraction of mortality attributable to particulate air pollution estimates how many deaths were caused directly or indirectly to air pollution. Deaths from different causes are scored according to the likelihood that air pollution played a part in causing the condition and this is multiplied by the numbers of deaths from these causes in that area.

In 2020, OHID calculated that 7.2% of deaths in Greenwich were attributable to pollution from PM_{2.5}, compared to 7.1% in London and 5.6% in England⁵⁴. The results suggest that boroughs in central London have the highest proportion of mortality due to air quality, while boroughs in outer London tend to have a lower proportion.



Analysis by Imperial College estimated that in 2019 the equivalent of 3,600 to 4,100 deaths in Greater London were attributable to human made PM_{2.5} and NO₂ (61,800 to 70,200 life years lost). In Royal Greenwich, the estimate was the equivalent of 113-129 deaths^{2,55}. The chart below presents the mean fraction of mortality attributable to PM_{2.5} or NO₂ in each London borough: this is 7.9% in Greenwich. Again, boroughs in inner London tend to have a higher rates.



Source: GLA (2022)²

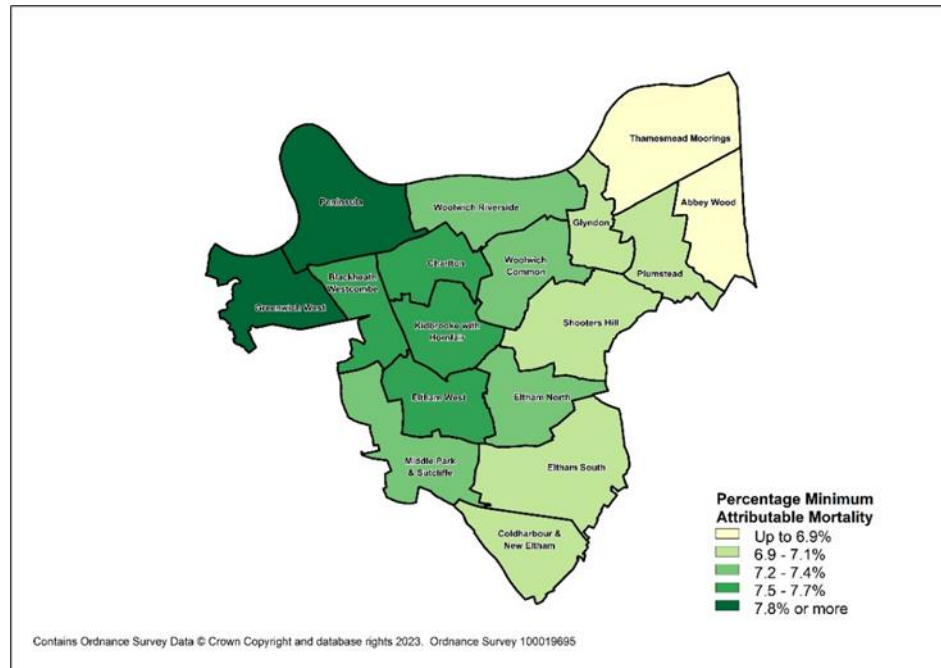
Note: to avoid double counting this method reports the larger estimate of deaths (whether attributed to NO₂ or PM_{2.5}) and therefore might be an undercount

Source: OHID (2023) [Public Health Outcomes Framework](#)⁵⁴

Fewer Londoners live in areas exceeding the UK legal limits for NO₂ or PM_{2.5}

At ward level, the mean fraction of mortality attributable to PM_{2.5} or NO₂ ranged from 6.6% of deaths in Thamesmead Moorings ward to 8.3% in Peninsula. (A map showing wards in boroughs neighbouring Royal Greenwich can be found in the Annex section E).

Minimum % of mortality attributable to exposure to PM_{2.5} and NO₂ in 2019



Source: GLA (2022)²

Note: to avoid double counting this method reports the larger estimate of deaths (whether attributed to NO₂ or PM_{2.5}) and therefore might be an undercount).

Air Pollution and Vulnerable Locations

Using LAEI^{2,31}, the GLA have estimated the number of Londoners living in areas with higher levels of pollution and the number of sites such as schools, hospitals and care homes which are in these areas. This indicates that pollution has decreased with relatively few Londoners living in areas where pollution exceeds the UK's legal limits, although no areas of London have reached the 2021 WHO targets for either NO₂ or PM_{2.5}.

By 2019, fewer than 200,000 Londoners lived in areas exceeding the UK's legal limit for NO₂ compared to just over 2 million in 2016. The number of state primary and secondary schools located in areas where NO₂ exceeded the limit fell from 450 to 20. And by 2019, fewer than 10% of hospitals were in areas exceeding the NO₂ limit⁵⁶.

By 2019, average PM_{2.5} concentrations had fallen by 19% on average across London and over a million Londoners (mostly in outer London) lived in areas where PM_{2.5} concentrations were lower than the interim WHO target of 10µg/m³. Most Londoners lived in areas where the levels exceeded this target and most educational establishments, hospitals and care homes were in areas which do.

In Greenwich the number of people living in areas exceeding the UK legal limit for NO₂ fell from over 22,000 in 2016 to around 500 in 2019 (from 7.9% to 0.2% of the population). Average PM_{2.5} fell from 13.2µg/m³ in 2016 to 10.7µg/m³ in 2019 (down 19%) and by 2019 all Greenwich residents lived in areas which met the UK PM_{2.5} limit. A small proportion of the Greenwich population (0.6%, around 1500 people) now lived in areas which met the interim WHO target of 10µg/m³.

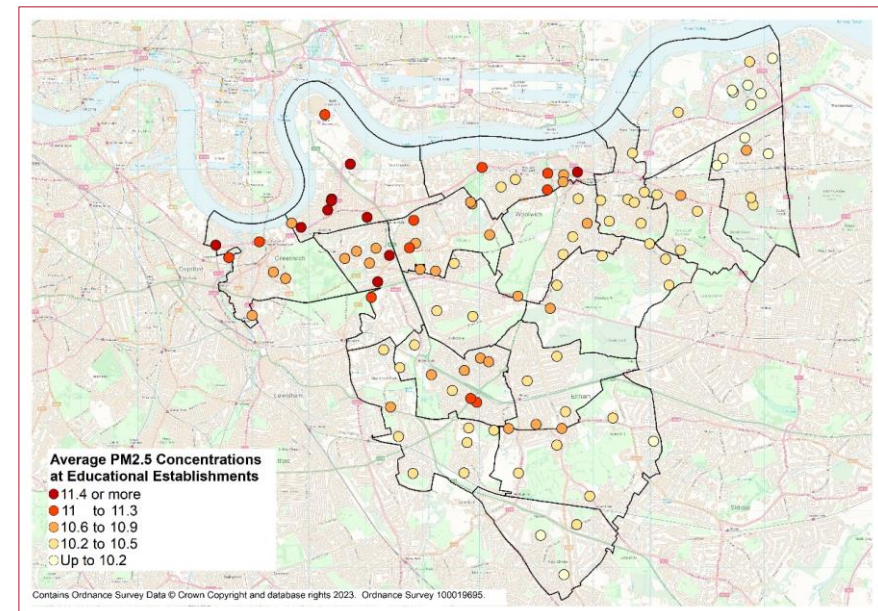
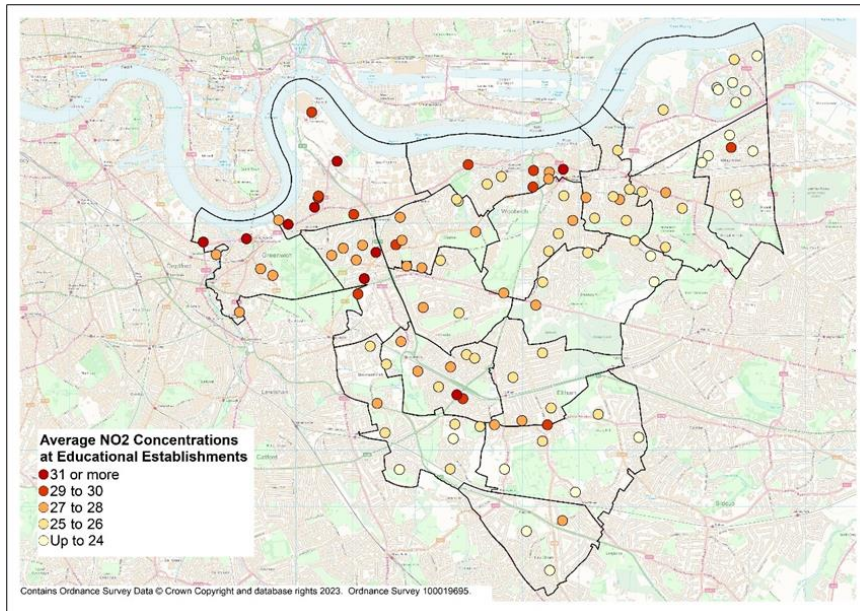
Children are developing and vulnerable but continue to be exposed to harmful levels of PM_{2.5}

Impact on children in Greenwich

In 2021, there were 56,000 Greenwich residents aged under 15 years (19.4% of the population), and nearly 72,000 children and young people aged under 20 (24.9%). Children are more vulnerable to poor air quality because their lungs are still developing.

