TfL Consulting

London's experience of working towards clean air

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For:

Artha Global

MAYOR OF LONDON

TRANSPORT FOR LONDON

EVERY JOURNEY MATTERS

Foreword: London's Journey to Improve Air Quality

In September 2022, the Government of India upgraded the target for the reduction of particulate matter concentration in the 132 cities covered under the National Clean Air Action Plan (NCAP). The NCAP requires state and local administrations to take the lead in reducing vehicular emissions by developing strategies to regulate the use of fossil-fuel vehicles, and accelerate the use of zero-emission vehicles.

Clean Air Zones (CAZs) are an effective first step, that in tandem with other complementary measures, such as electrifying bus and taxi fleets, and designing streets for walking and cycling, can help us achieve ambitious targets to reduce levels of particulate matter in our cities. As India urbanises, CAZs are an adaptable tool to help cities decarbonise the transport sector. This project will help Indian cities establish their own roadmaps towards establishing Clean Air Zones and other clean air initiatives, for the immediate future.

In the global context, London has been a leader in recognising the impact transport emissions have on health. Since 2003, Transport for London (TfL), The Mayor of London, and other stakeholders, have successfully implemented various initiatives to improve air quality. They have done so by implementing initiatives such as the Low Emission Zone (LEZ), Ultra Low Emission Zone (ULEZ), Low Traffic Neighbourhood Programmes, Healthy Streets Programmes, monitoring of emissions at neighbourhood level, congestion charging, and other initiatives. Over a period of two decades, London has become a world leader in reducing transport emissions aimed at improving air quality. As a key partner, TfL will share their expertise on clean air initiatives throughout the course of the project.

This report shares a detailed illustration of some of the key projects delivered by London to improve air quality. It provides policy makers with an array of tools which they could employ in order to reduce transport emissions and improve air quality for their cities. Furthermore, the report also details important steps on stakeholder engagement, science and technology, and the policy impact the initiatives have had. Finally, the report demonstrates that the journey to creating cleaner air requires long term and sustained action - a journey London has been on for close to two decades and continues today.

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CONTENTS

LIST OF ABBREVIATIONS

Abbreviation	Definition
ANPR	Automatic Number Plate Recognition
CBI	Confederation of British Industry
CC	Congestion Charge
DLR	Docklands Light Railway
DPIA	Data Protection Impact Assessment
EU	European Union
GLA	Greater London Authority
HGV	Heavy Goods Vehicle
LEZ	Low Emission Zone
LTN	Low Traffic Neighbourhood
MTS	The Mayor's Transport Strategy
NHS	National Health Service
NO_2	Nitrogen dioxide
NOx	Nitrogen Oxides
PHV	Private Hire Vehicle
$PM_{2.5}$	Particulate Matter 2.5
ULEZ	Ultra Low Emission Zone
WHO	World Health Organization
ZEZ	Zero Emission Zones

Scale Symbol Key

Symbol	Meaning
	Has more localised impacts, such as a neighbourhood
	Has city-wide impacts

Impact Symbol Key

Abbreviation	Definition
	Has positive impact on cycling
	Creates a relaxing environment
	Green infrastructure that provides shade, shelter, and welcoming environment
	Improves walking and wheeling for all walks of life
	Improves air quality
	Promotes the use of public transport
	Reduces road danger

Scheme	Scale		Impact							
										
School Streets										
Low Traffic Neighbourhoods										
Green Infrastructure										
Congestion Charge										
Low Emission Zone										
Ultra Low Emission Zone										
Scrappage schemes and retrofitting										
Potential Future Road User Charging										
Zero Emission Zones										
Bus Fleet										
Clean Freight										
Taxis and private hire										

 Reduces car use

1 Executive Summary

This report sets out how Transport for London is improving the quality of London's air. While fewer than two per cent of Londoners live in areas exceeding the UK (United Kingdom) legal limit for NO_2, all Londoners live in areas where concentrations exceed the much stricter World Health Organisation (WHO) guideline level for both $PM_{2.5}$ and NO_2. As the WHO highlight, there is no safe level of air pollution, and as such, this report sets out an introduction to the strategies, policies, and schemes that we have used to tackle air pollution, providing examples of what might work elsewhere.

This report is set at a high level, to give a sense of the breadth of work carried out, all in support of improving the air Londoners breathe, and each case study has links to sources of further published information. Improving air quality requires a holistic approach and is the result of numerous schemes and policy changes working together to produce results collectively. London is doing even more beyond the examples we highlight in this report, for example, growing the city's electric vehicle charging infrastructure to give people the confidence to transition towards electric vehicles.

The levers of change for improving air quality can be summarised as:

- Healthy Streets Approach - designing environments to welcome people not cars
- Investment in public transport and active travel
- Good quality data and robust monitoring
- Stakeholder engagement and communications
- It will take a package of measures to really tackle air quality and its associated disbenefits, a holistic approach is most effective. It also takes time to build consensus and support and requires strong political leadership.

Section 2 introduces the air quality problem in London, and explains how we at TfL work, delivering the Mayor's Transport Strategy, and working alongside London borough councils.

Section 3 explains the Healthy Streets approach, which underpins everything we do.

Section 4 introduces a series of case studies, to provide examples of the types of policies and schemes we have carried out, which may be applicable in other cities across the world.

Section 5 highlights the importance of monitoring these initiatives, and some of the ways in which we do that in London.

Section 6 explains the value of stakeholder engagement and our approach to it at TfL.

Section 7 summarises the key drivers of change for improving air quality.

2 Introduction

2.1 Air pollution and health impacts in London

Despite recent improvements in air quality, air pollution remains the biggest current environmental risk to the health of Londoners. Road vehicles are the single biggest cause of London's air pollution. They produce nearly half of all nitrogen oxides and emit tiny particles of rubber and metal - too small to see with the naked eye - into the air we breathe[1].

Air pollution affects the health of Londoners. The latest evidence shows that air pollution increases the risk of life-changing illnesses such as cancer, asthma, and lung disease as well as dementia in older people.

More than 500,000 Londoners live with asthma and are more vulnerable to the impact of toxic air. Around 4,000 Londoners die prematurely every year due to toxic air. The Mayor's air quality policies, in particular the Ultra Low Emission Zone (ULEZ) and Low Emission Zone (LEZ) schemes, are having a transformative impact - cutting the number of older, more polluting vehicles seen driving in London and reducing the levels of harmful air pollution. However, there is still much work to do to continue reducing pollution levels.

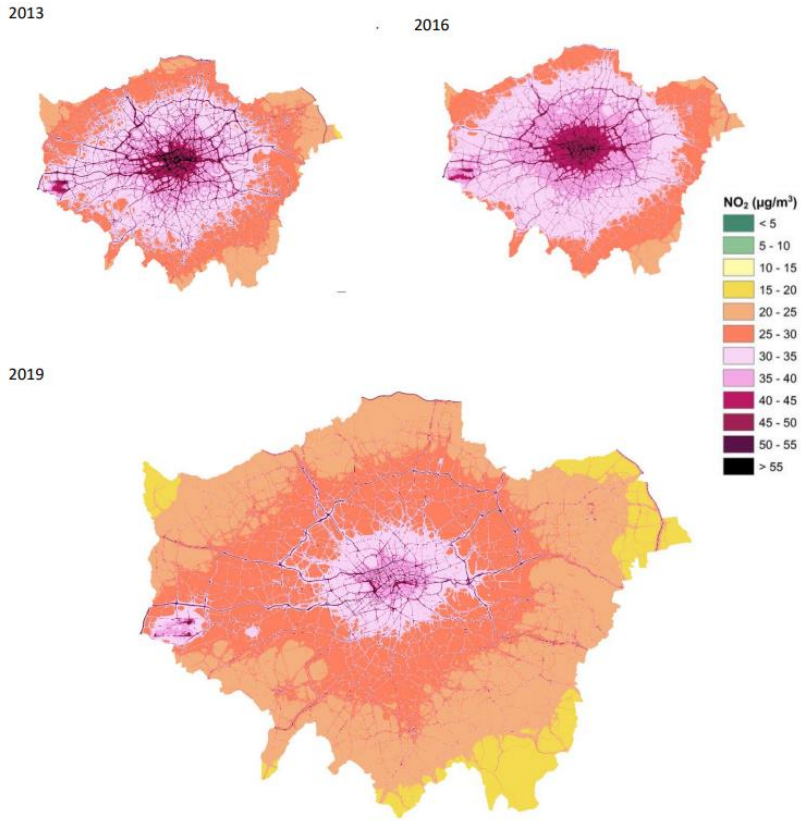

Figure I. NO_2 concentration in Greater London, 2013 – 2019

[1] London Atmospheric Emissions Inventory 2019 Update, available at: https://data.london.gov.uk/dataset/london-atmospheric-emissions-inventory--laei--2019

Figure 2. Polluting vehicles in London

In September 2021, the World Health Organization (WHO) updated its recommended guidelines for air pollutants reflecting the clear evidence of the health impacts of air pollution, even at low levels. In setting interim targets and guidelines for air pollution the WHO also sets out how fine particulate pollution has health impacts even at very low concentrations, and that there is no safe level.

There is also a wider economic benefit to tackling air pollution. Research from the Confederation of British Industry (CBI) has shown that cleaner air could boost the UK economy by £1.6 billion per year and improving air quality in London specifically would provide an economic benefit of almost £500 million per year to the local economy due to fewer days lost due to illness[2].

2.2 Mayor's Transport Strategy

The Mayor's Transport Strategy (MTS)[3], published in March 2018, outlines the Mayor's vision for transport in London. The overarching aim of the transport strategy is to reduce Londoners' dependency on cars and to increase the active, efficient, and sustainable (walking, cycling and public transport) mode share of trips in London to an ambitious 80 per cent by 2041. It sets out the need to reduce emissions – in particular, diesel emissions – from vehicles on London's streets, to improve air quality and support London reaching compliance with UK and EU (European Union) legal air quality

[2] Breathing life into the UK economy, available at: https://www.cbi.org.uk/media/5539/2020-09-cbi-economics-caf-report.pdf
[3] The Mayors Transport Strategy, available at: https://www.london.gov.uk/sites/default/files/mayors-transport-strategy-2018.pdf

limits as soon as possible. The MTS also sets a target of a zero-carbon city by 2050, with the Mayor recently setting an even more challenging target of being net zero by 2030.

