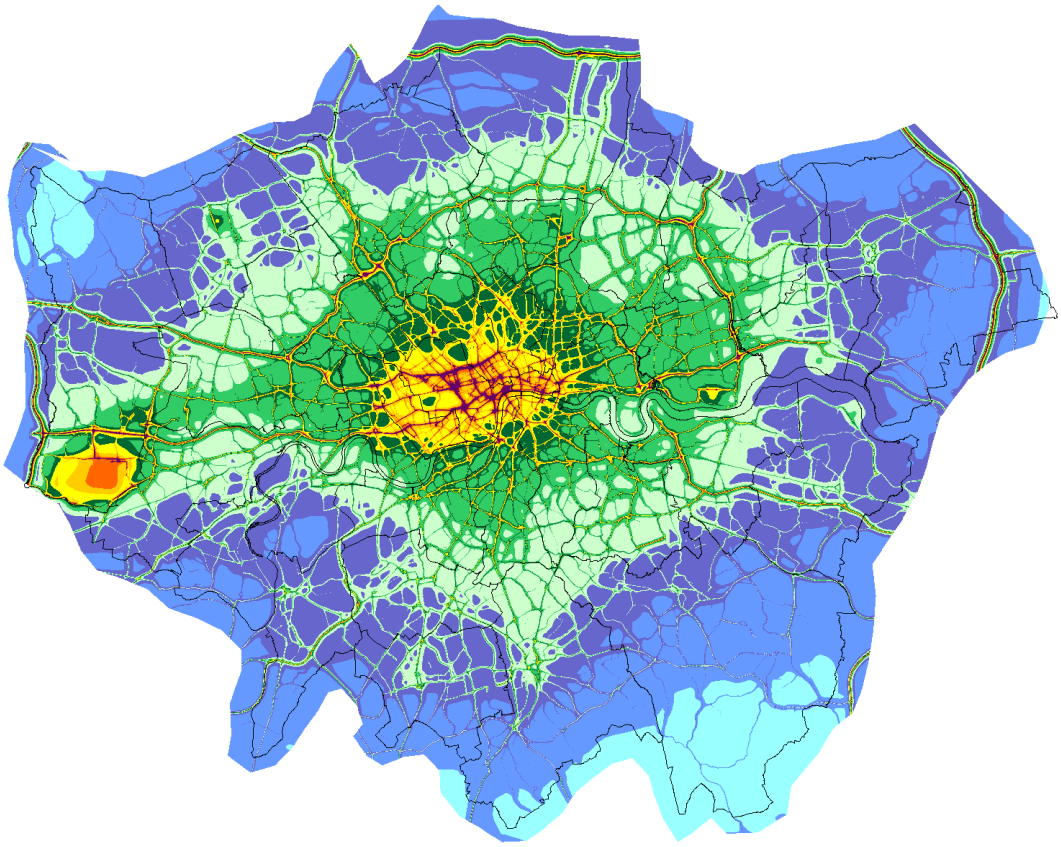
The London Low Emission Zone Feasibility Study

A Summary of the Phase 2 Report to the London Low Emission Zone Steering Group



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This document is a summary of the main report to the London LEZ steering group, reference:
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Summary

London's air quality has improved over recent decades, but is still the worst in the UK. There is strong evidence that current levels of pollution cause significant numbers of serious health impacts to Londoners. Concerns over these impacts have led to UK and European Union legislation, with air quality targets to protect human health. Much of London will meet these targets at the required dates. However, without further action, there are also likely to be considerable areas of London that do not.

To achieve the air quality targets, there is a need for additional action, particularly to reduce road transport emissions. There is a limit as to how much can be achieved through measures to address traffic reduction. However, major improvements can also be achieved by increasing the numbers of modern, cleaner vehicles. Newer vehicles have much lower emissions because of European legislation implemented over the past decade (known as Euro standards). It is possible to accelerate the introduction of cleaner vehicles, and reduce the numbers of older, more polluting vehicles, through a **low emission zone** (**LEZ**). An LEZ is a defined area that can only be entered by vehicles meeting certain emissions criteria or standards. Low emission zones have already been successfully implemented and run for many years in Sweden.