- By 2019 the number of Greenwich children aged 0-18 who were living in areas where NO₂ levels breached the legal limits of 40µg/m³ had fallen to around 100. Compared to around 5,000 0-18s in 2016 (from 8.5% to 0.2% of 0-18s)
- By 2019, all Greenwich schools and nurseries were located in areas which met the UK targets for NO₂ or PM_{2.5}.
- No schools were in areas which yet met the WHO NO₂ or PM_{2.5} targets and nearly all Greenwich children lived in areas where they were exposed to harmful levels of PM_{2.5}.

The maps below show the NO₂ and PM_{2.5} levels across all educational sites in Greenwich (including independent schools, higher education, as well as state schools). As expected, higher rates are associated with proximity to major roads. (Graphics showing educational sites ranked by pollutant levels can be found in the Annex Section F).



People aged 65 or more are likely to live with conditions that are exacerbated by poor air quality, but most continue to be exposed to harmful levels of air pollution

Impact on older people in Greenwich

In 2021, there were 30,000 Greenwich residents aged 65 years or more (around 10.5% of the population). People aged 65 or more are more vulnerable to poor air quality because their lungs are less elastic and have less ability to filter polluted air. People aged 65 or more are also more likely to live with conditions that are exacerbated by poor air quality.

- By 2019, fewer than 100 Greenwich adults aged 65 or more were exposed to NO₂ levels which breached legal limits of 40µg/m³ compared to around 1,900 in 2016 (from 6.7% to 0.1% of people aged 65+)
- The 2019 LAEI identified that no hospitals in Greenwich were in areas which breach the UK targets for NO₂ or PM_{2.5}.
- No hospitals were in areas which met the interim or current WHO targets and nearly all Greenwich adults aged 65 or more (99.2%) were exposed to harmful levels of PM_{2.5} in 2019.

Policy context for improving air quality



The World Health Organisation (WHO) has led efforts to tackle poor air quality

Historically some of the most important gains to air quality – and associated reductions in disease and death – have been due to large-scale policy implementation. For example, in the UK, the Clean Air Act of 1956 for the first time introduced effective regulation on domestic and industrial emissions. Over the next three decades, its implementation played a key part in reducing pollutant levels¹.

This was followed by targets derived from [European Union Directives](#)¹⁰. Most recently legal requirements in the UK have been tightened under the Clean Air Strategy (2019)²⁸ and the Environment Act (2021)²⁹.

The [Clean Air Bill](#)⁵⁷, or Ella's Law, was passed by the House of Lords in 2023 and is currently making its way through the House of Commons. Potentially this would make clean air a human right and require that the UK meets pollution limits within 5 years of the bill passing. The proposals include a citizen's commission reviewing progress⁵⁸.

There are many conventions and policies which underpin the efforts to improve air quality^{1,2,59}. Some key policies are highlighted here, with more examples in Annex Section G.

International policies and targets

Internationally the [World Health Organisation \(WHO\)](#) has led efforts to tackle poor air quality, and most air quality legislation in Europe and the UK is derived from the WHO's Air Quality Guidelines. These guidelines were originally published in 2005⁶⁰, and were updated in September 2021¹⁴, following reviews of latest evidence on the harms to health, especially those resulting from exposure to PM_{2.5}. Recommendations included reducing the target for average annual PM_{2.5} concentrations from 10µg/m³ to 5µg/m³ and average annual NO₂ concentrations from 40µg/m³ to 10µg/m³. WHO also proposed interim targets that states could aim for depending on their circumstances and ability to act.

Several networks within the [United Nations](#) also undertake work relating to climate change and air pollution, including the [United Nations Economic Commission for Europe \(UNECE\)](#). UNECE is working increasingly with other UN economic regions to tackle long-range transboundary air pollution: a task force to establish UNECE's international forum is led by Sweden and the UK⁶¹. The [Gothenburg Protocol](#)⁶² has set emissions ceilings levels which are implemented in the UK through several National Emission Ceilings Regulations⁵⁹.

In Europe, the European Union's Air Quality [Directive \(2008/50/EC\)](#)¹¹ set standards for a range of pollutants considered harmful to human health and the environment. The directive includes limit values, which are legally binding and must not be exceeded, and target values, which should be reached where possible (using cost-effective measures). This directive remains part of UK domestic legislation through the [Air Quality Standards Regulation](#)¹¹. The European Union has recently proposed new targets following the latest WHO recommendations⁶³. For example, the annual limit value for PM_{2.5} would be reduced to 10µg/m³ by 2030. As our neighbours, this is likely to have a beneficial impact on air quality in the UK.

Much UK policy and regulation is derived from EU directives and continues to evolve.

UK National policies and targets

Within the UK, air quality is currently managed through multiple policies, guidance, and regulation, much of which is derived from European Union Directives. There are limits and standards for various sectors and particular products, as well as maximum ceilings for national emissions. Key examples of UK legislation and guidance includes:

- [The Air Quality Standards Regulations 2010](#)¹¹ include criteria for determining how to assess whether emissions have met the air pollution limits, including considerations about appropriate locations to take samples and the length of exposure time.
- [National Planning Policy Framework \(NPPF\)](#)^{64,65} - sets national policy for planning. All areas are required to have a Local Plans which must be consistent with the national plan. Air quality is an element that must be considered.
- [The Environment Act 1995](#)⁶⁶ mandated local authorities to review air quality and designate air quality management areas (AQMAs) if improvements are necessary to achieve the national objectives. Local authorities which have wholly or partly designated their boroughs as AQMAs must produce an Air Quality Action Plan, setting out what measures they will put in place.
- [The Clean Air Strategy 2019](#) - a policy framework for air quality management and assessment in the UK. It set out detailed proposals across a range of sectors to tackle both indoor and outdoor air pollution. The strategy covers emissions of 5 of the most damaging air pollutants: fine particulate matter; nitrogen oxides; ammonia; sulphur dioxide; and non-methane volatile organic compounds.
- [The Environment Act 2021](#)²⁸ amends the Environment Act 1995 to strengthen the existing local air quality management (LAQM) framework with responsibility for tackling air pollution now shared between 'relevant

public authorities'. It also includes amendments to the Clean Air Act 1993 to improve enforcement of local smoke control including powers to control domestic burning (i.e., wood burning stoves). The Act required the UK government to bring forward at least 2 air quality targets, one of which would be PM_{2.5}, although these were not going to be legally binding PM_{2.5} targets.

- The 2023 [Environmental Improvement Plan](#)³⁸

As a national public health priority, these are supported by:

- [Public Health Outcomes Framework](#)⁵⁴ - sets out the overall vision for public health in the UK, with a set of key indicators to identify how public health is harmed and how it is being improved. This includes an indicator showing the number of deaths attributable to PM_{2.5}.
- [UK Health Security Agency \(UKHSA\)](#)⁶⁷ - the UKHSA's mission is to prepare for, prevent and respond to threats to health. The agency has made commitments to support improvements in air quality, including providing up to date information, and improving the evidence base relating to PM_{2.5}.
- [Annual Report of the Chief Medical Officer 2022](#)¹ - this statutory report focused on air pollution in 2022, examining the effects of air pollution on health, where improvements have been made, and action is still required. It drew attention to the research occurring in this field and the contribution of engineering solutions to monitor and control air pollution now and in the future. It also drew attention the importance of indoor air pollution and changing working locations.

Much of the recent national guidance emphasises the need for collaborative action at all levels^{1,3}. All organisations and entities have a role in identifying how they contribute to causing air pollution and how they can work with others to reduce this.

Going beyond the current UK legal requirements and aiming to reach WHO's interim PM_{2.5} target by 2030.