In addition to the overarching mode share aim, the transport strategy is focused on achieving the three broad themes below in Figure 3:

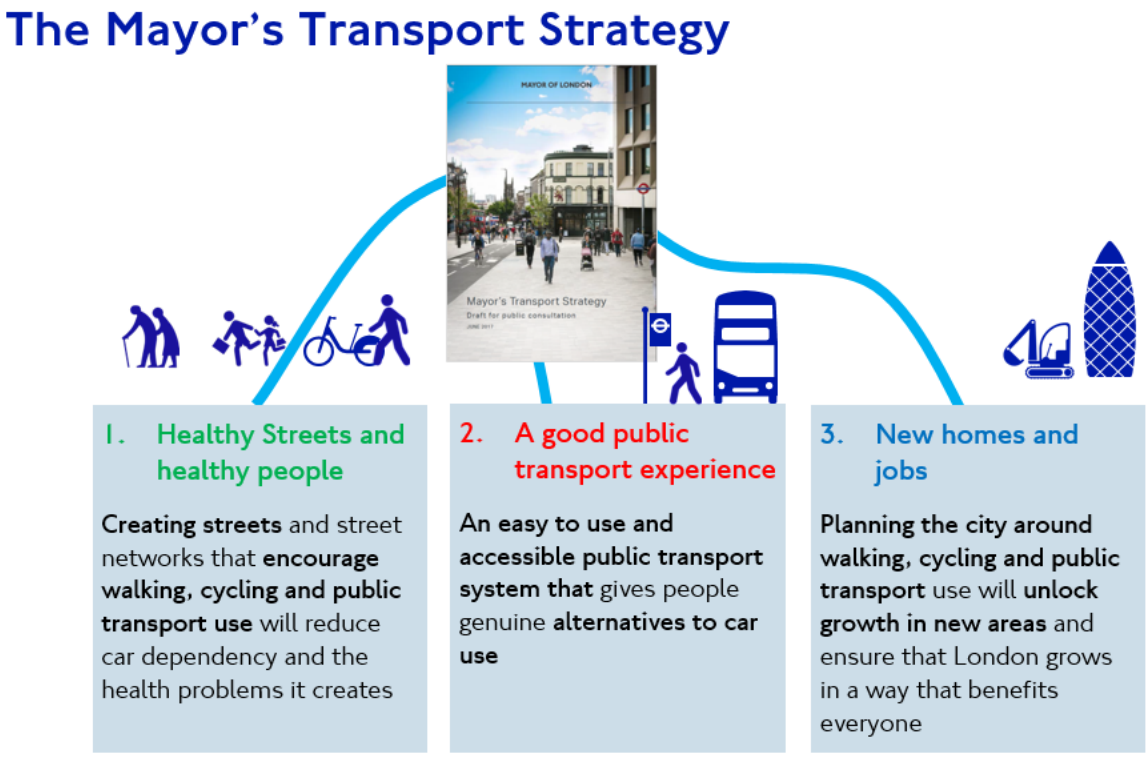

Figure 3: Key themes within the Mayor's Transport Strategy

The MTS guides all work carried out by TfL, and having such a strong focus on a healthy, green city supported by high quality public transport and active travel is essential to improving air quality.

2.3 Governance in London

2.3.1 Transport for London (TfL)

We are a part of the Greater London Authority (GLA) family of organisations led by the Mayor of London. We are the integrated transport authority responsible for delivering the Mayor's Transport Strategy and commitments on transport.

As a core element in the Mayor's overall plan for London, our purpose is to keep London moving, working, and growing, and to make life in our city better. We reinvest all our income to run and improve London's transport services and to make it safer, more modern, and affordable for everyone.

Our operational responsibilities include London Underground, London Buses, Docklands Light Railway (DLR), London Overground, TfL Rail, London Trams, London

River Services, London Dial-a-Ride, Victoria Coach Station, Santander Cycles, and the IFS Cloud Cable Car.

On the roads, we regulate taxis and the private hire trade, run the Congestion Charging scheme, operate all of London's 6,300 traffic signals and work to ensure a safe environment for all road users. We are responsible for the city's 580km "red route" network, which are the main roads in London, making up 5 per cent of London's roads, but carrying up to 30 per cent of the city's traffic. Other roads are managed by the local London borough councils.

2.3.2 London Borough Councils

London is divided into 33 Local Authorities, also called borough councils (see Figure 4). They are responsible for education, social care, waste collection, and leisure services. In terms of transport, they repair and maintain 95 per cent of London's roads, deal with parking enforcement, and provide the funds to allow a million older and disabled Londoners free travel on buses, tubes, and trains.

Figure 4. Map of London Borough Councils. Source: Directory.londoncouncils.gov.uk

2.4 Conclusion

We are improving London's air in partnership with local borough councils. No one single organisation can be successful alone. Neither is it a case of one single policy measure or initiative, but rather the amalgamation of dozens of initiatives all working towards the same objective and building upon each other year after year. Air quality, like health, will always be something that can be improved upon. Improving air quality does not happen overnight. The improvements we have made in London have taken years to achieve and are the result of continued action (see Figure 5). We started with smaller scale schemes, proving the benefits, and reassuring stakeholders, and built upon our successes, scaling schemes up in size, and number, to cover more of the city.

This report summarises some of the key initiatives (referred to here as case studies) we have delivered over the years to improve air quality, and how they have contributed to this aim. Wherever possible we have included a link to further published information on each. Many of these case studies focus on promoting more walking, wheeling (cycling, scooting, wheelchair use), and public transport, in order to reduce single occupancy car use. This not only reduces emissions of air pollutants, but improves public health and wellbeing through physical activity, as well as reducing congestion.

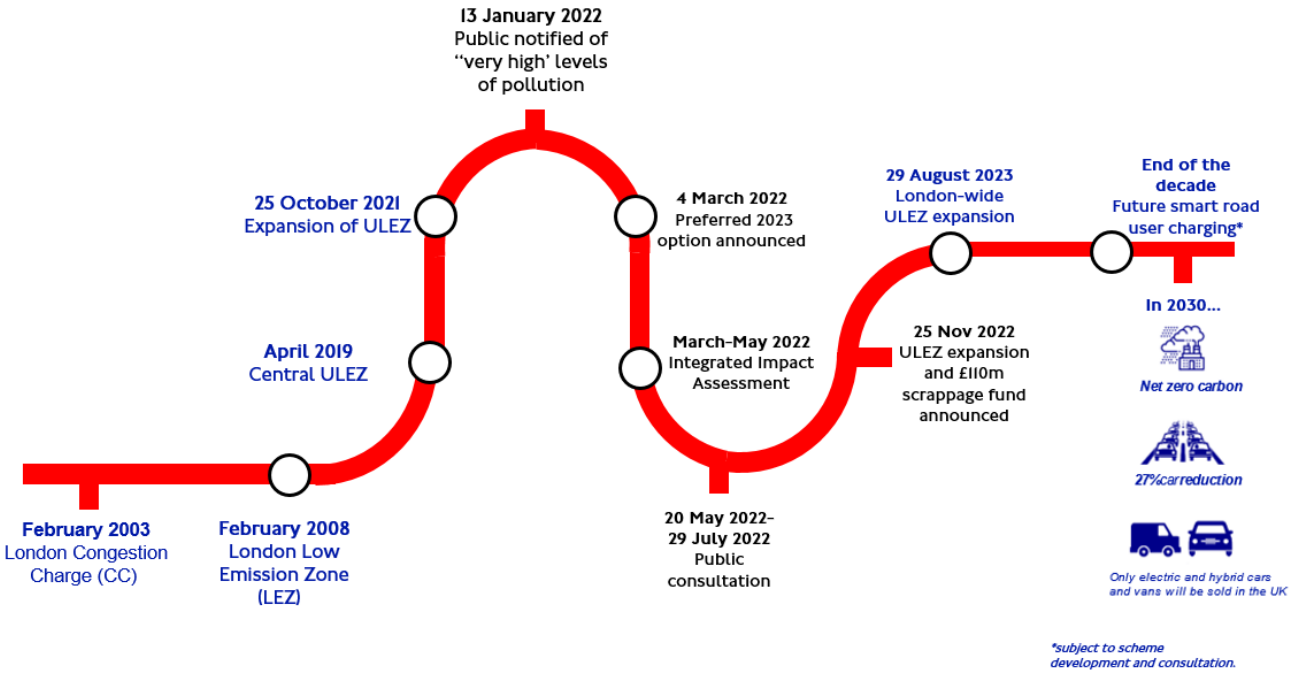

Figure 5. Timeline showing the progression of London Road User Charging schemes

3 Healthy Streets Approach

The best way to get more people walking, cycling, and using public transport is to improve the quality of the experience of being on those streets. The Healthy Streets Approach[4] therefore underpins all the other work we do. The Healthy Streets Approach focuses on creating streets that are pleasant, safe, and attractive, where noise, air pollution, accessibility and lack of seating and shelter are not barriers that prevent people - particularly our most vulnerable people - from getting out and about.

Figure 6. Example of a street with Healthy Streets' indicators

The Approach is based on 10 Indicators of a Healthy Street which focus on the experience of people using streets.

There are two main indicators:

- Pedestrians from all walks of life, reflecting London's diverse population
- People choose to walk, cycle, and use public transport

There are eight other indicators that point to the essential elements required to support these two main indicators (see Figure 7).

[4] Healthy Streets for London, available at: https://content.tfl.gov.uk/healthy-streets-for-london.pdf

Partnership Working

Delivery is not undertaken alone. We work with the London boroughs, representative groups, communities, developers, and landowners to provide tools, training, support, and guidance that will help these stakeholders embed the Healthy Streets Approach in everything they do. Vital to the success of the Healthy Streets Approach is our continuing work with the Metropolitan Police Service, who provide on-street law enforcement and education to improve the safety of our streets.

Monitoring Tools

There is a suite of tools designed to monitor how a street performs against the 10 Healthy Street Indicators. These tools can have different uses, as well as being used at different stages of a project:

- Guide to the Healthy Streets Indicators
- Healthy Streets Check for Designers
- Healthy Streets Survey

The Healthy Street Indicators are shown in the diagram below:

Figure 7. Healthy Streets Indicators. Created by Lucy Saunders.

Impacts

The Healthy Streets Approach is making London a healthier, more sustainable, safer, more connected and, ultimately, more successful city for all Londoners. To exemplify this, if all Londoners walked or cycled for 20 minutes a day, this would save £1.7 billion in the National Health Service (NHS) treatment costs over 25 years[5]. Businesses are also expected to benefit from the economic benefits the Healthy Streets Approach helps to deliver, including attracting more customers, increasing customer spend, improving productivity of staff and improving the vibrancy of an area 90 per cent.[6]

Every TfL scheme undertaken in the public realm is required to assess its impact on the ten Healthy Streets Indicators. A scheme might be re-designing a street or widening a footway for example. One small scheme on its own will make a difference to local people; and hundreds of schemes across a city will have an impact on wider air quality. The package of public realm improvement schemes which we have implemented over the years, all working to the Healthy Streets Approach, has shown a decrease in car use, an increase in active travel, and an overall improvement in air quality.

