MAYOR OF LONDON

LONDON LOW EMISSION ZONE – SIX MONTH REPORT

September 2021

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Foreword

Launched in 2008, London's Low Emission Zone (LEZ) is the oldest of the capital's emission control schemes. The emissions standards for the scheme have increased over time so it has progressively made a significant contribution to improving air quality.

In February 2017 the Mayor announced his intention to increase the standards from Euro IV to Euro VI by October 2020. The implementation of the new standards was deferred until March 2021 due to the Covid-19 pandemic. Since the changes to the scheme were announced many large and small businesses, sole traders, charities and private owners of large and heavy vehicles have shifted to cleaner vehicles. That they have managed to do so in the face of complex circumstances and difficulties caused by the Covid-19 pandemic is a true testament to their commitment to the city and the health of its residents: in fact the evidence showed a steady growth in compliance throughout the pandemic.

This report shows that these efforts have resulted in very high levels of compliance; over 95 per cent. Not only that but, because many vehicle owners made efforts to comply well in advance of the new standards coming into effect, improvements to air quality in London have come early, before the formal launch of the new standards.

Since the announcement of the ULEZ, the LEZ, and by extension the contribution of London's businesses and charities to cleaning up our air as well as reducing emissions nationally, has too often been overlooked. This report is a chance to celebrate their achievements.

Crucially these benefits have not just been realised in London; independent research highlighted in this report has shown how the lorries, buses, minibuses and vans which have been upgraded to meet the new LEZ standards travel extensively outside the capital. This means the LEZ has had knock on benefits for trunk roads, ports and town centres across England and the UK, improving air quality for millions of people across the country.

Key Findings

- Businesses and heavy vehicle owners have responded superbly to the need to upgrade for the tighter Low Emission Zone standards.

- Compliance 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 had not yet started**. In effect compliance has doubled since the scheme was announced in 2017.**

- Even the most challenging sector (non-TfL bus and coaches) are making great strides, with compliance at **87.1 per cent**, up from 51.9 per cent in May 2019**.** Non-TfL buses and coaches are often built individually or in small quantities making them harder to retrofit and more expensive to replace, difficulties that have been compounded by the significant loss of trade for many of these business during the pandemic.

- As part of the Mayor's commitment to lead the way and to radically transform the TfL bus fleet, **all of TfL's buses meet or exceed the Euro VI standard**. With the core fleet meeting the standards from the end of 2020, 3 months in advance of the scheme going live, this has reduced NO_x emissions from TfL buses by around 90 per cent since 2016.

- The LEZ also has significant benefits outside of London. Environmental Defense Fund analysis found that vehicles that passed through London's Low Emission Zone **went on to drive through 95 per cent of the major towns and cities in England and Wales**, with a combined population of 18 million people.

Introduction

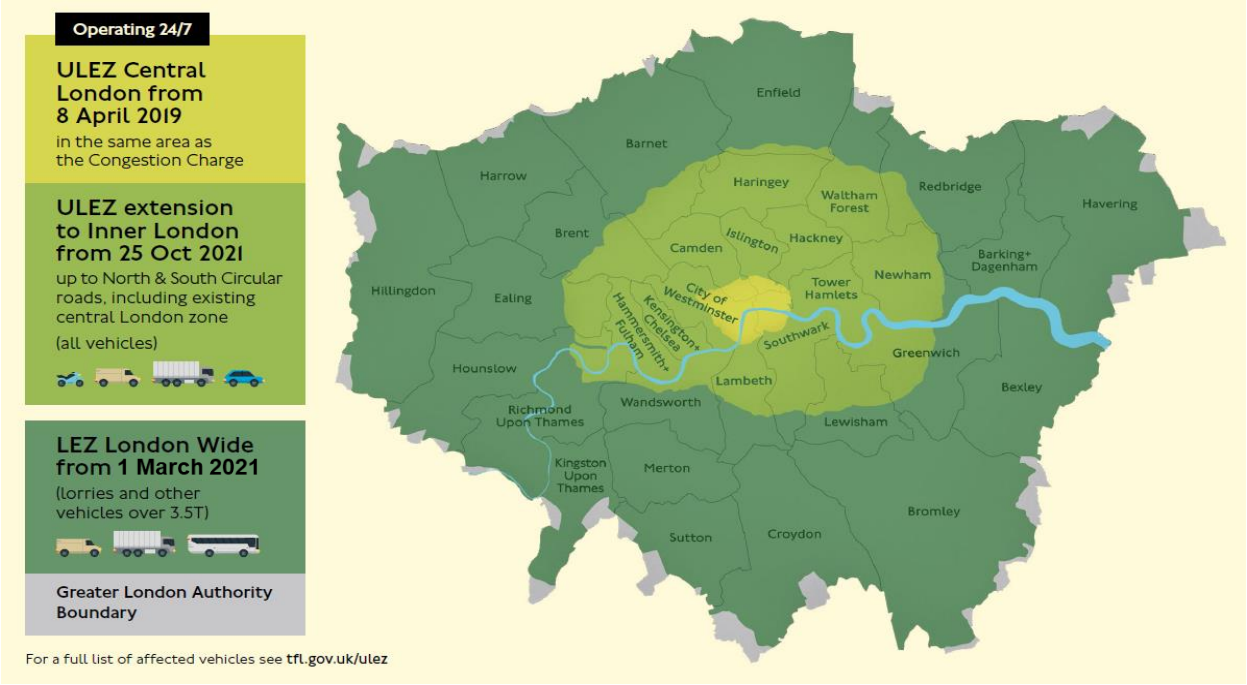
London's Low Emission Zone applies to large and heavy diesel vehicles, including, lorries, buses, minibuses and vans on nearly all of the roads in the capital.