London Regional Policy

There has long been an awareness of poor air quality in London and several thousand people died as a direct result of smog in the 1950s. Like many other large cities, recent policies have focused on transport, and as Transport for London (TfL) has responsibility for major roads and a large proportion of the transport infrastructure, this can be comprehensive^{1,2}. The Ultra-Low Emissions Zone was expanded in 2021 and is planned to increase to cover the whole of Greater London in 2023¹⁹. The aim is to discourage use of older more polluting vehicles. Other initiatives include promoting school streets and low traffic neighbourhoods (LTNs)^{1,2}.

Key policies include:

- [The London Plan 2021](#)⁶⁸ - this is the Spatial Development Strategy for Greater London. It includes an expectation that planning, and development will include improvements to air quality, reduce exposure to poor air, and minimise inequalities in levels of exposure. All new developments should take into account local air quality to ensure that they are suitable for their use and location and should be Air Quality Neutral (AQN). The largest developments will be required to take an Air Quality Positive (AQP) approach – not simply preventing air pollution, but using design, the urban realm and heating and transport infrastructure to actively improve local and regional air quality. Borough level plans are expected to be in 'general conformity' with the London Plan to ensure London wide planning is consistent and sustainable.
- [London Environment Strategy, May 2018](#)⁶⁹ - a range of measures to improve London's environment. This includes going beyond the current UK legal requirements for air quality - for example by aiming to reach WHO's interim PM_{2.5} target by 2030. Other objectives include:
 - Empower communities in London, particularly the most disadvantaged and those in priority locations, to reduce their exposure to poor air quality
 - Achieve legal compliance with UK and EU limits as soon as possible
 - Zero-emission London by 2030
- [Mayor's Transport Strategy 2018](#)⁷⁰ - reshaping transport in London using the Healthy Streets Approach and focussing on active travel:
 - One of 10 indicators for measuring the success of the Healthy Streets Approach is Air Quality
 - 80% of all trips to be made on foot, by cycle or using public transport by 2041 (up from 63%)
 - all Londoners to do at least 20 minutes of active travel daily by 2041.
- [Green New Deal and COVID Recovery \(2020\)](#)⁷¹ - Commitment to tackle climate change and improve air quality by doubling London's green economy by 2030 with increased job opportunities
- [London Local Air Quality Management Framework \(2019\)](#)^{72,73} - The London Local Air Quality Management (LLAQM) framework is the statutory process for London's local authorities to review local air quality action plans and improve air quality. The LLAQM was most recently reviewed in 2019 to ensure that boroughs are taking ambitious and co-ordinated action to meet regional air and environmental objectives.

Royal Greenwich - committed to improving health and wellbeing

Policies in Royal Greenwich

Royal Greenwich is committed to improving the health and wellbeing of residents and visitors to the borough, and one of the ways this will be delivered is through better air quality. Key policies include:



Our Greenwich²² - Royal Greenwich's Corporate Plan for 2023-27 sets out the overall vision and priorities that will guide services. This includes a focus on improving health, reducing health inequalities and improving air quality and the environment. The plan has 20 missions over 5 themes:

1. Communities
2. People
3. Place
4. Economy
5. Organisation

Examples of specific missions addressing air quality include:

- Mission 7-It is easier, safer and greener to move around the borough and the rest of London. There are fewer journeys made by diesel or petrol vehicles and fewer areas of poor air quality in the borough.
- Mission 10-Greenwich will play an active role in tackling the climate crisis and improving environmental sustainability, in line with our commitment of being carbon neutral by 2030. The net carbon emissions of RBG are reduced, limiting the borough's impact on the global climate crisis.

The plan is focused on improving the quality of life and health of local people and improving air quality is an important part of this. It builds on the previous commitments (2018-2022) to make Greenwich: healthier, safer, cleaner and greener, more prosperous, and a great place to be.

Local Plan: Core Strategy 2014-2028⁷⁴ - The Royal Greenwich Local Plan is part of the Local Development Framework. It is the key strategic planning document for the borough guiding development and planning application decisions. It runs to 2028.

The Local Plan includes strategic priorities around improving accessibility, capacity and quality of the public transport network, promoting sustainable travel in the Borough, and ensuring that the necessary physical, social and green infrastructure is provided or enhanced. The policy states that "Royal Borough is committed to reducing all types of pollution, including air pollution"; it also includes a specific policy E(c) on Air Pollution.

Another objective is to "To promote low and zero carbon developments throughout Royal Greenwich, to reduce carbon emissions and air pollution."

Carbon Neutral Plan (2021 – 2030)²³ - Greenwich have set an ambitious target to reach net zero carbon emissions by 2030. In this plan they set out the actions the Council and local community will need to take to achieve this.

Royal Greenwich - delivering sustainable growth and cleaner, greener, inclusive travel

Policies in Royal Greenwich contd...

[The Transport Strategy](#)²⁴ (2022-32) sets out Royal Greenwich's objectives for transforming transport. This includes a range of objectives and policies, supported by policy framework action plans. It is intended that the transport network will deliver sustainable growth and access to jobs, education and opportunities, and connect communities across Greenwich and beyond, while making Greenwich cleaner, greener and healthier. Improved air quality and improved health will result from reducing car use, prioritising active and sustainable travel, and encouraging use of cleaner vehicles, including public transport.

The strategy is organised over 5 themes:

1. A healthier Greenwich
2. A safer Greenwich
3. A cleaner, greener Greenwich
4. Economic Prosperity for all
5. A great place to be

Many of the objectives and policies outlined under each themes have a role in reducing transport's impact on air quality and improving health, but particularly those within 'A cleaner, greener Royal Greenwich'. Whilst policies in the 'A healthier Royal Greenwich' theme commit to improving health through for example active transport and increasing school streets and reducing health inequalities by considering accessibility and inclusion at early stages of developments.

[2019 Local Implementation Plan](#)⁷⁵ (LIP) - set out how the Mayor of London's transport strategy will be implemented within the Royal Borough, including the commitment to 80% of all trips being made by walking, cycling or public transport by 2041.

[Health and Wellbeing Strategy \(2019-2024\)](#)⁷⁶ - sets out the priorities for improving health and wellbeing in the Royal Borough of Greenwich. These include improving health in areas identified by the JSNA. This includes the Air Quality JSNA of 2016, which demonstrated the link between Air Pollution and Health.

[Air Quality Action Plan \(2017-2021\)](#)²⁵ sets out the actions that will be undertaken to improve Air Quality in Royal Greenwich. The AQAP for 2023-27 is currently being developed.

Actions to improve air quality and public health



Air pollution will continue to fall if the actions we already know work are continued and accelerated

Reducing air pollution is a complex challenge, but progress has been made. The Chief Medical Officers report on Air Quality in 2022 argued that outdoor air pollution will continue to fall if the actions we already know work are continued and accelerated. It can be expected that levels will decrease further as different sources and types of pollution are better understood and design and engineering solutions are found to resolve these. Tackling indoor air pollution will be increasingly important^{1,15}.

Organisations and authorities at all levels have a role in tackling air pollution, especially in sectors such as transport, energy, waste management, urban planning, and agriculture⁷⁷. Some actions must be taken by national government - or at least regional authorities - to drive the agenda forward and achieve consistent improvements. This might include leading on raising awareness as well as developing legal remedies or ensuring funding is available to support change^{78,79}.

As a local authority, Royal Greenwich is already integrating many of the actions that are known to contribute to improving air quality into their plans and programmes of work such as the Transport Strategy and has committed to going further and faster for example with our Carbon Neutral Plan.

From a public health perspective, the best measures to improve air quality are those which offer wider public health and wellbeing co-benefits, and which also reduce health inequalities across the population. We know that active travel such as walking and cycling not only reduces emissions but can also actively maintain or improve health. As another example, improving home insulation and creating warmer homes can achieve several goals – reducing fuel poverty, reducing emissions from use of fuel, and delivering the health and social benefits associated with a warmer home¹.

Actions should avoid disadvantaging vulnerable individuals and aim to reduce health inequalities. Accessible transport is important for people with

disabilities or who are older. There may be individuals and households who need support to make take up changes such as switching to electric vehicles or less polluting heating. For example, some drivers with disabilities will qualify for temporary discounts when the ULEZ is expanded or additional financial support for scrappage, and some NHS patients can qualify for refunds of charges⁸⁰.