Finance

Funding will vary depending on the nature of the street changes required, and the size of the area. Because this is embedded into our core strategy, it becomes built into the way we do things every day. So, whenever we make changes to a street environment, whether large or small, we aim to follow the Healthy Streets Approach by default. This makes it both more impactful and achievable.

More information

TfL Healthy Streets: https://tfl.gov.uk/corporate/about-tfl/how-we-work/planning-for-the-future/healthy-streets

[5] Healthy Streets for London, available at: https://content.tfl.gov.uk/healthy-streets-for-london.pdf
[6] Healthy Streets: a Business View, available at: https://content.tfl.gov.uk/healthy-streets-a-business-view.pdf

4 Case studies

4.1 School Streets

School streets enable more children to walk and cycle to school by introducing vehicle restrictions at drop-off and pick-up times around the school. The London boroughs have introduced more than 500 School Streets since the start of the Covid-19 pandemic, 373 of which were funded with support from TfL and the Greater London Authority (GLA).

Figure 8. Example of a School Street with moveable barriers

Stakeholder Engagement

Active travel charity Sustrans has supported the implementation of over 500 School Streets across more than 80 local authorities (both within and outside London). Typically, they carried out consultation and engagement through various events, talking to pupils during classroom sessions, families at the school entrance and residents in public spaces. Their advice on engagement is to start it as early as possible, you can never do too much, to talk to the wider community, make it accessible, and that negative views should not necessarily stop a scheme. Implementing a School Streets scheme is generally less contentious, and easier to gain buy in from local people, than some other types of traffic restriction measures.

Impacts

In 2022, we published a report[7] which presents case studies of five schemes in different London boroughs. The research found that borough officers, school staff and parents all agreed that having a School Street was a positive step towards safer, calmer, cleaner, and healthier local areas. The guidance is intended to help London boroughs decide how and when to introduce schemes locally and highlights the different design options available.

In 2022, we commissioned a study of five School Street schemes, carried out by the organisation 2CV, which found the following benefits[8]:

- Less motor traffic: 70 to 90 per cent reduction in the number of motorised vehicles per hour on the School Street during the closure period
- Reduced danger: motor vehicle speeds reduced up to 6.3 miles per hour in the hours of operation compared to outside them
- More active travel: an increase in the number of people cycling per hour during the closure period compared to outside the closure period
- Social benefits such as improved community spirit and pride in the school

Research from the Breathe London air quality monitoring network found that School Streets reduce nitrogen dioxide by up to 23 per cent outside schools during morning drop off[9].

We carried out a separate study which found that School Streets have strong support from Londoners, with 77 per cent of parents and carers from a sample of 35 schools expressing support for the changes being kept in the long term, subject to consultation[10].

Finance

The cost of implementing a School Street can vary dependent on the filtering method used, for example, some Schools Streets use Automatic Number Plate Recognition (ANPR) cameras to make sure that only permitted vehicles enter (issuing a fixed penalty notice to prohibited vehicles), while others may use collapsible bollards to filter vehicle traffic or fixed barriers such as large planters.

Challenges

While School Streets require little physical resources to implement, they do require a large amount of well-considered stakeholder engagement. A number of challenges can

[7] Getting to Know School Streets, available at: https://content.tfl.gov.uk/getting-to-know-school-streets-case-studies-2022.pdf
[8] School Streets Qualitative Research , 2cV, available a: https://content.tfl.gov.uk/school-streets-qualitative-research-2022.pdf
[9] Air Quality Monitoring Study: London School Streets, Air Quality Consultants (commissioned by GLA), March 2021, available at: https://www.london.gov.uk/sites/default/files/school_streets_monitoring_study_march21.pdf
[10] School Streets intervention sites vs control sites full report, TfL, Jan 2021, available at: https://content.tfl.gov.uk/school-streets-evaluation-report-website.pdf

stem from opposition from the local community due to temporarily impacting other transport modes (such as motor vehicles) surrounding the school street.

School Streets' timed restrictions will depend on the existence of appropriate traffic regulation. In the UK, School Streets are implemented with the use of existing regulation that creates a Pedestrian and Cycle Only Zone, with signage that states the times of operation. This is not without its drawbacks: entering the zone in a non-exempt motor vehicle is prohibited but leaving it is not, so some drivers drive into the zone before the enforceable time, wait for the school to open, then leave. Bespoke signage that creates a zone in which motor vehicles cannot move would be more effective. Also, the existing UK signage states times but not dates, so during school holidays the signs need to be covered or closed which requires resource; some signs are not covered, and this can cause confusion.

More information

Getting to know School Streets: Case Studies (2022): https://content.tfl.gov.uk/getting-to-know-school-streets-case-studies-2022.pdf

London Borough of Hackney, School Streets: https://hackney.gov.uk/school-streets

TfL Streets Toolkit: https://tfl.gov.uk/corporate/publications-and-reports/streets-toolkit

School Streets Evaluation Report: https://content.tfl.gov.uk/school-streets-evaluation-report-website.pdf

School Streets Monitoring Study: https://.london.gov.uk/sites/default/files/school_streets_monitoring_study_march21.pdf

4.2 Low Traffic Neighbourhoods

Low Traffic Neighbourhoods (LTNs) offer a cost-effective way of delivering safe and attractive streets for walking and cycling by preventing through traffic from using residential neighbourhoods to avoid main roads (often known as 'rat running'), while retaining local access for residents and visitors. This can be achieved by various approaches to design to limit the movement of motor vehicles on certain streets and improving conditions for walking and cycling. A successful LTN makes walking and cycling more convenient than the car for short trips, while maintaining essential access. It will also enhance the quality of place and reduce local air and noise pollution and road danger. LTNs have existed in London for many years, however since the COVID-19 pandemic we have seen over 120 new LTNs.

Figure 9. Example of Low Traffic Neighbourhood

Stakeholder Engagement

Representative polls show that LTNs have overall public support, however at the local level, opinions are often highly polarised. The installation of LTNs is usually accompanied by extensive engagement with local communities and stakeholders conducted by the boroughs responsible for their installation. LTNs are normally installed on a trial basis at first, so their impacts can be understood and the trial forms

part of the consultation on whether to make the LTN permanent. Opinions often change after the trial period.

Response rates to LTN consultations and engagement vary and are unlikely to be a representative sample of the population living in a LTN area. Certain groups of people are more likely to respond, especially those with the strongest views on such schemes. The nature of responses also varies according to the type of respondent. For example, when asked about the impacts of their LTNs, London Borough of Islington found that those who do not own a car are consistently more positive, even on questions to which car ownership should not be a factor. Boroughs are increasingly attempting to find new ways to undertake engagement and consultation on LTNs to maximise responses from those who do not typically engage with consultations, for example younger people or those with lower incomes. This is to ensure responses received reflect the views and needs of our diverse population.

Monitoring

A variety of data is typically collected alongside the implementation of LTNs. Motor traffic and cycle counts both within and on the boundaries of the LTN are used to indicate the impact on traffic reduction and enabling cycling. Pedestrian counts may also be completed to monitor changes in footfall. Air quality monitoring is also typically undertaken at some locations in the LTNs. Automatic Number Plate Recognition or telematic data may be used to understand the impact of the LTN on vehicle routing. Over the longer term, impacts on crime, vehicle collisions, and emergency response times may also be monitored at LTNs.

Impacts

LTNs are consistently shown to lead to major reductions in traffic. London-wide, a systematic review of LTNs introduced since 2020 analysed their impact on motor traffic on roads within the schemes and on their boundaries[II]. It found that:

- Motor traffic decreased at 74 per cent of count sites within LTNs
- The number of internal roads within the LTNs carrying over 1,000 motor vehicles reduced from 59 per cent to 34 per cent
- The median volume of traffic on roads within LTNs went from 1,226 to 666 motor vehicles
- 45 per cent of boundary roads saw a fall in motor traffic, and 53 per cent saw an increase
- The median motor traffic volume on boundary roads remained very similar, although changes at individual sites included both large increases and decreases
- Rates of cycling and walking increase
- Over the long term, car ownership and car usage by those living in LTNs declines

[II] Thomas, A. and Aldred, R. (2023). *Changes in motor traffic inside London's LTNs and on boundary roads.* Available at:https://docs.google.com/document/d/13Nsm_GFdH6CplpPpOZ7hbhLZScgqCAP7ZGI0xi4qDqA/edit#heading=h.e9amstptpyyl

- Traffic collisions and the risk of injury within the area declines

The direct impact on air quality can be hard to quantify to a specific LTN scheme, given they are small-scale local schemes. However, monitoring and research has shown that they contribute to improved air quality overall within the LTN, with no evidence they cause deteriorations on their borders[12] [13].

Challenges

LTNs can bring great benefit to all those who can walk, wheel or cycle by increasing accessibility. However, they can pose significant challenges for those reliant on a car, and their design should engage with and reflect this.

Financing

Similar to School Streets, the cost of implementing a LTN can vary dependent on the filtering method used, for example, some LTNs use ANPR cameras to make sure that only permitted vehicles enter (issuing a fixed penalty notice if prohibited), while others use large plants or bollards to filter vehicle traffic. However, LTNs are one of the quickest and cheapest ways to improve air quality in a localised area, reduce traffic and road danger, and meet the Healthy Streets indicators.

More information

Supplementary Guidance on Low Traffic Neighbourhoods: https://content.tfl.gov.uk/lsp-app-six-a-supplementary-guidance-ltns-v1.pdf

TfL LTN Article: https://madeby.tfl.gov.uk/2020/12/15/low-traffic-neighbourhoods/

[12] Xiuleng, Y., McCoy, E., Hough, K. & de Nazelle, A. (2022) Evaluation of low traffic neighbourhood (LTN) impacts on NO_2 and traffic. Transportation Research Part D: Transport and Environment, Volume 113, December 2022. Available at: https://www.sciencedirect.com/science/article/pii/S1361920922003625#bb0020

[13] London Borough of Hackney (2021) *Improving air quality by supporting sustainable transport.* Available at: https://hackney.gov.uk/air-quality-sustainable-transport/#air

4.3 Green Infrastructure

London's green infrastructure is its network of parks, green spaces, gardens, woodlands, rivers, and wetlands, as well as features such as street trees and green roofs. Green infrastructure provides multiple benefits, including improving air and water quality, supporting mental and physical health, encouraging active travel, cooling urban areas during heat waves, reducing surface water flooding, and carbon storage. Green infrastructure is a key element of Healthy Streets.