This study investigates the feasibility of an LEZ in London. It investigates the costs and benefits of the LEZ, what it could achieve and how it could be implemented. It provides information to allow the Mayor, in conjunction with the Association of London Government (ALG), London boroughs and the Government, to determine whether low emission zones would work towards meeting London's air quality targets and whether they should be taken forward to implementation. The study has considered a large number of different options for a low emission zone in London. The conclusions from the study, should a low emission zone for London be taken forward, are as follows:

- **Area**. The study recommends that the most appropriate option for a London LEZ would be a scheme including all of the Greater London area.

- **Vehicles**. The study recommends that the low emission zone start with a scheme that targets lorries, London buses and coaches. These vehicles have disproportionately high emissions per vehicle and targeting them produces greatest emissions reductions for least cost. However, the study recommends that the zone be potentially extended in later years to include vans (subject to further investigation of the socio-economic effects of such a scheme on small companies/owner drivers) and taxis (though taxis should be addressed earlier through the licensing process). The study does not recommend that cars are included in the scheme, but does recommend that some action is needed, alongside any LEZ, to target the removal of very old cars in London (those built before 1993).

- **Legislation and Enforcement**. The study recommends that the legal basis for an LEZ should be a Traffic Regulation Order. A manually enforced scheme, targeting heavy vehicles only, would enable the quickest introduction of an LEZ (where offenders are pursued through the courts). However, automatic enforcement using cameras would ensure higher compliance and so greater air quality benefits. Automatic enforcement would require additional powers to decriminalise the offence and administer penalty charge notices through a civil process, but this would provide a revenue stream that could help support the additional running costs. An automatic approach would be needed if the LEZ were to include vans to ensure adequate detection rates. It is recommended that the certification scheme for a low emission zone be based on age of first registration, as a proxy for Euro standard with a certification database for exemptions and retrofitted vehicles.

- **Implementation Date.** The work necessary to set up the legal basis for a London LEZ would make it extremely difficult to implement a fully operational scheme before the middle of 2006, and more realistically before late 2006. Therefore, the first LEZ that could be introduced in London would not be early enough to help progress towards the initial air quality targets for 2005. However, there is one advantage from a slightly later LEZ introduction, because it would tie in with the availability of Euro 4 vehicles (manufactured from late 2006 onwards) which have much lower emissions. Should an LEZ be

introduced, the study recommends that it is progressive, i.e. it would apply tighter emission criteria in future years. Any scheme needs to be clear about these future criteria so that operators can plan their future vehicle purchases accordingly.

- **Costs of Implementing and Operating an LEZ.** The costs of setting up and running a London low emission zone vary with the exact scheme and the types of vehicles included. A manually enforced scheme for lorries would have the lowest cost to set-up (an estimated £2.8 million to set-up, with running costs of around £4 million each year). There are a number of ways an automatically enforced scheme (based on vehicle recognition through cameras) could be introduced. The costs of introducing a network of fixed cameras across London are prohibitively high. Therefore, should an automatic enforcement approach be adopted, the study recommends the use of the existing Central London Congestion Charging Scheme (CCS) infrastructure, combined with the use of mobile ANPR cameras, and possibly a small number of additional fixed cameras outside this area. This type of scheme is estimated to cost £6 million to £10 million to set-up, with running costs of around £5 million to £7 million each year, but might generate revenues of £1 million to £4 million per year. It is stressed that none of the LEZ schemes considered in the study would be likely to be self-financing.