Recommended actions include:

1. Going beyond national targets to reduce pollutant levels particularly PM_{2.5}
2. Monitoring stations and further action to reduce PM_{2.5}
3. Providing the public with information around the risks of air quality.
4. Providing information for people particularly at risk
5. Transport and Travel
6. The built environment and planning
7. Investigating and tackling indoor pollution
8. Investments and procurement
9. Waste management
10. Improving health and reducing baseline risk of cardiovascular and respiratory disease
11. Awareness raising
12. Engagement and inclusion
13. Communicating Benefits
14. Getting People Involved

Headline

1. Going beyond national targets to reduce pollutant levels particularly PM_{2.5}

Currently the UK government is aiming to achieve the 2005 WHO targets. For PM_{2.5} this means achieving an annual average of 10/m³ by 2040 when WHO has reduced the target to 5/m³ in 2021. While it's possible the UK targets will be strengthened in the future, additional action that goes beyond minimum requirements and reduces pollution levels earlier and faster is important^{1,81}.

The GLA has committed to hitting the interim (2005)⁶⁰ WHO targets by 2030 and where possible exceeding them, using the powers it has⁸². Other organisations and authorities in London can support this by examining ways in which it might be possible to take additional actions as well as advocating that central government lead and deliver appropriate elements at a national level.

2. Monitoring stations and further action to reduce PM_{2.5}

More monitoring stations are needed in the UK, and coverage should be more even. Insufficient numbers of stations have led to uncertainty in the results and with areas of poor air quality potentially missed. It has also been recommended that there should be a greater number of stations which monitor PM_{2.5} given the impact these pollutants have on health^{4,79,83}.

Detailed city level monitoring is also important, to inform local targets and priorities. The [Breathe London](#)⁸⁴ initiative has introduced additional lower cost static and mobile sensors which identified high levels of pollution in many areas with unexpected hotspots⁸⁵.

3. Providing the public with information around the risks of air quality.

Communicating the levels and health effects of air pollution can help people to understand why and how they can reduce their personal exposure to air pollution and protect themselves and their households.

Although there are sources of information available (such as UK-Air website), it has been reported that there is still low public awareness of these sources. It has also been found that the information on monitoring sites is not always easy for people to understand and to know what action they could take in response^{4,67,78,79}.

There should be further action from central and local government to:

- publicise available sources
- increase the accuracy of results by increasing the number of air quality sensors
- work with the public to develop reports that are easy for members of the public to understand and act on, especially those who are most likely to need them

Healthcare and other professionals can raise awareness of the role of indoor air pollutants

4. Providing information for people particularly at risk

Providing information for people particularly at risk –

Individuals and groups at increased risk from air pollution will benefit from targeted information and support from healthcare and other professionals. (This includes people suffering from cardiovascular or respiratory disease, women who are pregnant and households caring for infants under 12 months old).

One of the findings of the coroner's report into the death of Ella Kissi-Debrah found there had been insufficient understanding of these issues among clinicians and that more training might be needed⁴.

Healthcare and other professionals can raise awareness of the role of indoor air pollutants in triggering or exacerbating asthma, other respiratory conditions or cardiovascular conditions and signpost clients to further sources of support^{3,36,86}. This advice might include:

- Avoid or reduce strenuous activity in highly polluted locations, or when pollution levels are raised -especially if experiencing symptoms such as sore eyes, a cough or sore throat.
- Increase use of an asthma reliever inhaler as necessary.
- Close external doors and windows facing busy streets when traffic is heavy or congested.
- Avoid allergens (where these trigger asthma) such as household sprays and air fresheners
- Avoid or reduce activities that produce particulate matter such as using open solid-fuel fires or candles (and keep rooms well-ventilated if they use them).
- Not to smoke indoors or in enclosed spaces, especially around women who are pregnant, or people caring for babies

They can signpost clients to air pollution alerts and encourage them to follow them and take recommended actions where this is possible. This might mean ensuring clients with means to access such reports (eg a phone to receive text messages). Sources of Information about air pollution levels include:

- Defra's [UK air](#) website provides current and forecast levels of air pollution and health advice
- social media updates ([DefraUKAir](#) on Twitter)
- a free air pollution helpline (0800 55 66 77)

Frontline health and care professionals can also register for text messaging services such as AirText in London

Where clients have repeated or worsening respiratory symptoms such as a cough or wheezing, health professionals can ask about housing conditions and ventilation, and help clients request a housing assessment from the local authority³⁵.

Increasing use of less polluting methods of transport is important in reducing air pollution

5. Transport and Travel

There are a range of recommendations for transport and travel^{1,2,3}. Increasing use of less polluting methods of transport, including electric vehicles (EVs) is important in reducing air pollution, as is reducing the number of vehicles that are on the road at any one time. This can be supported by:

- Improving and increasing infrastructure for Electric Vehicles (EVs) including charging points
- Financial incentives to swap to EVs such as preferential access to parking or reduced parking costs.
- Discouraging use of more polluting vehicles in general or at particular times or locations – where they remain in use emissions will be spread over the day. Examples include:
 - Congestion Charging Zones (CCZs) – these are intended to discourage traffic at busy times. London’s was introduced in 2003.
 - Low Emission Zones (LEZ/ULEZ) – drivers are charged when travelling in older or more polluting vehicles within these areas to encourage moves to newer models. In London there has been some financial support to help drivers do this⁸⁷.
 - Low Traffic Neighbourhoods – remove all through traffic from selected areas⁸⁸.
 - School Streets – traffic is prohibited close to schools at particular times. These restrictions can also be applied close to other busy and vulnerable locations.
- Reducing emissions from transport services and fleet
 - National and local public authorities should continue to replace their vehicles and fleet with the latest least polluting models and should look to their contractors and the procurement process to encourage this more widely³⁶.
 - Providing infrastructure including sufficient charge points for EVs in the fleet
 - introducing and training staff in fuel-efficient driving
 - join voluntary schemes such as the [ECO Stars Fleet Recognition Scheme](#)⁸⁹ – which provide recognition, guidance and advice to operators of goods vehicles, buses and coaches, with the aim of reducing emissions and fuel consumption.
 - Monitoring driving style through available technology
- Reducing the total number of cars within the borough by:
 - Promoting car club membership⁹⁰ – these can be a good incentive to reduce number of vehicles owned and mileage per household. Car club vehicles also tend to be more efficient models.
 - increasing the number of passengers per vehicle through car sharing - reducing the number of vehicles on the road at any point
 - expanding controlled parking zones to ensure fair access to available parking spaces.
- Encouraging improved driving technique and use of vehicles
 - for example, anti-idling campaigns which ask drivers to turn engine off while not moving. NICE³⁶ has recommended the use of bylaws and other action to support this especially at locations such as schools and hospitals.
 - Avoiding stop start congestion and creating a steadier flow of traffic
 - Good vehicle maintenance to optimise use of fuel
- Promoting change in business and industry
 - Encouraging use of rail for freight
 - Encourage ‘last-mile’ delivery strategies to encourage clean transport in urban areas.
 - Encourage businesses to consolidate deliveries, with more goods transported in fewer vehicles.

Increasing use of less polluting methods of transport is important in reducing air pollution

Transport and Travel cont...

- Making improvements to public transport
 - accelerating the electrification of public transport, including railways or investigating other lower pollution technologies where this is not possible
 - Improving practices such as stopping diesel trains being left running in enclosed stations.
 - reduce emissions and from other forms of transport and related infrastructure including railways and at stations, watercraft, and ground vehicles at airports. Identifying actions to reduce these where possible, including any processes that can be electrified.

EVs are not pollution free - they require power and produce some emissions from tyres and brakes¹. They can also be heavier vehicles resulting in more impact to the road surface. Recent reports have suggested parking facilities will need to be remodelled to accommodate them in larger numbers⁹¹. Some of these issues might be resolved in the future - new technologies may help reduce non-exhaust emissions of PM_{2.5} such as low-emission tyres, or by smoother driving from autonomous vehicles.

EVs will be required for certain purposes such as public transport and essential services, but rethinking transport as a whole is necessary with more priority given to pedestrians and to active travel⁹². Active travel, such as walking and cycling, produce fewer emissions and can also positively improve health^{1,3}. It can:

- increase fitness levels and reduce the risk of chronic illness
- lead to less road traffic and fewer road traffic accidents⁹³
- Increase social interactions and connectivity
- Provide affordable options for transport and exercise as the cost of living increases

- Ensures travel is sustainable - there are more travel options whatever the external pressure e.g. increased price of fuel³⁰

Fewer private vehicle journeys and less congestion would reduce emissions, and by reducing PM_{2.5} on urban roads would likely contribute to reducing health inequalities. The benefits increase if active travel alternatives are used. Active travel can be supported through:

- Designing [healthy streets](#)^{94,95} and neighbourhoods which encourage people to walk and cycle
- Ensuring streets are safe and accessible to all with pedestrian-friendly pavements
- Providing cycling infrastructure including segregated cycle lanes and secure bike racks
- Responsible and safe use of dockless bikes and e-scooters
- delivering cycling lessons or cycling proficiency training
- working with schools, normalising active travel
- Working with employers to support their staff and business to transition to forms of active and lower emission travel including electric vehicles, e-bikes and e-cargo bikes
- Working with employers to discourage personal car use such as workplace parking levies⁹⁶
- providing and promoting walking routes across multiple locations
- Provision of a reliable public transport network is a proven way to encourage shift from cars. Walking to public transport provides opportunity for physical activity and is an easy way for many to build this into daily life. Most people can begin walking for short journeys straight away.