Figure I0. Example of Green Infrastructure

At regional and national scales, vegetation plays an important part in removing air pollutants through leaf surfaces. However, at the street scale, the main value of green infrastructure for urban air quality is not its ability to remove pollutants, but its ability to control their flow and distribution.

Vegetation at smaller scales, i.e. street scale, can be used to control the flow and distribution of pollutants by controlling their dispersion: the transport of pollutants by the wind away from the source and dilution with cleaner surrounding air. There is no 'one size fits all' intervention (and the effects are highly localised) but the right green infrastructure in the right place can reliably reduce exposure to air pollution. A vegetation barrier can as much as halve the levels of pollutants just behind the barrier.

Challenges

The key challenges with Green Infrastructure so far are:

- Data quality: can be inconsistent as to determining where green infrastructure already exists
- Maintenance: there can be lack of clarity around what levels of maintenance new Green Infrastructure assets will receive
- It is still considered a 'nice to have'
- Skills and training: more awareness to embed and maintain long-term and to avoid poor implementation
- Processes: establish proper monitoring and evaluation processes#

Impacts

We are calculating the economic value of a range of benefits that our natural assets provide, such as carbon storage, recreation (evidence shows that well-designed green infrastructure can help to encourage a greater uptake of walking and cycling), and air pollutant removal. One study by King's College London found that levels of NO_2 reduced by 23 per cent when a green wall was placed between a busy road and a school playground.[14]

More information

Enhancing our Green Infrastructure: https://tfl.gov.uk/corporate/about-tfl/enhancing-green-infrastructure#on-this-page-4

Managing our Green Infrastructure: https://tfl.gov.uk/corporate/about-tfl/green-infrastructure

Using Green Infrastructure to Protect People from Air Pollution: https://www.london.gov.uk/sites/default/files/green_infrastruture_air_pollution_may_19.pdf

[14] For more information see: The impact of a green screen on concentrations of nitrogen dioxide at Bowes Primary School, Enfield, A Tremper, (2018)

4.4 Road User Charging Schemes

To tackle the triple challenges of improving air quality, the climate emergency and congestion, TfL employs a suite of Road User Charging Schemes. These are:

- Congestion Charge (CC)
- Low Emission Zone (LEZ)
- Ultra-Low Emission Zone (ULEZ)

Figure II. Congestion Charge and LEZ Signage

These schemes have been delivered in succession over the last 20 years, with the Congestion Charge being the first to be launched in 2003. Figure I2 provides a timeline of when each of these Road User Charging Schemes was delivered. While each of these schemes has been delivered at intervals over the past 20 years, it was not necessarily planned this way from the outset and has been something that has evolved over time.

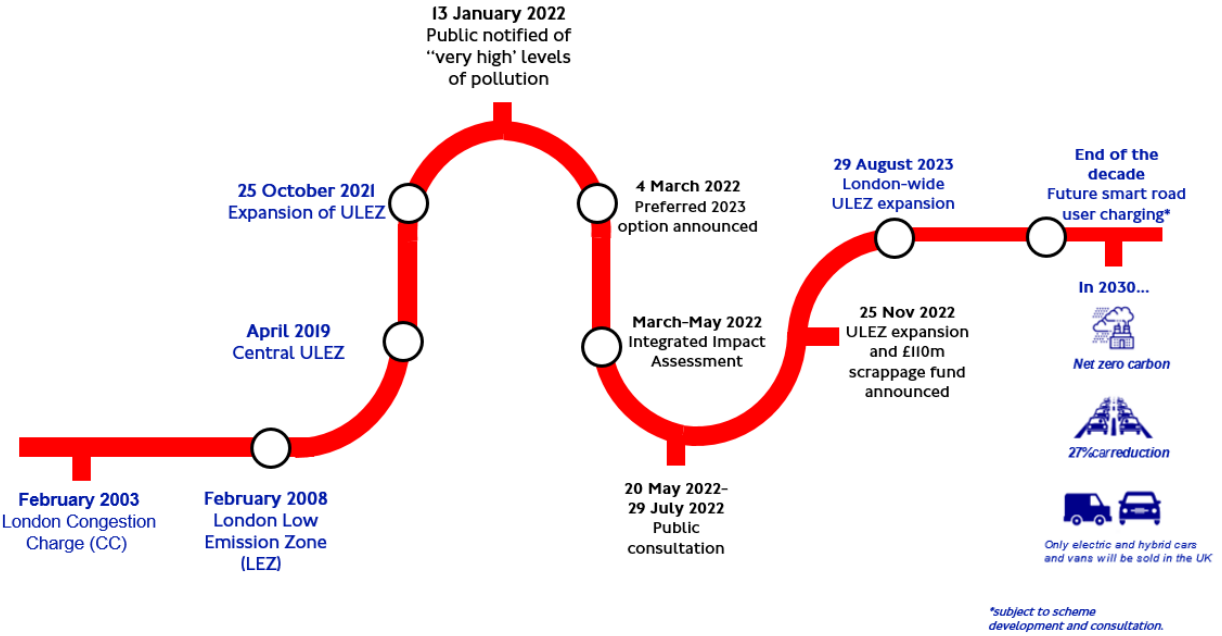

Figure 12. Timeline showing the progression of London Road User Charging schemes

Figure 13 shows the Congestion Charge and ULEZ geographically on a map of London. The LEZ boundary is the same as the boundary for the London-wide ULEZ expansion.

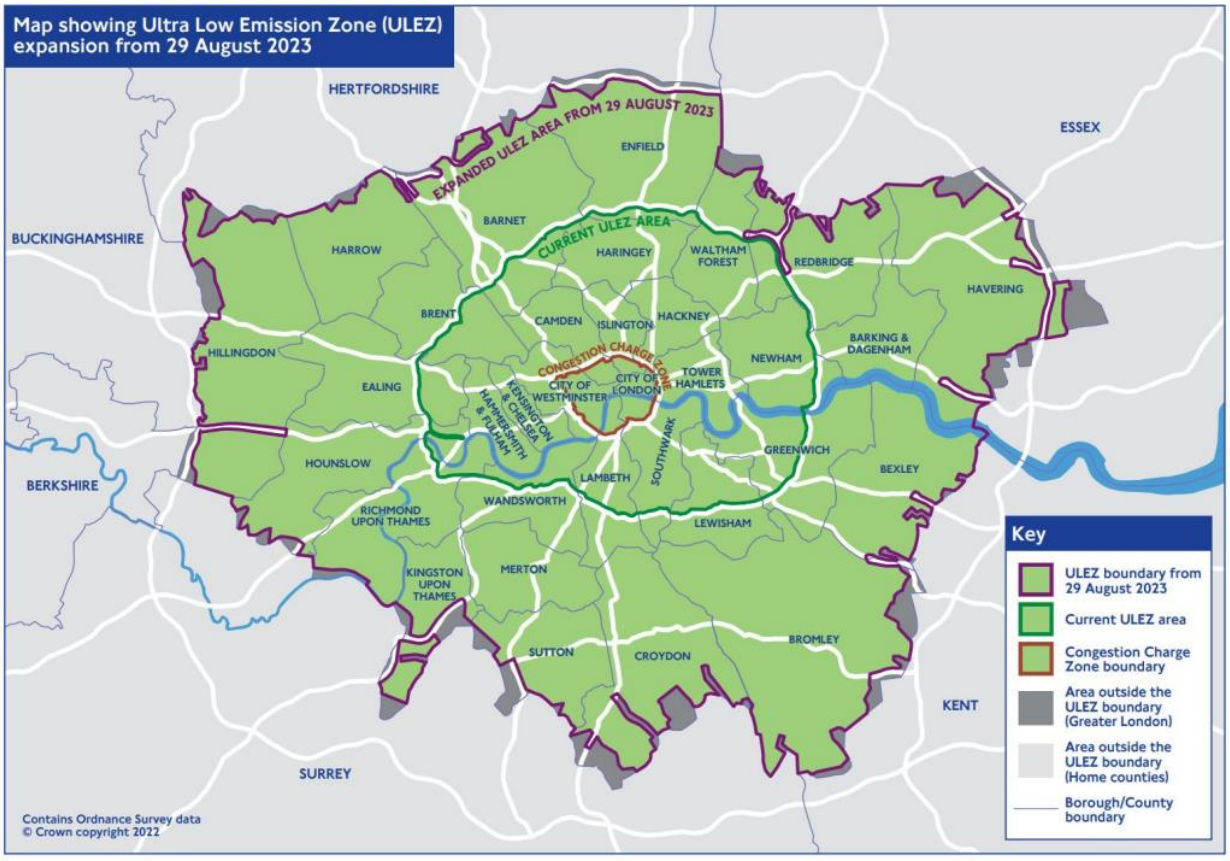

Figure 13. ULEZ and Congestion Charge Boundaries Map

4.4.1 Congestion Charge

Designed to tackle road traffic congestion in central London, the world-leading Congestion Charge was launched in February 2003 and has been in use for 20 years. In its present form the Congestion Charge is a £15 daily charge if you drive within the Congestion Charge zone 7:00-18:00 Monday-Friday and 12:00-18:00 Saturday-Sunday and bank holidays. When first introduced in 2003, the charge was £5, and has risen incrementally over the last two decades. The charge has been supported by a wide range of complementary measures, including: substantial improvements to bus routes into and around the zone; new 24hr, inter-peak and evening public transport services; a fares freeze; and fares restructuring.

Green Discount: A 100 per cent 'green discount' for cars and vans has always been offered as part of the Congestion Charge. The criteria for the discount is tightened every few years to reflect improving vehicle technology and to regulate the numbers eligible. The latest iteration – the Cleaner Vehicle Discount applies to battery electric or hydrogen fuel cell vehicles and is due to end in December 2025.

During the first year, the Congestion Charge:

- Limited traffic entering the zone by 18 per cent during weekday charging hours
- Reduced congestion by 30 per cent
- Boosted bus travel in central London by 33 per cent
- Enabled 10 per cent of journeys to switch to walking, cycling and public transport[15]

In addition to these immediate impacts, the Congestion Charge has helped reduce the trend of worsening congestion. Analysis shows there would have been three million additional journeys by car across London in 2019 without the changes we introduced to encourage more sustainable travel patterns over the last two decades, of which the Congestion Charge was a critical first step. This has helped ensure London's growth has been sustainable. Nearly £5 billion was lost to congestion in 2019, a figure that would have been much higher with the three million additional car journeys that, in conjunction with wider transport interventions across London, the Congestion Charge helped avoid.