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

The Low Emission Zone (LEZ) was the first of London's charging-based emissions reductions schemes. 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.

In the intervening years the evidence of the harm caused by air pollution, even at levels below legal limits, has continued to grow while emissions and concentrations remained stubbornly high. Which is why, as part of his wide-ranging programme to clean up London's air the current Mayor, Sadiq Khan, introduced new tighter LEZ standards for HGVs, buses and coaches from March 2021. The difference between Euro IV, the previous LEZ standard for these vehicles, and Euro VI, the new standard, is significant; about a 50 per cent reduction in Particulate Matter emissions and a 65 per cent reduction in NO_x emissions.

Figure 1: LEZ and ULEZ boundary



Between 2008 and 2013 the LEZ contributed directly to a 20 per cent reduction in PM_{10} emissions in London and indirectly to a 27 per cent reduction in $PM_{2.5}$ emissions and a 25 per cent reduction in NO_x emissions[a] (all sources).

While this is a significant achievement it was not enough to secure compliance with legal limits for PM_{10}[b] or NO_2, or with the more ambitious WHO recommended targets for $PM_{2.5}$[c].

From 2016 the current Mayor, Sadiq Khan, consulted on proposals to further tighten the LEZ standards. This consultation was run in parallel with the proposals for significant amendments to the Ultra Low Emission Zone (ULEZ) including bringing forward the implementation date and expanding it to a wider area of London. At the time these consultations received the largest response of any GLA or TfL consultations.

As a result, the ULEZ was introduced in April 2019 and will be expanding up to (but not including) the North and South circular roads on 25 October 2021.

For the majority of vehicles covered by the LEZ, the standards were proposed to be aligned with the ULEZ standards from October 2020[d]. However, to allow the freight

[a] https://www.london.gov.uk/sites/default/files/les_appendix_2_-_evidence_base_0_0.pdf. The reduction in $PM_{2.5}$ is described as "indirect" because the Euro standards do not have a specific limit for $PM_{2.5}$, so the reduction is because $PM_{2.5}$ is a fraction of the PM_{10} emissions, which are regulated.

[b] PM_{10} legal limits were achieved in absolute terms by 2015, although in 2013 and 2014 formal compliance was demonstrated after natural sources had been subtracted: https://uk-air.defra.gov.uk/library/annualreport/index

[c] The WHO targets for most pollutants were updated in September 2021, but in 2013 the less stringent 2005 targets applied.

[d] For larger vans and minibuses the LEZ standards remain unchanged, however they are separately subject to the ULEZ standards in central and, from October 25 2021, inner London.

industry to focus on its core operations during the pandemic the enforcement of these standards was delayed until March 2021. This report focuses on compliance with the new LEZ standards in the run up to, and for the first six months after their introduction.

Low Emission Zone Standards over time

When it was introduced in 2008 the focus of the Low Emission Zone was to reduce emissions of particulate matter, and specifically PM_{10} which is all particulate matter with a diameter of less than 10 microns (µm). While the focus of air pollution debates in recent years has turned to the smaller $PM_{2.5}$ fraction, reductions in PM_{10} have historically benefitted public health and contributed to a long-term reduction in $PM_{2.5}$. This is because around 47 per cent of PM_{10} emissions in London are made up of the smaller $PM_{2.5}$ fraction[e].

One consequence of the focus on PM_{10} was that the LEZ initially required compliance only with the Particulate Matter element of the Euro emissions standard. The changes introduced more recently have broadened the scope of the scheme to include oxides of nitrogen (NO_x) as part of the Mayor's programme to achieve compliance with legal limits for NO_2 as soon as possible.

Since 2012 there have been different standards for HGVs, buses and coaches, and larger vans and minibuses. With the introduction of the central London T-charge in 2017, and in 2019 the ULEZ, there were different emissions standards for vehicles driving in central London than in the wider LEZ zone.

The changes to the LEZ standards in March 2021 brought a greater alignment with the ULEZ, and for the majority of large and heavy vehicles there is now only one standard to consider across the whole of London.

[e] https://data.london.gov.uk/dataset/london-atmospheric-emissions-inventory--laei--2016

Table 1: Emissions standards for large and heavy vehicles over time

	LEZ standards - Londonwide		T-charge/ULEZ standards: central London	
Date	Standard for HGVs, buses and coaches	Standard for larger vans and minibuses	Standard for HGVs, buses and coaches	Standard for larger vans and minibuses
February 2008§	Euro III (PM only)	N/A	N/A	N/A
January 2012	Euro IV (PM only)	Euro 3 (PM only)		
October 2017			Euro IV (PM and NO_x) Euro VI (PM and NO_x)	Euro 4 (PM and NO_x)*
April 2019				Euro 4 for petrol vehicles (NO_x only) Euro 6 for diesel vehicles (PM and NO_x) †
March 2021	Euro VI (PM and NO_x)		N/A	

§ February 2008 for HGVs over 12 tonnes, July 2008 for HGVs over 3.5 tonnes, buses and coaches
** T-charge standards for larger vans and minibuses were petrol Euro 4 (NOx only) and diesel Euro 4 (PM and NO_x.) The standards were only applied during congestion charge hours (Monday – Friday 7am – 6pm)*
† From 25 October 2021 the ULEZ expands up to the North and South circular roads. The standards will remain the same.