Increasing use of less polluting methods of transport is important in reducing air pollution

Transport and Travel cont...

- Car-free days – these have been successful in introducing active travel and reducing car use
- 20MPH zones improve road safety and can also reduce emissions in areas characterised by stop-start traffic³⁶. This will encourage active travel

Certain options may now be more appealing. The COVID pandemic has led to many people working at home and this can potentially reduce daily vehicle use, including demand for car parking spaces at work. Car clubs might become more attractive to people who no longer feel they need a vehicle every day. At the same time working from home can increase exposure to indoor pollution and reduce levels of incidental physical activity. There might be an increased need to ensure people include some physical activity including active travel in their day. This can be supported by good urban design that encourages people to be active outdoors.

6. The built environment and planning

Urban planning should be used to influence uptake of active transport and to reduce air pollution^{1,36,41,68} especially near vulnerable locations such as schools, children's play areas and hospitals. The layout of the built environment can influence:

- Level of pollution - uptake of cycling and walking will lead to fewer emissions
- Flow of pollution - wind flow within the 'urban canopy layer' – building design and location has the potential to limit the movement of pollutants or support diffusion.
- Exposure to pollutants - new developments can be located at an appropriate distance away from sources of pollution or mitigations can be put in place to reduce the exposure to pollutants.

Planning rules can:

- Require minimum distances between buildings and roads
- Increase green spaces
- require interconnecting and attractive areas to encourage walking, outdoor play, and use of public transport.
- Avoid situating hospitals, care homes, schools and playgrounds near polluted areas or take additional steps to prevent and disperse pollutants where these are located^{36,97}.
- Locate amenities at the neighbourhood level to reduce unnecessary travel⁹⁸
- build a walking and cycling network that connects with other public transport networks.
- Invest in public transport infrastructure, making it an attractive and

convenient everyday choice.

- Avoid roadbuilding and road widening

Green infrastructure^{99,100} can enhance both new and old developments if the right solution is used for the location. Trees have potential to reduce gaseous pollutant levels at local sites and across cities and they can be used as barriers preventing pollution reaching homes, but in some cases, they may reduce wind speeds and trap pollutants within 'air pollution hotspots'.

Other green infrastructure includes:

- Green screens and green roofs. These involve growing vegetation on rooftops, walls or other screens. They can also provide other benefits such as noise reduction, improved aesthetics, etc.
- Small parks. These have also been shown to be effective at reducing a range of pollutant levels.

Emissions from buildings - buildings account for a substantial proportion of NO₂ emissions. When planning new developments or regenerating older stock:

- replacement of old commercial and domestic boilers with new ultra-low NO_x models;
- Improved building energy efficiency to reduce energy demand, through existing building retrofits and high standards for new buildings.
- using planning processes to ensure new developments are air pollution neutral or better.

7 Investigating and tackling indoor pollution³⁵

- Raise awareness of sources of indoor pollution and how to remove or reduce these – promote what is already happening and why.
- Work with partners to identify issues and areas of concern in public indoor spaces
- Improved standards for rental properties and action against landlords
- Promotion of support for private householders to make improvements to their homes
- Support improved design that maximizes both warmth and ventilation.
- Taking action on damp and mould in rental properties
- Remind the public of the importance of safety checks for gas appliances and provide advice on phasing out of these appliances. Promote cleaner solutions for cooking, heating and lighting and replace these within own infrastructure

Action on woodburners and smoke: It is recommended that their use is discouraged, and that where they are used people are aware of the least polluting models and options for use¹⁰¹. It may be possible to limit their use on days with low wind speeds, especially in smoke control areas.

8. Investments and procurement

Central and local government and other public bodies may be able to use the contracting and procurement process^{102,103,104} to influence emissions by:

- reducing investments in polluting industries and activities
- requiring services and external providers are working towards the same standards

- using their purchasing power to showcase innovation
- encourage and support greener industrial and agricultural practices through purchasing decisions.

Power Generation - cities and regions can drive alternative power generation by encouraging use of low-emission fuels and renewable sources (like solar, wind or hydropower)^{102,103}. For example:

- developing co-generation of heat and power
- lead by example by installing solar on municipal buildings and use city wide and regional purchasing power to procure clean energy and stimulate clean energy generation in the region.
- provide financial incentives for the installation of renewable energy on buildings.
- consider updating planning regulations to require solar on new buildings so that rooftop solar panels and other on-site power generation becomes an integral part of the area's energy system.
- building-scale renewable energy production can be linked to EV charging points and further contribute to zero emissions.

Industry¹⁰² -Cities and regions should take action to increase and incentivise¹⁰² the use of clean technology and avoidance of pollution by industry.

9. Waste management

Develop effective strategies for waste reduction, waste separation, recycling and reuse or waste reprocessing; as well as improved methods of biological waste management. Avoidance of burning of waste and enforcement of smoke free zones^{101,102}.

10. Improving health and reducing baseline risk of cardiovascular and respiratory disease

People who are generally well are on balance better able to manage the impact of short-term exposure to air pollution by maintaining their health and fitness through regular moderate exercise such as walking and cycling and eating a healthy diet¹.

Health professionals and public health teams provide support the public to reduce their risk of developing respiratory or cardiovascular disease by programmes aimed at smoking cessation, maintaining and increasing levels of activity and healthy eating, as well as promoting good management of hypertension and COPD.

In neighbourhoods affected by air pollution, or which are known to have greater levels of socio-economic deprivation, increasing people's opportunities to exercise, to reach green spaces, and to access healthy foods, can contribute to maintaining and improving health.

This is not necessarily the case for people already living with existing chronic illness such as COPD who may need support to maintain their health while minimising their exposure to air pollution⁸³.

The health sector also has a role in exploring the impact of air pollution on health of local population and whether measures taken are making a difference to everyone in the population, by reducing health inequalities and the impact on people with long term health conditions⁵⁸.

11. Awareness raising

There is a need to provide clear and consistent communications to the public. Ideally this would be led by central government with all departments and agencies working consistently towards the same goals^{4,78,79}.

- the population needs to understand what needs to happen and why,
- they need to know how pollutants are created, and how they affect the body
- information needs to be accessible and easy to understand
- they need to know steps they can take to reduce their emissions and to reduce their exposure, and what the benefits will be

Although certain actions can only be taken at a communal level, there are still many smaller actions individuals and households can take. For example:

- checking air quality levels at [LondonAir](#), DEFRA's [UK-Air](#) or other sources and following recommended actions based on the [Daily Air Quality index](#)
- walking or cycling especially when journeys are less than a mile, and using quieter roads where possible when walking and cycling
- using public transport
- avoid driving as much as possible, especially in rush hours (to avoid congestion)
- driving economically to use less fuel and reduce the number of collisions. This also saves money.
- turning off vehicle engines when waiting, especially when other people are nearby or when waiting for children during the school run.
- Stopping smoking, especially during pregnancy or when indoors
- Turning down central heating and turning off appliances when they are in standby or not in use
- following Defra guidance¹⁰⁵ on the best use of open fires and wood-burning stoves when using these can't be avoided completely

- keeping homes well aired by opening windows as much as possible – for some residents this might need to be when pollution outside is at its lowest levels
- Cutting down on household chemicals or trying chemical-free and allergy friendly products.
- consider lower-emission alternatives when they are buying their next car, updating their home heating system, or carrying out other home improvements.
- Look out for government grants or other incentives for installing energy-saving measures and home electricity generation using solar panels or wind turbines can reduce use of fossil fuels

See also Annex Section H

12. Engagement and Inclusion

Many people are already concerned about the impact of air quality on their and their family's health, and support measures to improve air quality. Polling by London Councils has consistently shown a high percentage of respondents think it is a priority¹⁰⁶. Feedback when developing Our Greenwich²² demonstrated that air pollution and an improved environment remain key concerns of the Royal Greenwich population.

Ongoing consultation is essential to keeping residents informed and building support for measures that may need to be taken. It is important to engage with the public to hear their concerns and experiences and involve them in developing solutions, especially people and communities most affected by poor air and health inequalities.