While the Congestion Charge has been tackling road traffic congestion, the growing scientific evidence on the deadly impacts of toxic air pollution created an imperative to move quickly to cut harmful emissions. The Congestion Charge played a key role in encouraging early take up of less polluting vehicles through the greener vehicle discounts available. As the scientific evidence became clearer, the discount evolved to

[15] Congestion charging Central London, Impacts monitoring Second Annual Report April 2004 https://content.tfl.gov.uk/impacts-monitoring-report-2.pdf

require progressively greener vehicles, but still around 4,000 Londoners die prematurely each year due to air pollution.

Money raised from the Congestion Charge has been invested into helping Londoners make journeys in more environmentally friendly ways, with increases in buses and reallocation of road space helping to make London a more liveable and efficient city. This has delivered better facilities for people walking and cycling, such as protected cycle lanes, which has seen a growth of those cycling of 137 per cent since the start of the millennium[16].

More Information

Congestion Charge 20-years on Press Release: https://tfl.gov.uk/info-for/media/press-releases/2023/february/congestion-charge-marks-20-years-of-keeping-london-moving-sustainably

TfL Congestion Charge Publications Page: https://tfl.gov.uk/corporate/publications-and-reports/congestion-charge

Impacts Monitoring, First Annual Report: https://content.tfl.gov.uk/impacts-monitoring-reportl.pdf

Impacts Monitoring, Second Annual Report: https://content.tfl.gov.uk/impacts-monitoring-report-2.pdf

[16] Congestion Charge marks 20 years of keeping London moving sustainably (Press Release), 17 February 2023, available at: https://tfl.gov.uk/info-for/media/press-releases/2023/february/congestion-charge-marks-20-years-of-keeping-london-moving-sustainably

4.4.2 Low Emission Zone

The Low Emission Zone (LEZ) was the first of London's emissions-based charging schemes, aimed at tackling the city's toxic air problem. It was introduced in February 2008 for Heavy Goods Vehicles (HGVs) over 12 tonnes and extended to include HGVs over 3.5 tonnes, buses, and coaches in July that year. In January 2012, the standards for HGVs, buses and coaches were tightened and the scheme was further extended to include larger vans and minibuses.

Large and heavy vehicles that do not meet the required emissions standards are required to pay a daily charge of between £100 and £300. The aim of the scheme is to drive emissions reductions across what has been the most individually polluting sector of the road traffic fleet in London.

Figure 14. Example of Heavy Goods Vehicles travelling in London

Stakeholder Engagement

A study was undertaken with operators of vehicles to be affected by the introduction of a LEZ. The study included face-to-face and telephone interviews, a questionnaire survey with hauliers/fleet operators and workshops with industry trade associations and other relevant bodies. While limited to a small number of respondent companies, the survey work included a range of company size and vehicle types, including operators of both lorries, HGVs, and vans.

Impacts

In 2021, tighter LEZ emission standards for heavy vehicles were introduced and, as a result, compliance with these new emissions standards continued to grow over the first 6 months of the scheme and by the end of August 2021 stood at 95.5 per cent compared to only 48 per cent in 2017 when the changes to the LEZ were announced but not yet implemented[17].

The purpose of the LEZ is to improve air quality in London by helping to reduce the number of older, more polluting heavy vehicles that enter the zone. Although we know the impact it has been having on vehicle compliance, it is difficult to disaggregate the improvements in overall air quality over a large area and show what has been attributable specifically to this scheme. A localised study by Imperial College London (London Borough of Hackney and London Borough of Tower Hamlets), showed the LEZ had a positive impact on air quality (NO_2), and long-term lung volume of local children increased[18]. However, the limited scope (only HGVs, buses, and coaches) meant there was still more we could do to have greater impact.

More Information

TfL Low Emission Zone Publication Page: https://tfl.gov.uk/corporate/publications-and-reports/low-emission-zone

The London Low Emission Zone Feasibility Study: https://content.tfl.gov.uk/phase-2-feasibility-summary.pdf

London Low Emission Zone – Six Month Report (2021): www.london.gov.uk/sites/default/files/lez_six_month_on_report-final.pdf

[17] London Low Emission Zone – Six Month Report, September 2021, available at: https://www.london.gov.uk/sites/default/files/lez_six_month_on_report-final.pdf
[18] Impact of London's low emission zone on air quality and children's respiratory health: a sequential annual cross-sectional study, available at: https://www.thelancet.com/pdfs/journals/lanpub/PIIS2468-2667(18)30202-0.pdf

4.4.3 Ultra Low Emission Zone

Central London ULEZ (2019)

To go further in tackling toxic air, on 8 April 2019 the Mayor of London launched the world's first Ultra Low Emission Zone (ULEZ) in central London, which requires all vehicles to meet minimum emission standards or pay a daily charge of £12.50. The ULEZ was expanded up to, but not including the North[19] and South circular roads on 25 October 2021.

The ULEZ operates 24 hours a day, every day of the year except Christmas Day (25 December).

The ULEZ scheme uses Euro emissions standards; these standards are a range of emissions controls that set limits for air polluting Nitrogen Oxides (NOx) and Particulate Matter (PM) from engines. New vehicles must show that they meet these limits to be approved for sale. The Euro emissions standards for ULEZ are:

- Euro 4 for petrol cars and vans (generally vehicles sixteen years old or less)
- Euro 6 for diesel cars and vans (generally vehicles six years old or less)
- Euro 3 for motorcycles and other L-category vehicles

Impacts

The ULEZ was introduced in central London in March 2019 and expanded to inner London in October 2021. The central London ULEZ had a clear impact – a reduction in roadside nitrogen dioxide levels by 44 per cent in Central London and 20 per cent in inner London[20]. In the first month of operation the average compliance rate (excluding non-typical days) with the ULEZ standards was around 71 per cent in congestion charging hours. This compliance rate is much higher than what was seen when plans were first announced (39 per cent in February 2017), and the month prior to launch (61 per cent in March 2019).

[19] The North circular road (officially the A406) is a 41 km ring road in North London. The South circular Road (officially the A205) is a 33km ring road in South London. Together, the North and South circular roads make a complete ring-road around London.
[20] Inner London Ultra Low Emission Zone Expansion One Year Report: https://www.london.gov.uk/programmes-strategies/environment-and-climate-change/environment-and-climate-change-publications/inner-london-ultra-low-emission-zone-expansion-one-year-report?auHash=IxeIM3L6iJh-CwYvb2wek2UKMCSJvpOqMgtpRAMt5B8

Figure 15. Example of ULEZ Road Signage

Inner London ULEZ (2021)

With the success of the Central London ULEZ in reducing toxic air pollution, the Mayor decided to expand the ULEZ to include the Inner London Boroughs on 25 October 2021. This expansion took the ULEZ to 18 times its original size and covers four million people – around 44 per cent of London's population.

Impacts

The ULEZ is recognised by independent experts as one of the most effective and rapid interventions at addressing air pollution and health inequality.

In February 2023, the GLA published a report[21] evaluating the impacts of the ULEZ and the LEZ schemes, focusing on one year following the ULEZ expansion to inner London and for the LEZ, over a year and a half on from the enforcement of tighter LEZ standards.

[21] Inner London Ultra Low Emission Zone Expansion One Year Report, https://www.london.gov.uk/programmes-strategies/environment-and-climate-change/environment-and-climate-change-publications/inner-london-ultra-low-emission-zone-expansion-one-year-report#key-findings

The findings indicate that the Mayor's air quality policies, and in particular the ULEZ and LEZ schemes, are having a significant impact in reducing the number of older, more polluting vehicles seen driving in London and on reducing the levels of harmful air pollution that Londoners are exposed to.

The number of older, more polluting vehicles in the zone has continued to reduce significantly. There was an almost 60 per cent reduction in non-compliant vehicles detected in the zone since the expansion came into operation, an average reduction of 74,000 polluting vehicles per day.

There has been an overall reduction in vehicles and traffic flows in the zone. In October 2022, there were 47,000 fewer vehicles seen in the zone on an average day (a reduction of almost 5 per cent) and data suggest traffic flows are around three per cent lower than in the weeks before the expansion.

The air in the zone is substantially cleaner. The ULEZ expansion to inner London has led to four million people breathing cleaner air, including 1,362 more schools. Particulate matter ($PM_{2.5}$) levels have also continued to reduce across London with a 41 per cent reduction in average concentrations in central and inner London since 2017.

Harmful nitrogen dioxide (NO_2) concentrations are estimated to be 21 per cent lower than they would have been in inner London without the ULEZ and 46 per cent lower than they would have been in central London. This is above what was predicted for the scheme. Substantial reductions in NO_2 concentrations were seen at roadside locations, with a 56 per cent reduction in central London, 47 per cent in inner London, and 37 per cent in outer London since 2017. Background monitoring sites away from the main road network also had significant reductions in NO_2 of 47 per cent in central and 45 per cent in inner London, since 2017.

Planned expansion of ULEZ London-wide, August 2023

Despite recent improvements in air quality, air pollution remains the biggest current environmental risk to the health of Londoners. If no further action is taken to reduce air pollution, around 550,000 Londoners will develop diseases related to poor air quality over the next 30 years. In this case, the cost to the NHS and social care system in London is estimated to be £10.4 billion by 2050.

A public and stakeholder consultation was held for a period of 10 weeks (20 May – 29 July 2022) on proposals to expand the ULEZ to all London boroughs. Considering feedback received and adapting the scheme as a result with a number of additional mitigations, the Mayor decided to expand the ULEZ from 29 August 2023.

The proposed expansion of the ULEZ London-wide will benefit the further five million Londoners who live in outer London, as well as those visiting and working in the city. The expansion is forecast to reduce Nitrous Oxide (NO_x) emissions from cars and vans in outer London by 10 and seven per cent respectively in 2023 compared to the baseline without the scheme. London-wide the reduction in road transport NO_x emissions is expected to be five per cent in 2023 compared to the baseline without the scheme, equivalent to 362 tonnes of NO_x.

Monitoring of the Scheme

The impact of both the ULEZ and LEZ can be assessed using several metrics, including:

- Number of vehicles and compliance rates
- Modelling of vehicle emissions
- Changes in fleet composition
- Air quality monitoring
- Traffic flow data

It is the concentration of pollution in the air, along with the potential of vulnerable individuals being closer to this, which is the biggest impact on peoples' health. While reducing volumes of emissions is the vital step in reducing concentrations, there are other important factors that affect concentrations, particularly the weather, natural seasonal variations and, for NO_2, significant atmospheric chemistry processes involving other pollutants and sunlight. For this reason, it takes time for a robust quantification of the impact on concentrations to emerge.