- **Emission Criteria.** The emission criteria set for a London low emission zone will dictate the air quality benefits and the costs to operators. The study recommends that for lorries, buses and coaches the criteria are based on Euro standard (age) and other emission standards (the Reduced Pollution Certificate (RPC)). The study recommends that vehicles should meet an initial criterion of Euro 2 plus RPC (or equivalent) in 2006/7. It also recommends that this criterion be tightened to Euro 3 plus RPC (or equivalent) in 2010. However, there are two additional conclusions put forward alongside this latter recommendation. Firstly that a NO_x based RPC scheme would help the effectiveness of the scheme and could allow greater NO_2 improvements. Secondly that it might be beneficial to introduce the Euro 3 plus RPC criterion earlier than 2010 using a rolling approach (applying the RPC to Euro 3 vehicles based on age). The study recommends a different approach for vans, should these vehicles be included, using a rolling ten-year-old age limit. A similar age-based standard is also recommended for licensed taxis and private hire vehicles.

- **Costs to industry**. The number of vehicles affected by a London low emission zone is potentially very high, as a large proportion of the national fleet operates in London at some point during each year. A London LEZ would therefore have a significant national impact. The recommended emission criteria would have a significant effect on tackling the older, higher polluting, section of the vehicle fleet. The cost to vehicle operators is likely to be significantly higher than the costs of setting up and operating a London low emission zone. For example, the costs of introducing the recommended LEZ in 2007 could have a cost to industry of £64 million to £135 million (the range reflects the number of vehicles that operate in London). The exact costs would depend on operator behaviour in response to the zone. Existing Government grants, should these be continued, would offset some of these costs, though the numbers of vehicles affected by a low emission zone in London would exceed existing grant levels. However, the costs to operators would be significantly lower than the values above if the Government vehicle excise duty rebates for retrofitted vehicles were maintained in future years. Introducing a stricter emission criterion than that recommended above would impact a prohibitively high proportion of the fleet and would result in extremely high costs to operators.

- **Stakeholder consultation.** Survey work has indicated that operators would be broadly supportive of a London low emission zone. Most operators would comply with the zone, though this might be achieved by transferring the older vehicles in their fleets outside London and moving newer vehicles into London (or onto London routes). Any LEZ would be likely to have greatest impact on operators of specialist vehicles and smaller companies. More investigation of the potential impacts of any LEZ on van operators is needed.

- **Comparison of costs and benefits**. A London low emission zone would improve the health of Londoners by reducing air pollution related impacts. It would also have small benefits in reducing noise. In later years, it could potentially lead to reduced emissions of the greenhouse gas CO_2. The economic benefits of these environmental improvements would more than offset any costs of introducing and operating the scheme, for example the estimated health benefits in London from the recommended

scheme for 2007 are estimated at £100 million. Moreover, these benefits are a sub-total, as they only include the air quality improvements in London - there would also be benefits outside London from cleaner vehicles affected by the London LEZ travelling elsewhere. Overall, the study concludes that the benefits of the schemes are likely to be broadly similar to the overall costs (including the costs to vehicle operators). The recommended heavy vehicle LEZ has greatest benefits, relative to costs. A number of wider socio-economic effects have also been identified that include both positive and negative effects.

- **Air Quality.** A London low emission zone would have modest benefits in improving overall emission levels and absolute air quality concentrations in London, but it would make a larger contribution to reducing exceedences of the air quality targets. The recommended LEZ would have greatest impact in targeting PM_{10} emissions and air quality exceedences. It is estimated that the recommended scheme would achieve a 23% reduction in total London PM_{10} emissions in 2010. It would also achieve a 43% reduction in the area of London exceeding the relevant PM_{10} air quality target in 2010, and a 19% reduction in the area of London exceeding the relevant NO_2 air quality target in 2010.

Air Quality Benefits of the Recommended LEZ.

	Reduction in Emissions (relative to baseline)			Reduction in Area Exceeding Targets (relative to baseline)		
Pollutant	**2007**	**2010 A)**	**2010 B)**	**2007**	**2010 A)**	**2010 B)**
NO_x (NO_2)	1.5%	2.7%	3.8%	4.7%	12%	18.9%
PM_{10}	9.0%	19%	23%	0%*	32.6%**	42.9%**

* London should meet the relevant air quality for PM_{10} in this year without any additional action for an average year's weather.
** Exceedence of the annual meanPM_{10} objective.
The 2007 scheme only includes lorries, buses and coaches.
In 2010: A) includes lorries, buses and coaches and B) includes lorries, buses and coaches, vans and taxis.