It is important to demonstrate leadership and empower communities rather than expecting individuals to change behaviour. Although there are steps most residents can take, combatting air pollution more broadly is often outside the control of individuals, particularly those most vulnerable to its effects^{3,79,102,107}.

13. Communicating Potential Benefits

Important to focus on benefits that tackling air pollution can bring^{104,108}. Such as:

- improved health and wellbeing³,
- affordable warmth,
- a stable energy supply
- reduced risk of flooding and damage to property
- environmental health and diversity⁹⁹
- new job and career opportunities – Green New Deal⁷¹
- promotion of training and apprenticeships in relevant fields.

Deliver marketing campaigns to break down barriers to use of public transport, and active travel. Focus messaging on what the region will gain from increased road space for people walking and cycling, rather than what car users will lose.

14. Getting People Involved

Members of the local community and schools may be keen to join in with programmes measuring pollution such as the Breathe London Community Programme⁸⁴ or sign up up to the Asthma. UK [Clean Air Champions Scheme](#)¹⁰⁹.

Royal Greenwich can draw on their [Community Champions](#)¹¹⁰ or might consider developing a specific volunteer pathway for Greenwich residents

Involvement of voluntary and community groups will be important in raising awareness, identifying barriers and delivering the changes needed.

What action is Greenwich taking?



Royal Greenwich has been at the [forefront of controlling air pollution](#) for many years. For example, becoming the first local authority in the country to declare a Low Emission Zone (LEZ), for the Greenwich Peninsula, in 2004, and the borough continues to take forward action on a number of fronts^{13,111}, including:

- maintaining the largest real-time monitoring network in London with ten automatic monitoring station sites, with supplementary monitoring such as:
- placing two diffusion tubes outside Hawksmoor primary school in August 2019, as part of the Public Health ‘Superzone’ initiative.
- Working with the Port of London Authority (PLA) and neighbouring boroughs to assess the impact of short-term, local river activity on air quality in the Greenwich area

preventing emissions from developments and buildings by:

- working with developers to reduce emissions from demolition and construction, with greater focus on prevention of emissions than remedies for emissions.
- ensuring compliance of NRMM with LEZ standards
- require an Air Quality Neutral Assessment for qualifying schemes
- moving away from offsetting payments as a means to increase compliance and balance emissions
- securing green spaces in new developments in line with London Plan/Local Plan policies and supplementary guidance.
- reviewing the most appropriate locations for increased development of housing and other facilities in the borough to ensure appropriate levels of development.

Delivering improvements in energy efficiency by:

- setting a carbon reduction target of Net Zero by 2030 for the borough’s emissions with an evidence base detailing the trajectories to achieve the target.
- The Council has supported a project to install renewable energy at the Thamesmere and Coldharbour Leisure centres, and through its Capital Programme has delivered energy efficiency measures on its own housing stock, including retrofitting six properties with increased loft insulation and upgrading over 627 boilers.
- installation of heat pumps at the Ernest Dence Estate²⁷, alongside other improvements such as loft insulation, and low energy LED lighting. Heat pumps are a low carbon and cost-effective alternative to traditional gas boilers .
- completing preparations for installation of solar panels at Greenacres School.
- nearly 900 low or zero carbon council homes completed or under construction by the award-winning Greenwich Builds²⁶ programme. Ten percent of the new homes will be wheelchair accessible

Working with schools to:

- Increase active travel through the [TfL STARS](#)¹¹² accredited travel planning programme to reduce car use.
- working with schools to create four permanent school streets (which reduce vehicles near the school, increase active travel and promote exercise), and to trail several more schemes.

Taking action on fleet and logistics –

- continuing to upgrade Royal Greenwich's fleet to lower and zero emission vehicles, including over 30 electric vehicles, and planning increased power capacity at the Birchmere Centre to enable further electrification of the fleet.
- Aiming to gain accreditation for RBG's fleet and fleet management against schemes such as the [Fleet Operator Recognition Scheme \(FORS\)](#)¹¹³, ideally to Gold level. Several vehicles have already reached the silver standard.
- updating procurement policies to require suppliers with large fleets to have attained at least the Bronze FORS accreditation and Construction Logistics Cycle Safety (CLoCS) accreditation.
- investigating possibility of using freight consolidation centres, and opportunities for cycle freight

Improving green infrastructure

- increased planting of trees around Greenwich – more than 2000 trees planted in the last four years.
- £1m of investment to enhance parks and the planting of more than 2000 trees in the last four years.
- increasing access to segregated cycleways

Working with public health to:

- provide a new Royal Greenwich air pollution website with advice for the public and businesses about what they can do to help cut air pollution.
- deliver the Stay Warm Stay Safe programme, which includes an energy efficiency assessment and support to reduce fuel bills where residents are over 60 or have other vulnerabilities.

Taking action to support best use of vehicles

- Discouraging unnecessary idling of vehicle engines (e.g. through anti-idling campaigns)
- Further expansion of 20 mph limits on residential roads

Royal Greenwich Transport Strategy

The Royal Borough's recently adopted [Transport Strategy](#)²⁴ includes a range of objectives and policies supported by Policy Framework Action Plans. Most of the themes in the strategy have a role in reducing transport's impact on air quality and improving health with theme 3: 'A cleaner, greener Royal Greenwich' explicitly relating to air quality.

Transport Strategy Themes and Objectives:

Theme 1: A healthier Greenwich	Theme 2: A safer Greenwich	Theme 3: A cleaner, greener Greenwich	Theme 4: Economic prosperity for all	Theme 5: A great place to be
Our transport network will make it easy for people of all ages and abilities who are living, working, and visiting Greenwich to be healthier.	Our transport network will be safer for everyone, however they choose to travel.	Our transport network will result in cleaner air through reducing car use, prioritising active and sustainable travel, and encouraging cleaner vehicles. Greenwich's transport network will be resilient to climate change and future trends and uncertainties.	Our transport network will support good growth and sustainable access to a wide range of services, jobs and opportunities. Our transport network will keep people moving, enabling people and goods to move efficiently.	Our transport network will improve the connectivity, communication, and collaboration in our communities, now and in the future.
Objective 1.1: Improve the accessibility of our streets	Objective 2.1: Reduce the risk of being killed or injured on our streets, for everyone, especially people walking and cycling	Objective 3.1: Reduce emissions from transport in the borough	Objective 4.1: Increase accessibility to a range of jobs, services and opportunities	Objective 5.1: Improve the connectedness and inclusivity of our communities
Objective 1.2: Increase the proportion of people who choose to walk and cycle for their everyday journeys	Objective 2.2: Help everyone to feel safe on our streets and in our public places, especially people walking, cycling and using public transport	Objective 3.2: Create and manage a more resilient transport network	Objective 4.2: Use our streets more efficiently and effectively	Objective 5.2: Create more streets and spaces that help bring people together
Objective 1.3: Reduce car dependency in the borough				Objective 5.3: Support the visitor economy with improved accessibility to, from and within the borough

The following Policies in the ‘A cleaner, greener Royal Greenwich’ theme are directly linked to improving air quality:

- Policy 3a - Reduce harmful emissions from transport in the borough
- Policy 3b - Accelerate the transition to low and zero emission vehicles
- Policy 3c - Transition the Royal Borough’s fleet to zero emissions vehicles
- Policy 3d - Promote the use of car clubs in the borough to support a reduction in car use and ownership and the use of lower emission vehicles when necessary
- Policy 3f - Work with partners to support and harness the benefits of new and emerging transport technologies and trends

The following Policies in the ‘A healthier Royal Greenwich’ theme are directly linked to health improvement:

- Policy 1a - Ensure our streets and public places are accessible and inclusive
- Policy 1b - Create streets and places that encourage people to walk and cycle
- Policy 1c: Promote walking and cycling in the borough, through our health and walking activities
- Policy 1d - Increase personal bicycle ownership, and improve the availability of and access to cycle hire in Royal Greenwich
- Policy 1e - Increase the amount of good quality cycle parking in Royal Greenwich
- Policy 1f - Use the road user hierarchy set out below to appraise transport schemes in the borough
- Policy 1g - Reduce through traffic by delivering schemes which encourage

walking and cycling and to discourage driving, such as school streets and Traffic Management schemes

- Policy 1h - Share the costs of street space fairly in the Royal Borough of Greenwich by exploring schemes such as a workplace parking levy
- Policy 1i - Expand the coverage of Controlled Parking Zones (CPZ's) to the whole borough

Benefits delivered in partnership with the GLA and TfL

Royal Greenwich has also benefitted by many actions delivered by the GLA and TfL² such as:

- ULEZ has led to increase in large and heavy vehicles operating in London which meet Euro VI standards. Up from 48% in February 2017 to 95% in August 2021.
- £61m in funding for scrappage schemes helped replace nearly 15,000 older, more polluting vehicles.
- Since 2021 all buses in TFL’s 9,000-strong core bus fleet meet or exceed the cleanest Euro VI emission standards. There are over 600 zero emission buses in the fleet – the largest in Western Europe. Bus-related NOx emissions decreased by 90 per cent.
- Phasing out diesel taxis. All newly registered taxis to be Zero Emission Capable (ZEC) and there are now over 5,000 ZEC taxis, including more than 100 fully electric taxis in operation in London. This is from a baseline of zero in 2017.
- Since 2023 newly licensed private hire vehicles must also be ZEC - with a 10-year age limit, this should ensure all will be by 2033.