Data Privacy

The ULEZ uses a network of ANPR cameras to identify non-compliant vehicles and enforce the scheme. The cameras along the boundary and within the zone operate as a single network for the whole zone. This means that when a non-compliant vehicle is identified, even if it is observed on multiple cameras, only a single evidential record is retained for enforcement purposes to minimise the data collected. To effectively operate and enforce an enlarged ULEZ in August 2023, it is anticipated that approximately 2,750 additional ANPR cameras may be needed 22. All data, including images of Vehicle Register Marks (VRMs), is end-to-end encrypted. Any new cameras added to the network also have a privacy check to ensure they are not pointing at properties or driveways.

TfL has a range of robust policies, processes, and technical measures in place to control and safeguard access to and use of personal data associated with the camera systems used for road charging schemes in London.

TfL has followed the required Data Protection Impact Assessment (DPIA) process and has a published DPIA on its website which sets out how it minimises data collection from ANPR cameras to only what is needed, how data will be used and how TfL keeps it secure.

Financing

The total implementation cost for expansion of the ULEZ at the time the Mayor took his decision was estimated at £159.5m. Separately, a £110m scrappage scheme has been provided as a key mitigation. The implementation costs are being financed by the GLA, which means TfL will pay them back as vehicle charges are collected. The scrappage scheme is being funded by the GLA as a grant. The expansion is expected to generate an

[22] Improving air quality and Londoners' health, tacking climate change and reducing congestion, consultation overview, available at: https://haveyoursay.tfl.gov.uk/cleanair

incremental net operating surplus of approximately £200 million with a range of approximately 50 per cent in the first full year of operation. All revenue must be used to deliver the MTS, for example, be reinvested into London's transport network, such as expanding outer London bus services.

More Information

TfL ULEZ Publication Page: https://tfl.gov.uk/corporate/publications-and-reports/ultra-low-emission-zone

Data Privacy: https://tfl.gov.uk/corporate/privacy-and-cookies/road-user-charging

ULEZ Consultation Materials: https://haveyoursay.tfl.gov.uk/cleanair

Summary of all London's road user charging schemes in more detail: https://www.c40knowledgehub.org/s/article/How-road-pricing-is-transforming-London-and-what-your-city-can-learn?language=en_US

4.4.4 Scrappage schemes and retrofitting

From February 2019, the Mayor introduced a series of vehicle scrappage schemes, starting with a scheme for vans and minibuses, followed by a car and motorcycle scrappage scheme for Londoners on lower incomes and disabled Londoners, which opened in October 2019. Finally, a scheme for heavy vehicles opened in September 2020. These schemes were very popular, with all funding being allocated by 24 November 2021, shortly after the expansion of the ULEZ on 25 October 2021.

Scrappage schemes have been provided alongside road user charging schemes to help certain groups of people adapt to the new emissions standards. A scrappage scheme was one of the main recommendations made by the recent ULEZ Integrated Impact Assessment, to reduce the negative impact on certain protected characteristic groups e.g., disabled people[23].

Launched by the Mayor of London on 30 January 2023, the current scrappage scheme has built on the success on the previous one, as well as the lessons learned. The current scrappage scheme has funds of £110m, and allows Londoners on lower incomes and disabled Londoners, as well as charities, sole traders, microbusinesses, and small businesses to choose from a number of new options, including, scrapping cars, vans, motorcycles, minibuses, and wheelchair accessible vehicles. As well as scrapping non-compliant vehicles, van or minibus owners can opt to retrofit them to meet the emissions standards [24].

[23] London-wide ULEZ Integrated Impact Assessment (ULEZ Scheme IIA): https://ehq-production-europe.s3.eu-west-1.amazonaws.com/2e0438f24520ece474690bb99a94108e4a555b1e/original/1652882837/c7731c1b9dd3c304567a31d5b4816351_London-wide_ULEZ_Integrated_Impact_Assessment_%28ULEZ_Scheme_IIA%29_%282%29.pdf?

[24] TfL Scrappage Scheme, available at: https://tfl.gov.uk/modes/driving/ultra-low-emission-zone/scrappage-schemes

Figure 16. Scrappage scheme advert

Impacts

Following the closure of the first ULEZ Car and Motorcycle Scrappage Scheme, we issued an online questionnaire using a research agency to better understand the impacts of the scheme. The results show that the scheme was effective in reducing vehicle ownership and changing travel behaviour, supporting the Mayor's target of 80 per cent of all trips in London to be made on foot, by cycle or using public transport by 2041. The initial tranche of scrappage schemes removed 15,232 older and more polluting vehicles from London's roads.

It is estimated that the scrappage schemes have supported the removal of a total 140 tonnes of NO_x, 0.5 tonnes of $PM_{2.5}$ and 2,000 tonnes of CO_2.[25]

More information

Scrappage Scheme Evaluation Report: https://content.tfl.gov.uk/ulez-scrappage-schemes-evaluation-report.docx

Current Scrappage Scheme (2023): https://tfl.gov.uk/modes/driving/ultra-low-emission-zone/scrappage-schemes

[25] Based on average annual mileage information for vehicles

4.5 Future Road User Charging

What is clear from each of the Congestion Charge, Low Emission Zone and Ultra-Low Emission Zone is that tackling the triple challenges of improving air quality, the climate emergency, and reducing congestion is complex and cannot be comprehensively addressed by any one measure. However, reducing vehicle traffic is key and the success of road user charging schemes in achieving this have proven that they must be part of the solution.

New technology could be used to integrate the existing schemes into a smarter, simpler scheme that would charge motorists on a per mile basis. Different charging rates could apply depending on variables such as how polluting a vehicle is, the time of day or the location in which the vehicle is driven.

For any new road user charging scheme to be effective, we would also need to continue to make improvements to walking, cycling and public transport. If we do all these things together, we could reduce traffic, making room for essential car journeys, improving journey times for buses, emergency services and freight and servicing trips as well as cutting the number of hours spent stuck in traffic and its associated costs. Any new scheme would be subject to further public and stakeholder consultation.

4.6 Zero Emission Zones

The most effective way to reduce exposure to pollutants and to improve air quality is to continue to reduce the overall amount of vehicle miles travelled in London, alongside a shift to zero emission vehicles. Local Zero Emission Zones (ZEZs) offer the potential to both reduce traffic and improve air quality at specific air pollution hotspots to deliver health benefits to a local area. In a ZEZ, vehicles are subject to restrictions on exhaust emissions beyond those in the Ultra Low Emission Zone or Low Emission Zone.

We have produced guidance for borough councils in London interested in implementing a ZEZ, available at the 'TfL Zero Emission Zones Guidance' link in the 'More Information' box below. The design of ZEZs should consider access requirements for people with accessibility and mobility needs, such as vehicles specially adapted for disability needs, taxis, and wheelchair accessible PHVs (Private Hire Vehicles) and blue badge holders. Where an exemption is granted, it should be on the basis of access only rather than allowing through traffic. Enforcement options include use of automatic number plate recognition cameras at entry points into the zone or manual enforcement. In addition, physical interventions that form part of Healthy Street schemes can provide barriers to vehicle access.

In March 2020, the City of London Corporation[26] implemented phase I of the Beech Street Zero Emission Scheme with the aim of creating a vibrant retail street with a high-

[26] The City of London Corporation is the governing body of the City of London, the historic centre of London and two square miles in size, more information available at: https://www.cityoflondonschool.org.uk/about/city-of-london-corporation

quality public realm at the centre of the Culture Mile while improving air quality though a reduction in NO_x emissions.

The scheme restricted polluting traffic from using Beech Street as a "through route" whilst allowing access for zero emission capable vehicles and for any vehicle type that was accessing a property on Beech Street.

The result of the scheme is that it improved air quality by reducing NO_2 in the scheme area.

More Information

Beech Street Final Report: https:democracy.cityoflondon.gov.uk/documents/sI62499/Beech%20St%20G5%20Issues%20Report%20Final%20Dec2I.pdf

Beech Street Zero Emissions Scheme: https://cityoflondon.gov.uk/services/streets/traffic-schemes-and-proposals/beech-street

TfL Zero Emission Zones Guidance: https://tfl.gov.uk/info-for/boroughs-and-communities/zero-emission-zones

4.7 Bus Fleet

A high-quality, frequent, reliable, and affordable public transport network is essential in shifting journeys away from the private car and improving air quality. London already has one of the largest electric bus fleets in western Europe and our goal is to convert the entire fleet to zero-emission no later than 2034. Since 2017, we have worked to phase out older polluting diesel buses, replacing with new and retrofitting older mid-life buses with cleaner exhausts to meet Euro VI emissions, thereby reducing harmful NO_x emissions from buses by an average of 90 per cent, and particulate matter by around 80 per cent. Since January 2021, our entire bus fleet has met ULEZ emissions standards. By accelerating the delivery of a zero-emission bus fleet to 2030, with additional government funding, we can make bus travel a zero-carbon travel option in all parts of London. This would take 500,000 tonnes of carbon emissions per year out of the transport system.

Figure 17. Electric Bus

A modern public transport service that provides an inclusive customer experience, is safe and secure, offers attractive journey times and provides the connections people need, alongside improved environments for walking and cycling, would enable Londoners to live low-carbon, car-free lifestyles. Investing in the public transport network can also support other measures, such as road user charging, as part of a comprehensive traffic reduction package.

More Information

Bus Action Plan: https://content.tfl.gov.uk/bus-action-plan.pdf

4.8 Clean Freight

As London grows, so will the demand for freight, servicing, and deliveries. Accommodating this efficiently means finding new and innovative ways to move freight in London. This will lead to reduced numbers of vans and lorries on London's streets, preserving space for essential goods and services that need to be moved by these vehicles.

We have worked in partnership with businesses to successfully trial a number of last-mile and consolidation initiatives, with the objective of reducing delivery and servicing activity. Using the learnings from these projects we have produced four toolkits covering Sustainable shopping, Re-timing deliveries, Cycle freight and Waste consolidation, to help other businesses set-up similar schemes[27]. The toolkits are currently being refreshed and we are looking at areas to develop new ones.

Outlined in the Mayor's Transport Strategy, we are aiming to reduce morning peak freight transport in central London by 10 per cent by 2026. The pandemic had a marked effect on morning peak freight levels in central London, with a reduction of more than 20 per cent compared to 2016 levels.