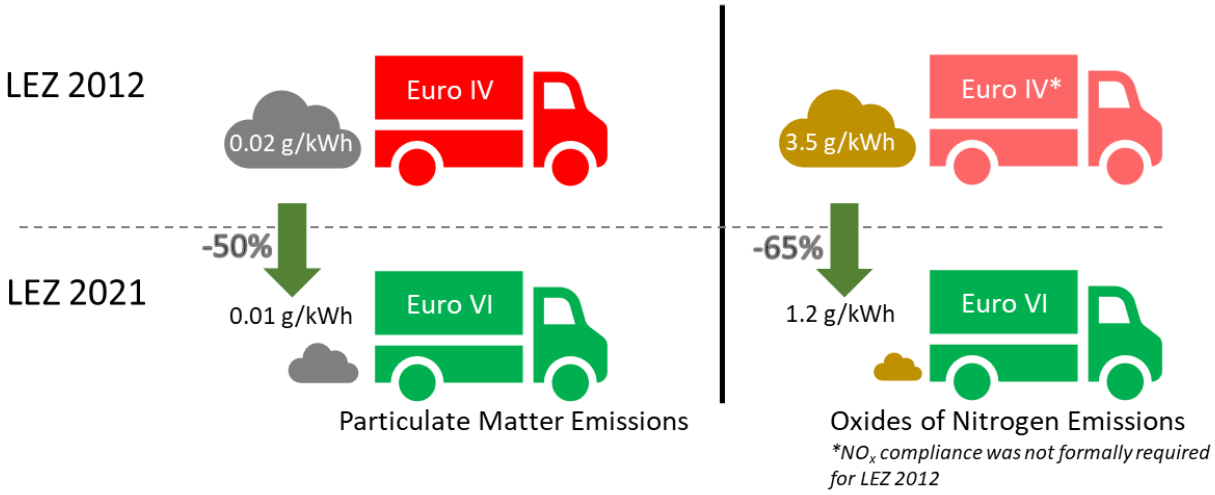
Comparison of Euro emission standards

Like the Ultra Low Emission Zone, the LEZ is based around the Euro standards for engine emissions.

Euro emissions standards are set differently for larger engines of the type used in buses and heavy goods vehicles and smaller engines more often used in vans and cars. This is indicated by the use of Roman numerals for the larger engines and Arabic numbers for the smaller engines.

The first Euro standards came into effect in 1992 and impose emissions limits for Particulate Matter and Oxides of Nitrogen, as well as some other pollutants. Over time the standards have got stricter, with the most recent standard (Euro VI) coming into effect from the end of 2012 for the heaviest vehicles (Euro 6 for cars and vans came in from 2015). Despite their name the Euro standards have been adopted in UK law and remain in effect post Brexit.

Figure 2: comparison of Euro Standards for different pollutants



The difference between Euro IV, the previous LEZ standard, and Euro VI, the new LEZ standard is significant: about a 50 per cent reduction in PM emissions and a 65 per cent reduction in NO_x emissions.

Assessing the impacts of LEZ

The purpose of the LEZ is to improve air quality in London by helping reduce the number of older, more polluting vehicles that enter the zone. Unlike the ULEZ, the LEZ is focused solely on larger and heavier diesel vehicles. While this is an appropriate policy response to the historically disproportionate impact of these vehicles on air pollution it adds complexity to attempts to draw out specific changes in ambient air quality attributable solely to this scheme. This is because benefits from other policies and schemes will also contribute to overall changes in air quality.

Added to that complexity, even in a normal year air quality is subject to a range of effects, such as weather and seasonal variations in atmospheric chemistry and behaviour, including changing traffic flows, that make it complicated to compare and quantify the short term (less than 1-year) impacts of large projects such as the Low Emission Zone.

The impact of the Covid-19 pandemic, and individual, regional and national responses to the need to control it have meant that 2020 and 2021 have been different from previous years, and especially so for businesses who are likely to be the owners and operators of vehicles directly affected by the LEZ.

The first national lockdown in March 2020 imposed severe restrictions on personal activity and on most sectors of the economy, and even saw people being advised to avoid public transport for all but the most critical journeys. Anyone who could do so was told to work from home.

Subsequent easing of lockdown measures over the summer of 2020 saw some sectors of the economy, including construction and high street retail, returning to previous levels of running but others, such as professional sports, theatres and tourism remaining severely curtailed.

In the autumn schools returned alongside the introduction of a three-tier system, which was soon superseded by a “circuit breaker” lockdown in November and then “tier four” restrictions in London. In response to lockdown, the ULEZ, LEZ and Congestion Charge schemes were suspended between March and May 2020.

In July 2021 the majority of lockdown restrictions were formally lifted, but responses have been mixed with some sectors of the economy back in full swing and others only slowly emerging. At the time of writing this report, in autumn 2021, there are concerns about the shortage of drivers for heavy goods vehicles, both as a result of new post-Brexit visa restrictions and self-isolation rules for people exposed to Covid-19; a shortage drivers has

the potential to temporarily reduce the number of vehicles subject to the LEZ on the roads.