Introduction of the Non-Road Mobile Machinery Low Emission Zone (NRMM LEZ) which has reduced construction related emissions since 2016

- £1m spent on air quality action at schools and nurseries, including auditing the air quality at 50 primary schools and 20 nurseries in the city's most polluted areas.
- Expanding London's EV charging infrastructure with over 300 rapid charge points and 3,000 standard charge points installed. London now has over 600 rapid charge points and 8,000 residential charge points, a third of the UK's total.
- London's first rapid charging hub at Stratford International with 2 more planned including at Glass Yard, Greenwich.
- 300 School Streets delivered by March 2021 delivering safer, less polluting, and more active journeys to school,
- Supporting the Vehicle Idling Action behaviour change campaign which runs school workshops and delivers training across London.
- TfL developed the StreetSpace for London programme, to provide safe and appealing spaces to walk and cycle as an alternative to car use. By March 2021, almost 100km of new or upgraded cycle routes were built, and 86km of bus lanes were upgraded to 24/7.
- Breathe London Community Programme⁸⁴ supplying low cost air quality monitoring equipment
- The Daily Air Quality Index (DAQI) / Mayor's Air Quality Alerts and airTEXT offers information on levels of air pollution and health advice. This is circulated through wide variety of communication methods, including more than 2,500 countdown signs at bus stops.

Recommendations



1. Keep on doing what we are doing!

The CMO's 2022 report on Air Pollution emphasised the need to continue to do what we know works and accelerate actions. Improving air quality should be the responsibility of everyone from individuals to large scale organisations. Royal Greenwich has set ambitious targets and has already begun to set out how these will be delivered. For example, the Royal Greenwich Transport Strategy²⁴ seeks to:

- increase opportunities to take part in active travel and leisure
- reduce private car use, and accelerate the transition to low and zero emission vehicles, including working towards a fully zero emissions fleet
- creating streets and places that encourage people to walk and cycle,
- Consulting with disabled people and other relevant groups to ensure accessibility and inclusion are considered at an early stage as standard

2. Improving monitoring of Air Quality

- Review number and location of monitoring stations in Greenwich, especially those monitoring PM_{2.5}, and increase these where necessary.
- Increase and review location of stations in response to new developments in and around the borough
- Work with GLA or London wide campaigns to increase these in London, especially stations monitoring PM_{2.5}. There are few monitors in some neighbouring boroughs and may be missing hotspots and further opportunities to reduce emissions
- Identify opportunities to work with Greenwich residents increasing monitoring coverage e.g. joining Breath London Community Programme

3. Public Engagement and Inclusion

- Further action to raise public awareness of the issues and what they can do to protect themselves and support change
- Promote schemes such as vehicle scrappage, and support to install energy-saving measures and home electricity generation
- Use a variety of channels to promote this agenda including Community Champions and local networks
- Build on Our Greenwich – build support via public engagement. Involve a wide range of people, communities and groups, when developing and planning solutions. This could include schools, care homes, sheltered housing, etc

4. Communicating benefits of action to be taken and offer tangible examples

The potential benefits include new job and career opportunities for our residents. Royal Greenwich could work with partners to

- promote training and apprenticeships and employment opportunities in relevant fields.
- work with local educational establishments and training schemes to identify training and development opportunities
- Consider offering bursaries or other support for local residents taking up relevant courses

5. Providing additional support to people at risk

Working with our partners to :

- Disseminate information to other professionals about needs of people at risk and resources/services available to them in Royal Greenwich
- review training available about air pollution to staff working in health and social care locally, and ensure they can provide appropriate guidance and identify clients who might need signposting to other sources of support

6. Improving health and reducing health inequalities

- The health sector and public health to support improving baseline health of the population, including access to healthy exercise and food
- To continue to deliver smoking cessation support
- Taking action to reduce health inequalities, including targeted work with our most vulnerable groups ([Core20Plus5](#))¹¹⁴.
- Undertaking further analysis of hospital admissions and mortality due to conditions relating to air quality to see if actions appear to be improving health outcomes.

7. Indoor Pollution

- Raising awareness /taking action on wood burners and burning/smoke
- Continue to raise awareness of the impact of second-hand smoke on children, vulnerable, those with long term conditions and pregnant women
- Taking action to tackle damp and mould and to improve ventilation in the rental sector using new and existing regulations.

- Investigating impact of commercial kitchens and opportunities to reduce and contain emissions

8. Considering using contracting and purchasing power to influence change, showcase innovation and make less polluting investments

- Encouraging use of EVs in fleets and active travel
- Apply powers available to maximise supply of low and zero emission housing.
- Encourage the use of technologies such as solar panel on public buildings and incentivise these elsewhere

References



1. GOV.UK (2022) Chief Medical Officer's Annual Report 2022 – Air Pollution
2. Greater London Authority (2022) [Air Quality in Royal Greenwich: A Guide for Public Health Professionals](#).
3. Public Health England (2018) [Health Matters: Air Pollution](#)
4. Barlow, P (2021) Regulation 28 Report To Prevent Future Deaths (Coroner's Office for Inner South London)
5. NHS Digital (2022) [Quality and Outcomes Framework 2021-22](#)
6. Public Health England (2018) Estimation of costs to the NHS and social care due to the health impacts of air pollution
7. CBI Economics (2020) Breathing Life into The UK Economy
8. Walton, H et al (2015) Understanding the Health Impacts of Air Pollution in London (Kings College London)
9. Office for Health Improvement and Disparities (2023) [Public Health Profiles](#)
10. European Union (2008) [Directive 2008/50/EC](#) of the European Parliament and of the Council (on ambient air quality and cleaner air for Europe). Official Journal of The European Union
11. DEFRA (2023) [UK Air Quality Policy Context](#)
12. Transport for London (2023) [Ultra Low Emissions Zone](#)
13. Royal Borough of Greenwich (2022) [Air Quality Annual Status Report 2021](#)
14. World Health Organisation (2021) [WHO Global Air Quality Guidelines: Particulate matter \(PM2.5 and PM10\), ozone, nitrogen dioxide, sulfur dioxide and carbon monoxide](#).
15. Imperial College London Environmental Research Group (2022) Pathway to WHO – Achieving Clean Air in The UK
16. London Borough of Lewisham (2023) [Regeneration \(Convoy's Wharf\)](#)
17. Transport for London (2022) [Improvements and Projects - Silvertown Tunnel](#)
18. Thames Water (2023) [Investing in Our Region - Thames Tideway Tunnel](#)
19. Transport for London (2023) [ULEZ Expansion 2023](#)
20. Transport for London (2023) [Cycleways](#)
21. Transport for London (2023) The Ultra Low Emission Zone is expanding to help clear London's air: [A guide to ULEZ Expansion](#) across all London boroughs from 29 August 2023
22. Royal Borough of Greenwich (2023) [Our Greenwich](#)
23. Royal Borough of Greenwich (2023) [Carbon Neutral Plan](#)
24. Royal Borough of Greenwich (2022) [Transport Strategy](#)
25. Royal Borough of Greenwich (2023) [Air Quality](#)
26. Royal Borough of Greenwich (2023) [Greenwich Builds](#)
27. Royal Borough of Greenwich (2021) Royal Greenwich Housing Estates to get [Innovative Heat Pump as Part of Trailblazing Scheme](#) to Tackle Climate Emergency
28. DEFRA (2019) [Clean Air Strategy 2019](#)
29. Legislation.gov.uk (2023) [Environment Act 2021](#)
30. Sustrans (2022) [Helping People Through The Cost of Living Crisis and Growing Our Economy](#)
31. Greater London Authority (2023) [London Atmospheric Emissions Inventory \(LAEI\) 2019](#) Accessed on 12/04/2023
32. World Health Organisation (2018) WHO Housing and Health Guidelines
33. Action on Smoking and Health (2020) Second hand Smoke
34. Day, P (2023) Gas Cooking: Hazardous to Our Health and Costly To Society (Air Quality News)
35. National Institute for Health and Care Excellence (2020) Indoor Air Quality at Home
36. National Institute for Health and Care Excellence (2019) Air Pollution: Outdoor Air Quality and Health
37. DEFRA (2022) Local Air Quality Management Policy Guidance (PG22)
38. DEFRA (2023) Environmental Improvement Plan 2023
39. Office for Health Improvement and Disparities (2023) [Wider Determinants of Health](#)
40. Greater London Authority (2021) [London Atmospheric Emissions Inventory \(LAEI\) 2013](#) Accessed on 12/04/2023
41. Royal Borough of Greenwich (2016) Outdoor Air Quality and Health. (Ed. Crosby, L - for Department of Public Health and Wellbeing)
42. Greater London Authority (2023) [London Atmospheric Emissions Inventory \(LAEI\) 2019 Air Quality Focus Areas](#)
43. Greater London Authority (2022) LAEI 2019 Review of Focus Areas
44. Giles LV et al (2011) From good Intentions to proven interventions : effectiveness of actions to reduce the health impacts. Environ Health Perspect 119:29-36 (2011). <http://dx.doi.org/10.1289/ehp.1002246>
45. White, N (2022) Black and Asian Children with Asthma Make up Highest Number of Hospital Admissions (The Independent)
46. Asthma + Lung UK (2023) [Air Pollution and Your Lungs](#)
47. Logika Noise Air Quality Consultants (2021) Air Pollution and Inequalities in London: 2019 Update
48. Ministry of Housing, Communities and Local Government (2019) [English Indices of Deprivation 2019](#) (gov.uk)
49. Office for Health Improvement and Disparities (2023) [Local Tobacco Control Profiles](#)
50. Office for Health Improvement and Disparities (2023) [Local Health](#)
51. NHS Digital (2023) [Hospital Episode Statistics](#)