With the Mayor's ambition for London to reach net zero carbon by 2030, cleaning up how freight is transported in London will play a key role in improving air quality and taking climate action.

We have published our Cargo Bike Action Plan in March 2023, setting out what we and our stakeholders plan to do to grow cargo bike delivery and servicing trips in London, as a safe, clean, and efficient alternative to vans and other light goods vehicles, being more reliable, taking less time, providing a clean and more economical alternative. The action plan outlines cargo bikes' growth potential, and addresses safety, behaviour change and infrastructure challenges.

[27] Deliveries toolkits, available at: https://tfl.gov.uk/info-for/deliveries-in-london/delivering-efficiently/deliveries-toolkits?intcmp=53241

Figure 18. Sustainable deliveries

With the aim of consolidating deliveries and reducing freight kilometres shifting to sustainable alternatives for deliveries, we continue working on identifying TfL estate land that can be used for lockers for Click & Collect services. As of March 2023, there are 28 Amazon lockers and 49 InPost lockers, with a total of 77 lockers at 51 TfL stations.

We have undertaken research that shows 39 per cent of vans are travelling around the capital less than a quarter full. This underutilisation provides an opportunity to use smaller vehicles such as cargo bikes. Construction culture has tended to focus on the larger material delivery but there are numerous items that can be accommodated by a cargo bike such as tools, generators, cables, paint, oils, and consumables. The benefit of a cargo bike is that they are smaller and can avoid queuing at sites with other construction freight. Maintaining segregation from heavy goods vehicles is very important especially when considering rider safety. We have worked with numerous sites to set up segregated loading areas specifically for cargo bikes. Having a comprehensive logistics set up to include routing, loading and management is key to successful operations and one which supplies environmental, safety and cost benefits.

In addition, we have also worked with Business Improvement Districts (BIDs)[28] to help promote and facilitate the consolidation of freight. BIDs' geographic scale is ideal for consolidation initiatives. An 18-month pilot project at Somerset House achieved a number of successes, including a reduction in the number of delivery and servicing vehicles recorded by the monitoring survey after one year. A key achievement was a 16

[28] A Business Improvement District (BID) is a geographical area in which the local businesses have voted to invest together to improve their environment. This could include extra safety, cleaning or environmental measures.

per cent reduction in the number of vehicles associated with the food and beverage outlets on site. There was an overall reduction of 12 per cent in the number of delivery and servicing vehicles from the baseline survey to the one-year follow-up monitoring survey.[29]

Stakeholder Engagement

We work with industry to understand the challenges they face and to encourage them to switch to alternatively fuelled vehicles, providing information on the LoCITY website[30] and having regular working group meetings with industry.

We have also conducted engagement processes with businesses to carry out specific initiatives with several stakeholders, to reduce the impact of last mile deliveries and find ways of using sustainable solutions.

We will continue to identify opportunities to shift freight trips from the road to less carbon-intensive and more sustainable modes such as rail and water. We have conducted light freight by water trials around the Thames with DHL (express courier service) and Guy's and St Thomas hospital, serviced on the ground by cargo bikes and electric vans, which are still operating.

More Information

Cargo bike action plan: https://content.tfl.gov.uk/tfl-cargo-bike-action-plan-2023-acc.pdf

Delivering the Mayor's Transport Strategy 2021/22 (p.30): https://content.tfl.gov.uk/tfl-mts-update-14-july-2022-acc.pdf

TfL Freight Publications Page: https://tfl.gov.uk/corporate/publications-and-reports/freight

Deliveries Toolkits: https://tfl.gov.uk/info-for/deliveries-in-london/delivering-efficiently/deliveries-toolkits?intcmp=53241

[29] Evaluation of Freight Consolidation Demonstrator Projects, available at: https://content.tfl.gov.uk/steer-assessment-of-demos-report-oct-2019.pdf
[30] https://locity.org.uk/

4.9 Taxis and private hire

Historically, the taxi trade has had a limited choice of diesel vehicles to use. This has led to the fleet becoming a significant contributor to poor air quality, particularly in central London, where they contribute 25 per cent of all transport NO_x in central London.

To tackle this, we are helping to phase out diesel taxis and establish the Capital's fleet as the greenest in the world by:

- Introducing a scrappage scheme for the oldest taxis from 2017. Up to £10,000 was available to drivers who chose no longer to licence their vehicle in London, with the exact amount depending on the age of the vehicle
- Requiring that, from 1 January 2018, no more new diesel taxis are licensed in London and all newly registered taxis are Zero Emission Capable (ZEC)
- Reducing the cost premium of new vehicles by providing a £3,000 grant towards the first 9,000 ZEC taxis licensed in London and lobbying Government to guarantee the plug-in car grant for these vehicles, enabling up to £7,500 in total
- Delivering a rapid charging network from 2017 to enable drivers to maximise fuel savings and operate mostly in zero emission mode, with locations dedicated to the taxis

From 1 November 2019 the maximum taxi operating age has been mandated so that no taxi will be licensed to operate over its relevant age limit. This applies to all licensed taxis. Between November 2020 and November 2022, the age limit of Euro 3, 4 and 5 diesel taxis were reduced by one year, each year. This has brought the maximum age limit for all taxis except those which are Euro 6 or Zero Emission Capable to 12 years. For more information on taxi age requirements, please see the "Taxi Age Limit Decision Paper" in the More Information section below.

Figure 19. Zero Emission Taxi

More Information

Emissions Standards for Taxis: https://tfl.gov.uk/info-for/taxis-and-private-hire/emissions-standards-for-taxis

Taxi and Private Hire Action Plan: https://content.tfl.gov.uk/taxi-and-private-hire-action-plan-2016.pdf

Taxi Age Limit Decision Paper: https://content.tfl.gov.uk/taxi-age-limit-decision-paper.pdf

Licensing in London: https://tfl.gov.uk/info-for/taxis-and-private-hire/licensing?intcmp=3521

5 Monitoring

Monitoring is essential to know whether a scheme has been successful in achieving the outcomes planned. It is invaluable in evidencing this success and securing support from stakeholders, including the public, and possible funding bodies. It is also required to test the effect of policy scenarios, to help determine what scheme would be most effective, and how to shape it. For the types of schemes included in this report, all working towards improving air quality, the typical types of data that we monitor are:

- Traffic flow and travel habits (i.e. number of trips by each transport mode, including driving, walking, cycling, and public transport)
- Road safety (reports of killed and seriously injured)
- Modelling of vehicle emissions
- Air quality monitoring

For certain schemes, additional data could be useful such as:

- Money spent in local businesses
- Local perceptions
- Levels of crime
- Emergency response times
- Fleet composition
- Number of vehicles and compliance rates (with emissions standards)

Monitoring should happen before, during, and after a scheme implementation, to be able to show any changes. Depending on the scheme, it may be useful to also monitor sites where the scheme has not been implemented, to provide a form of control test. As air quality is so heavily influenced by other environmental factors, notably the weather, monitoring these is also very useful. This helps to determine what impact the scheme had, and what would have happened without it.

The GLA and TfL work in partnership to produce a comprehensive set of air quality datasets. These enable us to formulate evidence-based policy and guide boroughs as they improve air quality locally.

The London Atmospheric Emissions Inventory (LAEI) is the key tool for air quality analysis and policy development in London. It is a regularly updated database of pollutant emissions and sources including geographically referenced data and maps. It relies upon an extensive network of air quality sensors across the City[31].

[31] Source: https://data.london.gov.uk/air-quality/

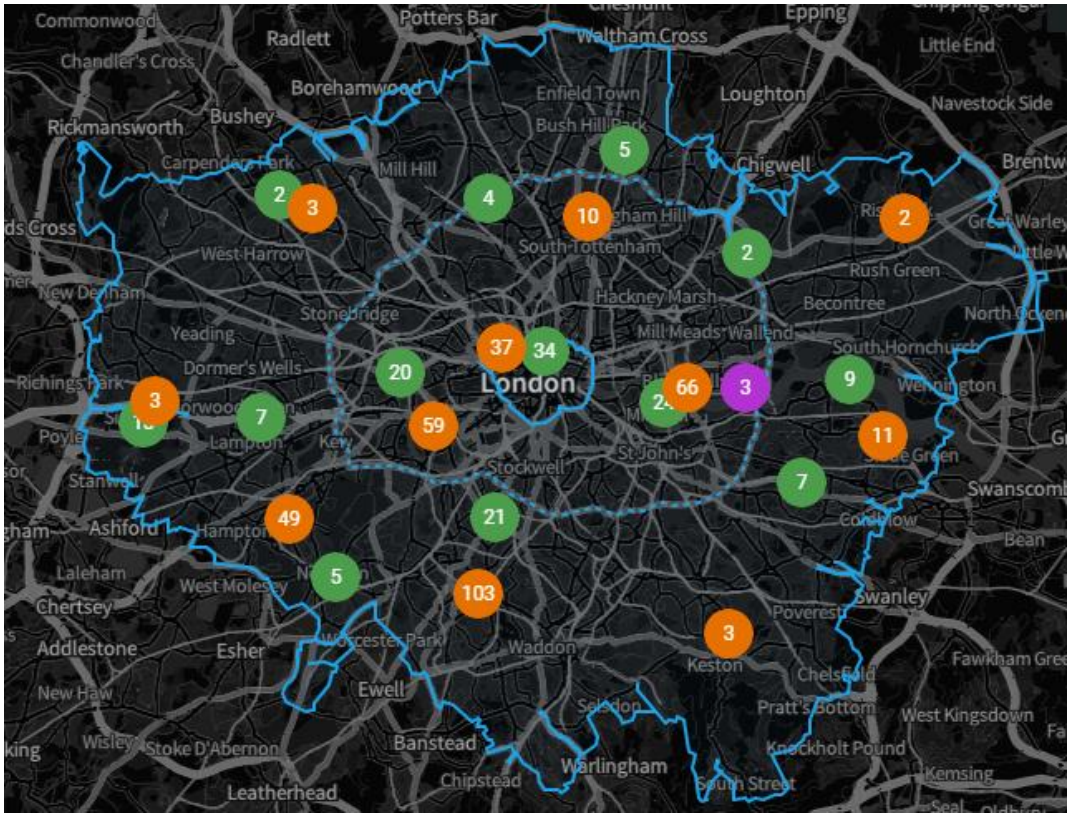

Figure 20. Map of locations of air quality monitoring across London

To understand the impact of certain interventions, TfL uses its strategic transport model "MoTiON" and other bespoke tools. MoTiON consists of a demand model and three assignment models, one of which is LoHAM – the London Highway Assignment Model. MoTiON can forecast personal journeys for highway, public transport, and active travel to, from and within London. The model can be used to assess forecasts of behavioural choices such as trip frequency, mode, and destination choices as well as route choice by highway, public transport, and cycle modes in response to a charge. Impacts presented on traffic, mode shift and vehicle kilometres are based on MoTiON and LoHAM outputs.