It will, therefore, be the job of future reports to examine air quality monitoring data and modelling studies of vehicle emissions in detail and draw out the impact of the LEZ, ULEZ (including the expansion of the ULEZ in October) and the Mayor's wider air quality programme in more detail.

Instead this report focuses on compliance rates as the most robust available indicator of the early impacts of the tightening of LEZ standards as well as considering whether any additional information about the performance of the scheme can be drawn from traffic flow.

Compliance with the new Low Emission Zone Standards

The introduction of tighter LEZ standards across London was consulted on in 2017, confirmed in 2018 and came into effect in March 2021, delayed from October 2020. Prior to this, large and heavy vehicles driving in central London were subject to the T-charge from October 2017, then the central London ULEZ from April 2019.

Many large and heavy vehicles are owned and operated by businesses who plan their replacement and deployment cycles well in advance. As a result, we would expect to see a progressive change in compliance rates over time including before the formal start of the scheme reflecting operators preparing fleets, along with further increases in compliance rates around the time of introduction of the standards in March 2021.

The Transport for London fleet of around 9,000 buses is formally subject to the LEZ standard. Through a combination of retrofit, replacement and the introduction of zero emission buses the TfL fleet now meets or exceeds the Euro VI standards throughout the capital. The TfL bus fleet is one of the largest heavy fleets operating in the capital and achieving this milestone in just 4 years is a significant achievement.

Not only is the whole TfL bus fleet compliant with the Low Emission Zone, but well over 500 of the buses, including double deck buses, in regular use are zero emission electric or hydrogen models. On the 17 September 2021 the Mayor announced that all new buses entering the fleet will now be zero emission. The innovations needed to build zero emission double deck buses will not only help TfL in driving down carbon as well as pollutant emissions but can also be applied in other cities and vehicles as part of wider national and international programmes to decarbonise transport and tackle climate change and improve air quality.

Table 2 shows compliance rates with the new LEZ standards over time.

This table shows that, six months after the launch of the tighter standards **95.5** per cent of affected vehicles meet the new, tighter standards. This is an increase of **47.5** percentage points since the new standards were announced in 2017, and an increase of **5.1** percentage points in the 6 months since the new standards came into effect. This shows the very high levels of pre compliance the scheme engendered but also that the scheme continues to deliver benefits to air quality with continually improving compliance rates.

Table 2: LEZ compliance rates

Month	LEZ Compliance Rate (new standards)
Feb – 2017 baseline§	48%
May-19*	71.0%
Sep-19*	73.7%
Jan-20*	78.5%
May-20†	83.2%
Jun-20†	83.4%
Jul-20†	83.8%
Aug-20†	85.0%
Sep-20†	85.0%
Oct-20†	85.8%
Nov-20†	87.9%
Dec-20†	88.7%
Jan-21†	89.9%
Feb-21†	90.4%
March-21	93.5%
Apr-21	94.3%
May-21	94.5%
June-21	94.9%
July-21	95.3%
August-21	95.5%
Overall change in compliance February 17 to present	**Increase of 47.5 percentage points**
Increase in compliance since the scheme was launched	**Increase of 5.1 percentage points**

Table notes:

§ February 2017 based on data from the London Atmospheric Emissions Inventory

** Analysis based on sampled days within these months, using historical data*

† Compliance rates estimated using information from ANPR camera data and associated vehicle information such as age and type of vehicle

While it is not possible to be absolutely certain what would have happened if we had not changed the standards for the Low Emission Zone, it is possible to estimate how many new, compliant, vehicles would have entered the fleet based on long standing trends.

Figure 3 below shows the overall observed compliance rate against our prediction of what would have happened without tighter standards for heavy vehicles in London. The lower line shows our estimates of what would have happened without these changes and the vertical green bar marks the point where the new standards went live Londonwide. Overall, the proportion of vehicles meeting the stricter emission limits is substantially higher than it would have been based on natural churn alone. This demonstrates that the scheme has been effective in cleaning up the fleet more rapidly than would have otherwise been the case, helping to improve air quality in London. It also shows how the acceleration in compliance started well in advance of the scheme launch, and this is also influenced by the central ULEZ in April 2019 as some vehicles will also have travelled into the ULEZ zone. Monitoring of LEZ compliance also shows there was a larger than average uptick in compliance in the month that the scheme launched (about 3.1 per cent in March compared to an average 1 per cent increase in the preceding 6 months).

Figure 3: Comparison of vehicles meeting the new standards with and without the LEZ and related scheme in place.