52. Greater London Authority (2023) [2020 Based Projection](#) (Housing Led identified Capacity Scenario Ward)
53. Office of National Statistics (2023) [Census 2021 Results](#)
54. Office for Health Improvement and Disparities (2022) [Public Health Outcome Framework](#)
55. Imperial College London Projects (2021) London Health Burden of Current Air Pollution and Future Health Benefits of Mayoral Air Quality Policies. Environmental Research Group - Imperial College London
56. London Atmospheric Emissions Inventory 2019 Summary Note FINAL version 2 (GLA) Accessed on 12/04/2023.
57. UK Parliament (2023) [Clean Air \(Human Rights\) Bill](#) (HL) (Accessed on 12/04/2023)
58. Hughes, G (2022) Clean Air Bill Passes Through to Next Stage at Lords (Air Quality News)
59. L.Smith and Bolton, P (2022) Air quality: policies, proposals and concerns - Research Briefing (House of Commons Library)
60. World Health Organisation (2005) WHO Global Air Quality Guidelines
61. UNECE (2023) [International Cooperation on Air Pollution](#) (Accessed on 12/12/2022)
62. UNECE (2023) [Gothenburg Protocol](#) (Accessed on 12/04/2023)
63. European Union (2022) [Proposal](#) for a Directive of the European Parliament and of the Council on ambient air quality and cleaner air for Europe
64. Ministry of Housing, Communities and Local Government (2021) [National Planning Policy Framework](#)
65. Designing Building: The Construction Wiki (2022) [National Planning Policy Framework NPPF](#) (Accessed 12/12/2022)
66. Legislation.gov.uk (1995) [Environment Act 1995](#)
67. Gov.uk (2022) [UKHSA Priorities in 2022 to 2023](#)
68. Greater London Authority (2021) [The London Plan](#) – The Spatial Development Strategy for London
69. Greater London Authority (2018) [London Environment Strategy](#)
70. Greater London Authority (2018) [Mayor's Transport Strategy](#)
71. Greater London Authority (2020) [A Green New Deal](#) (accessed 12/12/2022)
72. Mayor of London (2019) London Local Air Quality Management (LLAQM) [Policy Guidance 2019](#)
73. Mayor of London (2019) London Local Air Quality Management (LLAQM) [Technical Guidance 2019](#)
74. Royal Borough of Greenwich (2014) [Royal Greenwich Local Plan: Core Strategy with Detailed Policies](#)
75. Royal Greenwich (2019) [Third Local Implementation Plan](#)
76. Royal Greenwich (2019) [Royal Greenwich Joint Health and Wellbeing Strategy \(2019-2024\)](#)
77. World Health Organisation (2021) Ambient (Outdoor) Air Pollution
78. National Audit Office (2022) [Tackling Local Breaches of Air Quality](#)
79. House of Commons Committee of Public Accounts (2022) [Tackling local air quality breaches](#)
80. Transport for London (2023) [ULEZ Expansion: Support for Disabled People](#) (accessed 17/07/2023)
81. Client Earth (2022) [The UK Environment Act – what's happening now](#) (accessed 12/12/22)
82. Greater London Authority (2019) [PM2.5 in London](#): Roadmap to meeting World Health Organization guidelines by 2030
83. Asthma + Lung UK (2022) [Alerting The Nation](#)
84. Breathe London (2023) [About The Breathe London Network](#) (Accessed 17/07/2023)
85. C40 Knowledge Hub (2019) [Breathe London](#) (Accessed 26/05/2023)
86. Office for Health Improvement and Disparities (2022) [Air Pollution: Applying All Our Health](#). (Gov.uk, accessed on 21/02/2023)
87. Transport for London (2022) [Why do we have a ULEZ](#) (Accessed 28/11/2022)
88. Transport for London (2020) [Low Traffic Neighbourhoods: what, why and where?](#) (Made by TfL Blog)
89. Eco Stars (2023) [ECO Stars Fleet Recognition Scheme](#) (accessed on 17/07/2023)
90. Transport for London (2023) [Car Clubs](#) (Accessed 17/07/2021)
91. Simpson, J (2023) Car parks could collapse under the weight of electric cars. The Telegraph
92. Asthma + Lung UK (2023) [Putting The Brakes on Toxic Air](#)
93. Transport for London (2018) [Vision Zero Action Plan](#)
94. Transport for London (2017) [Healthy Streets for London](#)
95. Transport for London (2023) [Healthy Streets](#)
96. Transport for London (2023) [Workplace Parking Levies](#)
97. Asthma + Lung UK (2021) [The Invisible Threat – How We Can Protect People from Air Pollution and Create a Fairer, Healthier Society](#)
98. C40 Knowledge Hub (2020) [How to build back better with a 15-minute city](#) (Accessed 26/05/2023)
99. Public Health England (2020) [Improving Access to Greenspace: a new review for 2020](#)
100. Greater London Authority (2023) [Green Infrastructure](#) (accessed 17/07/2021)
101. DEFRA (2019) [Air quality: explaining air pollution – at a glance](#) (accessed 21/02/2023)
102. C40 Knowledge Hub (2019) [Six impactful actions cities can take to improve their air quality](#) (accessed 26/05/2023)

103. C40 Knowledge Hub (2022) [Six ways for cities to drive climate investment](#) (accessed 26/05/2023)
104. Clean Air Fund (2021) [Joined-up Action on Air Pollution and Climate Change](#) (accessed 19/07/2023)
105. DEFRA (2023) [Burn Better: Making Changes for Cleaner Air](#) (accessed 29/06/23)
106. London Councils (2023) [About Air Quality in London](#) (Accessed 17/07/2023)
107. McGrath, Matt (2019) ULEZ – How does London’s new emissions zone compare (BBC News, Accessed 28/11/2022)
108. C40 Knowledge Hub (2019) [Why clean air is vital for your city’s health and prosperity](#) (Accessed 26/05/2023)
109. Asthma + Lung UK (2023) [Clean Air Champions](#) (Accessed 28/11/2023)
110. Royal Borough of Greenwich (2023) [Become a Community Champion Today](#) (Accessed 28/11/2022)
111. Greater London Authority (2022) [Local Authorities and Air Quality](#) – A summary of action taken by London boroughs to improve air quality in 2020
112. Transport for London (2023) [About Stars](#) (Accessed 18/07/2023)
113. Fleet Operator Recognition Scheme (2023) [Prove You are Safer, Smarter and Greener](#) (Accessed 17/07/2023)
114. NHS England (2021) [Core20PLUS5 – an approach to reducing healthcare inequalities](#) (accessed on 19/07/2023)