Road transport exhaust emissions are estimated based on modelling tools using the European COPERT database of road transport emission factors for each vehicle type and the average vehicle speed. For particulate matter, non-exhaust emissions (brake and tyre wear) are also considered.

More Information

London Atmospheric Emissions Inventory (LAEI):

https://data.london.gov.uk/dataset/london-atmospheric-emissions-inventory--laei--2019

London's Strategic Transport Models:

https://content.tfl.gov.uk/londons-strategic-transport-models.pdf

6 Stakeholder Engagement

TfL Consultations

Consultations have played a key role in the development of the different air quality schemes we have outlined in this report. In simple terms, a consultation is a process where a change is proposed (at TfL this is typically a physical scheme / project or a change to policy) and members of the public and stakeholders have an opportunity to provide feedback on what affect the proposals would have on them.

Through the consultation process, we ensure that people who are likely to be affected by a proposed change have an opportunity to:

- Learn about the proposal
- Review all the necessary information relating to the proposal
- Consider how this might impact them
- Share their views with us

Importantly, a consultation is always run before a decision is made on how to proceed with a proposed change.

It is also a process where we, the organisation running the consultation, commit to listen to the consultation outcome and to consider this in our decision making before we proceed with any change. This might mean we either decide not to proceed, we alter our proposal, or we proceed as planned; based on what we have learned from the consultation.

Typically, consultation feedback is gathered through a questionnaire or survey. It can also involve public events and deliberative activities, such as focus groups or citizen assemblies, to ensure that those impacted by proposed changes have an opportunity to share their views.

Figure 2l. Public event run as part of stakeholder engagement

The importance of consultation

Consultation with the public and our stakeholders is an essential part of our decision-making process and helps us in the development of our transport policies, projects, and schemes. It supports an open and honest dialogue with those groups or individuals who will benefit from, influence or be impacted by a project, scheme, or policy. Importantly, it is a means to demonstrate to London's diverse communities that as an organisation we are transparent and honest when we propose to change our transport network or services.

Consultation is key to ensuring that as an organisation we can:

- Make informed decisions by listening to those impacted by our proposals
- Deliver schemes and services that are better aligned with what the public want
- Minimise uninformed objections to proposed services and schemes from the public or our stakeholders
- Bring the public and stakeholders with us through the decision-making processes
- Understand the needs of all our customers

Legal Requirements

We deliver all our consultations in line with the Gunning Principles. These principles were created in 1985 by Stephen Sedley QC to better define the legal requirements of the laws of consultation. Sedley defined that a consultation is only legitimate when the following four principles are met:

1. **Proposals are at a formative stage** - In other words a final decision has not yet been made or predetermined by the decision makers

2. There is **sufficient information to give 'intelligent consideration'** - The information we provide must relate to the consultation and must be available, accessible, and easily interpretable for consultees to provide an informed response

3. There is **adequate time for consideration and response** - There must be sufficient opportunity for consultees to participate in the consultation.

4. **Conscientious consideration** must be given to the consultation responses before a decision is made - this means that decision makers should be able to provide evidence that they took the consultation responses into account.

The Gunning Principles have been reinforced in UK case law specifically in 2001 and then in 2014 by the Supreme Court, which endorsed the legal standing of the four principles. Since then, the Gunning Principles have formed a strong legal foundation from which the legitimacy of public consultation is assessed. They are frequently referred to as the legal basis for judicial review decisions.

Representing the communities impacted

We run robust and legally compliant consultations using a variety of promotional and marketing channels to reach out to and raise awareness of our consultations with communities, residents, and stakeholders likely to be impacted by the proposals.

However, as with any consultation, the results may not show a fully representative sample of views from every impacted community or demographic. This is due to the natural sample bias that comes with any self-selecting engagement approach.

There are different reasons why some individuals may be motivated to respond to a consultation. Whatever the reason for different levels of engagement in a consultation, we see that despite a diverse sample of views that we capture during a consultation, the views of some are represented more than others.

To address this, we can monitor and reflect on the communities that are responding to our consultation, adjusting, or bolstering elements of our marketing and promotion plans where we might see under representation. Or we may suggest other data capture methodologies to help supplement the consultation data with additional sources of evidence. The type of additional actions we sometimes take to target underrepresented groups include, but are not limited to, the following:

- Targeted online or web events
- Targeted polling
- Additional media marketing

Stakeholder Engagement Capabilities at TfL

In addition to our formal consultation process, we also use the skills of dedicated stakeholder engagement teams within TfL to support the development and delivery of our projects.

These teams engage with key stakeholders, including local authorities, national government, elected politicians, businesses, and charities. Through these teams we can provide key functions such as:

- **Early engagement on policy and projects:** working with external national and strategic stakeholders and representative groups to feed into, help shape and improve our decision making on policies and projects.

- **Advocacy:** build productive relationships with influential organisations and representative groups across London and the UK and leverage these relationships to strengthen our reputation and support our calls for the right funding and policy environment.

- **General Public Affairs function:** act as a barometer, challenge, and strategic counsel function for the organisation, providing advice and approaches for strategic stakeholder communication and relationship management.

Figure 22. Example of TfL external stakeholder groups

7 Governance

TfL is a statutory body created by the Greater London Authority (GLA) Act 1999. This Act gives the Mayor of London a general duty to develop and apply policies to promote and encourage safe, integrated, efficient and economic transport facilities and services to, from and within London. As an organisation, we recognise the importance of governance and we set a very detailed framework to ensure accountability, effective decision-making, efficiency, risk management, stakeholder engagement, long-term planning, and compliance with legal and regulatory requirements.

- **Accountability:** As a public transport authority we are always accountable to the public and our stakeholders for our decisions. Therefore, we have established mechanisms for transparency, reporting, and oversight. By having effective governance structures in place, we can make informed and timely decisions. The processes and frameworks we have created ensure that decisions are based on relevant data, analysis, and stakeholder input. This helps us prioritise projects, allocate resources, and address the transport needs of London. Our governance also aims to establish clear lines of authority, roles, and responsibilities, reducing ambiguity and duplication of efforts.

- **Risk Management:** Because of the complex and dynamic environment in which we operate we are often faced with numerous risks and uncertainties. Having effective governance structures help us identify, assess, and mitigate risks. It establishes risk management frameworks, compliance procedures, and internal controls to minimise the likelihood and impact of risks on our operations, reputation, and the safety of the traveling public.

- **Stakeholder engagement:** We serve a diverse range of stakeholders, including customers, businesses, local communities, and government bodies. Our governance ensures that these stakeholders have avenues for engagement and participation in decision-making processes.

- **Long-term planning:** Transport infrastructure and services require long-term planning and investment. Our governance provides a framework for strategic planning, setting long-term goals, and policy-making that aligns with London's needs. It enables us to develop sustainable and integrated transport solutions, considering factors such as urban growth, environmental impact, and technological advancements.

- **Compliance and regulatory requirements:** We operate within a legal and regulatory framework that governs transport services, safety standards, and financial management. Our governance structure has established mechanisms for internal audits, financial reporting, and compliance monitoring, thereby safeguarding our integrity and reputation.

Meetings

The conduct of Board and committee meetings come under provisions of the Local Government Act (LGA) 1972. To support transparency, we also apply the same provisions to the meetings of our panels.

A public notice of the date, time and venue for meetings is published on the TfL website as well as at our head office and the meeting venue. The meetings are held in public unless information that is exempt from publication needs to be discussed. The meetings are also streamed live on TfL's YouTube channel, with a link provided on the agenda for each meeting.

Our current committees and advisory panels are listed below.

- Board
- Audit & Assurance committee
- Customer service & Operational performance panel
- Elizabeth line committee
- Finance committee
- Land & Property committee
- Programmes & Investment committee
- Remuneration committee
- Safety, Sustainability & HR (Human Resources) panel

Board Members

The GLA Act sets out certain provisions for the membership of the TfL Board, including the desirable experience the Members should possess between them.

Chief Officers

As permitted under the GLA Act, the Board delegates to the Chief Officers the discharge of any functions of TfL (except for those reserved to the Board or with specific delegations) and the day-to-day management of the business of the TfL Group.

8 Conclusion

Improving air quality in London has been a long-term process and requires a **holistic approach**. It is not the result of one single policy measure or scheme, but the amalgamation of many. Each policy measure builds upon the last and complements its neighbouring schemes, building up a network of schemes across the city, which together combine to have a significant positive impact on air quality.

This report has introduced some of the schemes that we have implemented in London and contains links to further information for each. Everything that we do in London is underpinned by the **Healthy Streets Approach**, helping to make the public realm more welcoming and attractive to spend time in, which encourages people to spend more time outdoors, interacting with their neighbours and local businesses, and being active by walking, cycling, and wheeling more than using cars.

Alongside this is the importance of long-term **investment in public transport and active travel** infrastructure. This is essential if we want to encourage people to travel in ways which do not involve the private car. **Strong political leadership** is also essential. Some schemes will initially cause objections and take time to be accepted, but we have found many times that often once local people experience it, and see the benefits for themselves, that they support it more.

Part of being able to show the benefits to local people, as well as politicians, is ensuring that we have **good quality data and robust monitoring**. This opens the door to changing opinions and creating support for a scheme, which often ultimately determines its success. This goes hand in hand with **stakeholder engagement and communications.** Clear, open, and honest dialogue with those groups or individuals who will benefit from, influence or be impacted by a project, scheme or policy is very important. It improves the efficacy of the work we do, as it is designed around real people and their needs, and it also builds support among stakeholders.

Finally, improving air quality does not happen overnight. The improvements we have made in London have taken years to achieve and are the result of continued action. We started with smaller scale schemes, proving the benefits, and reassuring stakeholders, and built upon our successes, scaling schemes up in size, and number, to cover more of the city.

The levers of change for improving air quality can be summarised as:

- Holistic approach
- Healthy Streets
- Investment in public transport and active travel infrastructure
- Strong political leadership
- Good quality data and robust monitoring
- Stakeholder engagement and behaviour change
- It takes time; build on success

Contact us

For more information or to discuss potential opportunities, email TfLConsulting@tfl.gov.uk or visit tfl.gov.uk/consulting

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