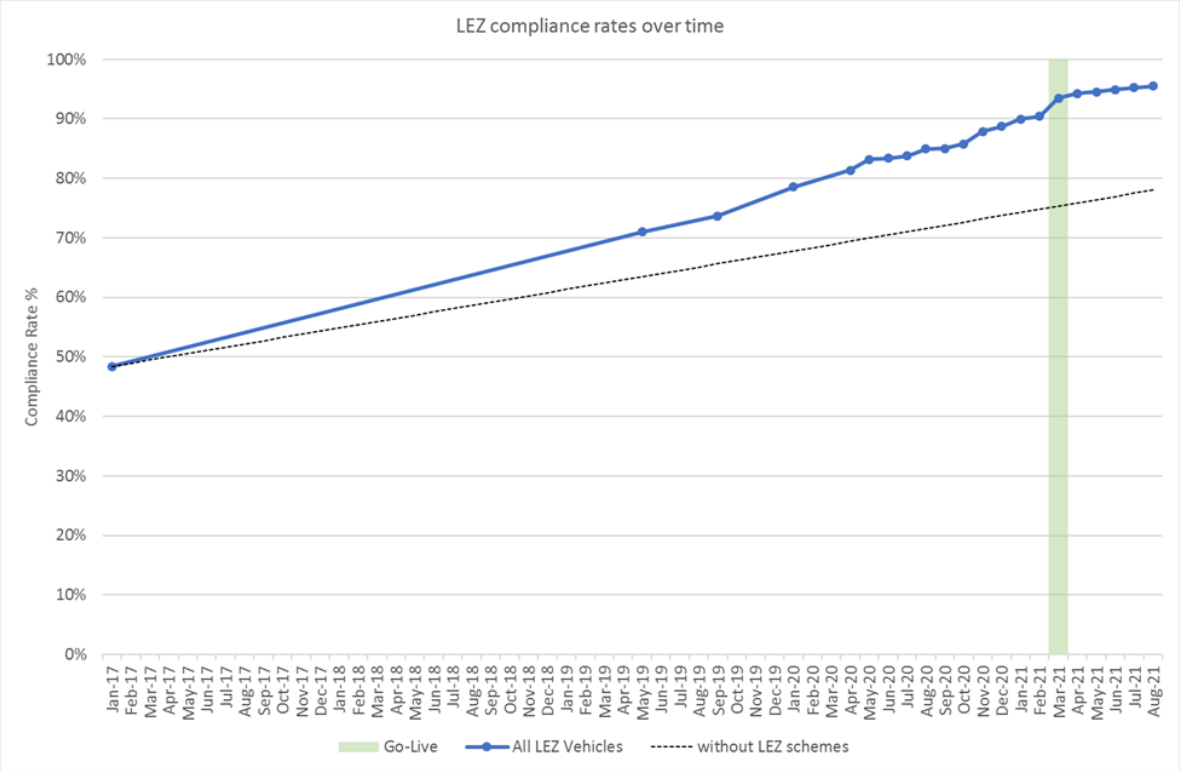


Table 3 below breaks down compliance by vehicle categories since May 2019 (the February 2019 baseline data was not broken down into vehicle categories and so is not used in this table). This table shows that compliance rates across all vehicle types are high, with no individual sector or type underperforming: in fact, all non-TfL sectors have shown impressive growth in compliance of in excess of twenty percentage points. This rapid and substantial reduction in emissions will contribute to long term reductions in air pollution throughout London, with consequent benefits for the health of all Londoners.

The relatively low increases in compliance for TfL buses is because of the very high baseline levels of compliance secured by TfL's actions prior to May 2019, including the introduction of Low Emission Bus Zones and the retrofit programme, as well as ensuring replacement buses met the standard. In September 2021 the Mayor announced that all new TfL buses will be zero emission, accelerating the change to an even cleaner fleet.

The lowest recorded current compliance rates are recorded for "non-TfL bus and coach", although this sector has also seen the highest growth since May 2019. Coaches are amongst the hardest vehicles to retrofit or replace, which is why the Mayor's heavy vehicle scrappage scheme included these vehicles. Since March 2021 TfL have also operated a short-term exemption of 3 months for coaches that have a confirmed order for retrofit equipment to allow for the additional time needed to build and fit the equipment.

Table 3: LEZ compliance by vehicle type

Month	LEZ Compliance Rate (TfL bus)	LEZ Compliance Rate (N2 vehicles - HGVs from 3.5-12 tonnes)	LEZ Compliance Rate (N3 vehicles - HGVs over 12 tonnes)	LEZ Compliance Rate (non-TfL bus and coach)
May-19	85.2%	61.3%	71.4%	59.1%
Sep-19	86.0%	64.0%	74.4%	64.2%
Jan-20	87.1%	70.0%	80.0%	67.2%
May-20	89.5%	73.5%	84.4%	60.9%
Jun-20	89.2%	74.3%	84.8%	62.3%
Jul-20	88.8%	75.5%	85.2%	70.1%
Aug-20	89.9%	76.6%	86.2%	73.5%
Sep-20	89.2%	76.8%	86.7%	74.4%
Oct-20	90.1%	77.9%	87.5%	73.9%
Nov-20	98.6%	78.4%	88.0%	72.0%
Dec-20	99.0%	79.0%	88.5%	72.9%
Jan-21	99.3%	79.8%	89.9%	69.3%
Feb-21	99.2%	80.7%	90.7%	70.3%
March-21	99.2%	84.4%	94.7%	81.6%
Apr-21	99.6%	85.8%	95.5%	83.0%
May-21	99.5%	86.4%	95.8%	84.4%
June-21	99.7%	87.6%	96.2%	85.0%
July-21	99.8%	88.3%	96.4%	85.9%
August-21	100.0%	88.5%	96.5%	87.1%
Overall change in compliance May 19 to present	**Increase of 14.8 percentage points**	**Increase of 27.2 percentage points**	**Increase of 25.1 percentage points**	**Increase of 28 percentage points**
Increase in compliance since the scheme was launched	**Increase of 0.8 percentage points**	**Increase of 4.1 percentage points**	**Increase of 1.8 percentage points**	**Increase of 5.5 percentage points**

Notes:

- *Compliance rates for larger vans (exceeding 1,205kg unladen and not exceeding 3,500kg GVW) and minibuses (not exceeding 5,000kg GVW) have been omitted as the standards for these vehicles did not change. Compliance for this class has been fairly static throughout the reporting period at > 99%.*
- *The modelled baseline for February 2017 was not broken down into vehicle types and this row has been omitted from this table.*

Traffic flows

As described earlier traffic flows in London have been subject to rapid and complex changes over the time period considered by this report.

It is also the case that, while other Mayoral policies and programmes seek to reduce the numbers of large and heavy vehicles on London's roads through a range of interventions, significant traffic reduction was not one of the aims of tightening the LEZ standards.

Figure 4 below shows overall observed traffic volumes each week in central, inner and outer London since the start of 2019. In broad terms the graph shows that traffic in inner and outer London has returned to more or less pre-pandemic levels. Traffic remains slightly lower than pre-pandemic levels in central London, but it is too early to tell if this is a permanent change.

Figure 4: Average daily traffic flows in London 2019 to present

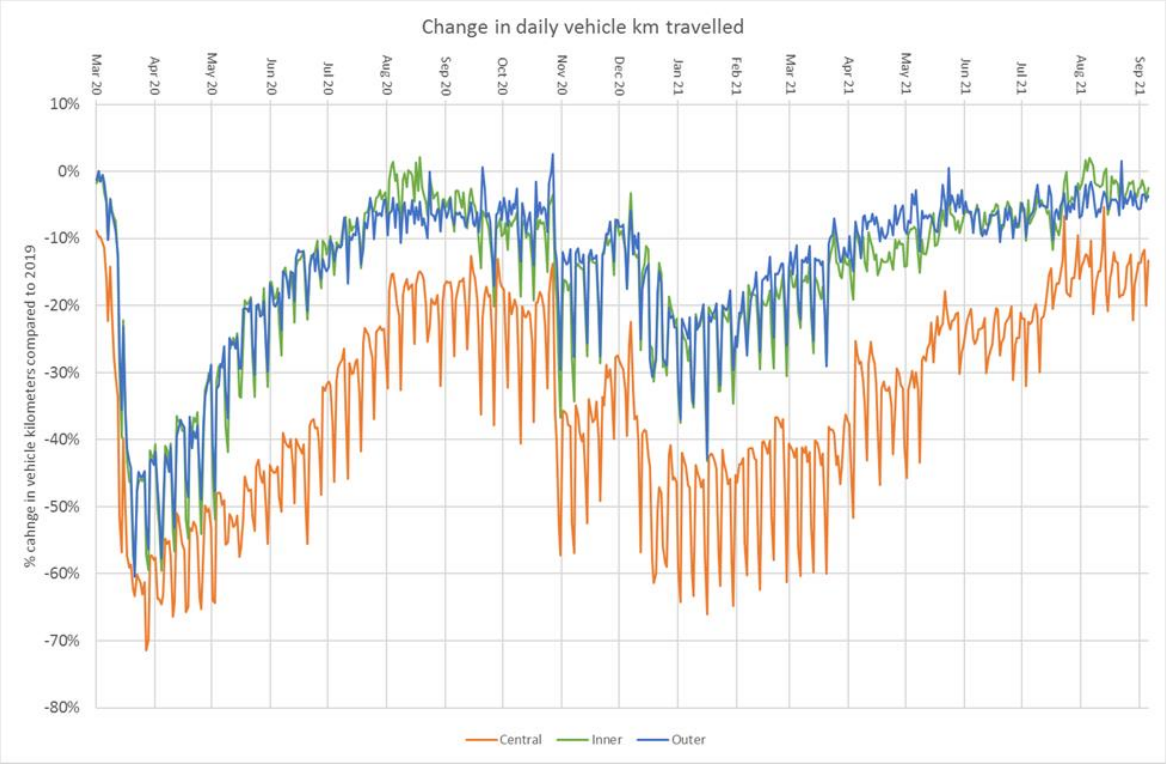
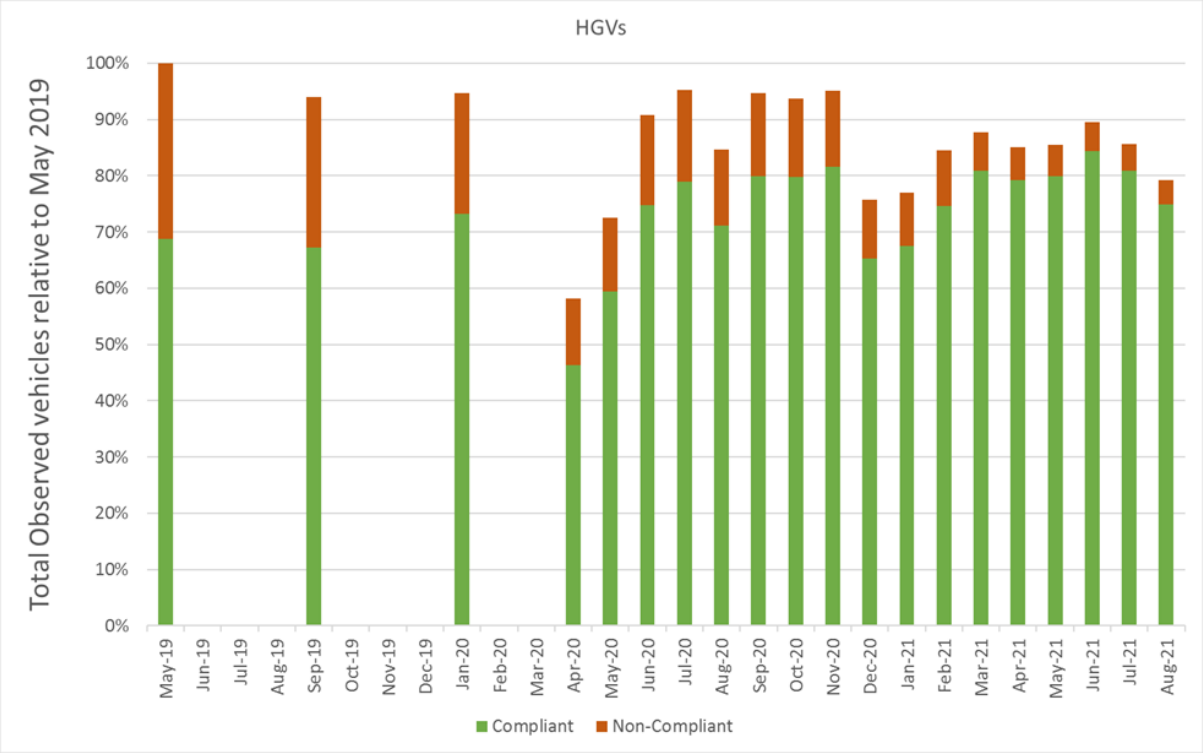


Figure 5 looks specifically at HGVs affected by the changes to the LEZ standards. The height of the columns shows the total volume of these vehicles against May 2019 (before the pandemic), with the green section representing the proportion of these vehicles that are compliant and the red non-compliant.

Figure 5 Combined HGV traffic flow and compliance rates



The graph shows that while the total volumes of HGVs approached pre-pandemic levels in late 2020 they have since declined again, with a larger drop off in recent months. While the measures to control the pandemic are clearly responsible for the large reductions in traffic in the spring of 2020 the more recent variability is likely to arise from a number of sources, including recently reported shortages of drivers and the ongoing variability in economic activity during the recovery.

The graph also shows that, irrespective of varying volumes, the proportion of compliant vehicles has increased every month except for September 2020. Indeed, one of the largest increases in compliance, excluding the go live month, was between October and November 2020, months with some of the highest observed numbers vehicles.

It is reasonable to conclude that, because of the preparations already made by businesses, compliance rates are unlikely to go down even if the volume of HGVs on London's roads returns closer to pre-pandemic levels.

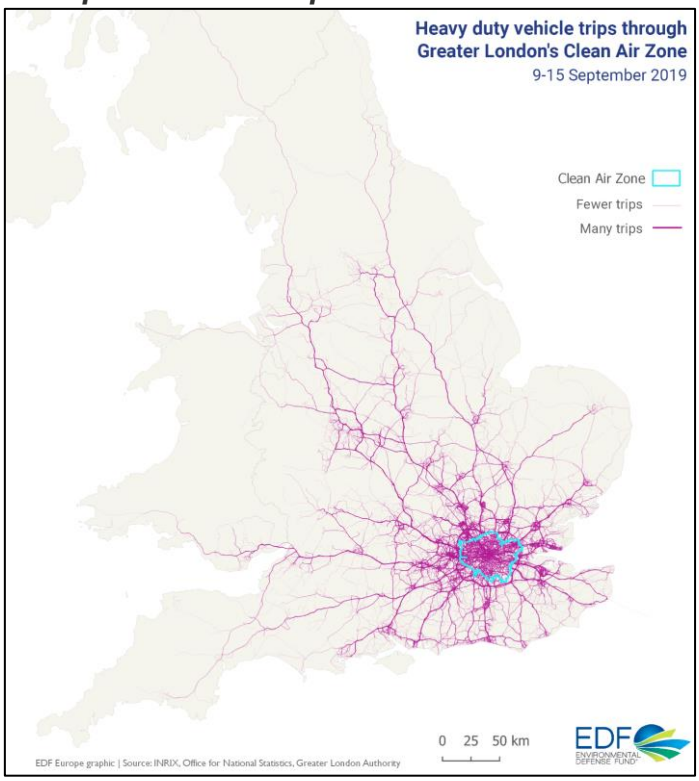
Impacts outside London

While the focus of Mayoral initiatives naturally on improving air quality in London, the nature of road vehicles is that they can travel more or less anywhere. Vehicles that comply with the new LEZ (and ULEZ) standards will continue to provide benefits even as they cross the Greater London boundary. As a result, the 'spill-over' benefits of vehicle owners taking action to comply with new emission standards are helping improve air quality across the country.

In August 2021 the Environmental Defense Fund (EDF) published an analysis of the impact of London's Low Emission Zone on the wider road network in England and Wales[f].

Using data from a single week in September 2019 the analysis found that heavy duty vehicles were driven on average for twice the distance outside the zone than within, with many of them driving substantially further outside the capital (Figure 6 below).

Figure 6: HGV trips passing through the LEZ
(Figure reproduced with permission from EDF Europe)



[f] Full report here: https://www.globalcleanair.org/files/2021/07/EDF-Europe-Examining-the-reach-of-Greater-Londons-Clean-Air-Zone.pdf. Data used in the report was procured from INRIX. INRIX has no affiliation with the analysis or results.

EDF's analysis found that on these journeys, vehicles that passed through London's Low Emission Zone went on to drive through 95 per cent of the major towns and cities in England and Wales, bringing the benefits of the London Low Emission Zone to an **additional 18 million people outside London**.

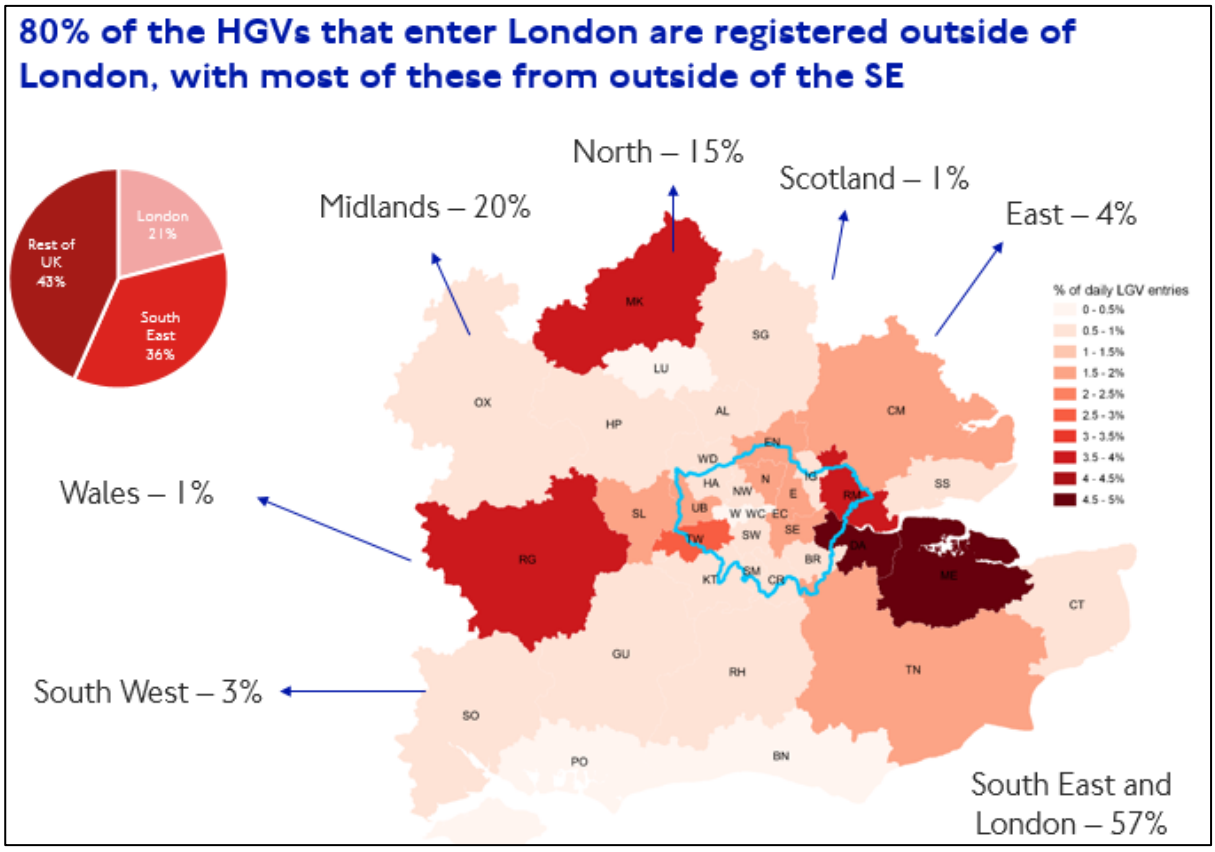
Cities as far afield as Cardiff, Sheffield, Norwich, and Bournemouth saw between 50 and 100 vehicles a day arriving after driving through the LEZ, while cities closer to the capital saw even greater benefits with places such as Slough and Watford seeing over 5,000 vehicles a day coming from, or going into, the LEZ[g].

Another way to understand how the LEZ affects large and heavy vehicles across the UK is to look at where the vehicles are registered. TfL did this for a snapshot of vehicles recorded in London and crossing the Greater London Boundary over a period of 1 week in February 2020.

Figure 7 below shows where vehicles crossing the Greater London boundary (both coming in and going out) each day are coming from or going to, with the coloured areas representing surrounding counties and the arrows showing regions further afield. This shows that the majority, around 80 per cent, of the heavy vehicles are registered outside of the capital, with most of those coming from outside the South East region.

[g] The dataset used by EDF recorded 20,000 unique vehicles each day, meaning about a quarter of these vehicles pass through nearby places like Slough and Watford. It should also be noted that the total number of vehicles passing through all of the cities is higher due to multiple counting where a single lorry visits multiple locations in a day.

Figure 7: TfL analysis of the registration location of HGVs entering or leaving London



Taken together these analyses show how action taken in London is benefitting much wider areas. Following London's lead, Bath and Birmingham have already launched their own Clean Air Zones, with similar emission standards. Portsmouth will be following suit later this year and other Clean Air Zones expected soon in Manchester, Bristol and other cities in England and Wales, not to mention the four major Scottish cities of Edinburgh, Glasgow, Aberdeen and Dundee. As this network of clean air cities grows, so will the knock-on benefits for people living in all areas of the UK.

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