It is stressed that the results of this study have to be seen in the context of a changing scenario with respect to the technical options, the reliability of the air quality predictions, and a number of other uncertainties. Changes in a number of key areas including the emission factors, the relative health impacts or importance of different pollutants, the estimates of air quality background in future years, and the costs of different technical options, would have a significant impact on the recommendations above. A number of areas are highlighted as warranting further investigation. These include:

- The potential for considering older cars in a low emission zone, or targeting these vehicles through alternative action.
- The assessment of the socio-economic effects on van owners and operators from an LEZ, particularly on small companies and owner-drivers.
- Further consideration of extending the current PM_{10} based RPC schemes forward in time, to all heavy vehicles, and to include NO_X.
- The consideration of a 'rolling' scheme for heavy vehicles after 2007, based on a 5-6 year age limit for these vehicles (beyond which time the vehicles would need to meet the RPC criteria).

Finally, a number of key tasks have been identified, that would need agreement and collaboration before the introduction of any LEZ. These include:

- A joint decision on whether to implement the zone between the Mayor, London boroughs, and the Government;
- Public consultation over the scheme, and agreement over any proposed modifications;
- Agreement on the approach for bus regulation and taxi licensing (TfL);
- Agreement on the format of the TRO and any associated Bill, and if relevant, regulations to decriminalise offences;
- Agreement on the national certification system; and
- Agreement over the funding and division of responsibilities.

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1. Introduction

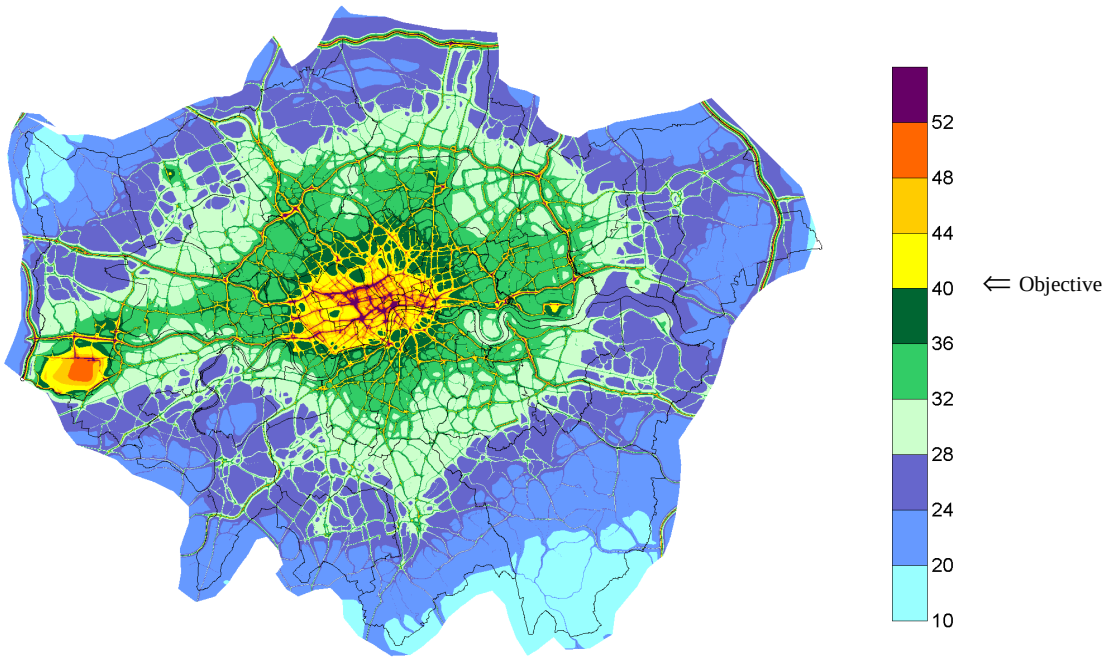
1.1. Although there have been improvements in London's air quality over recent decades, pollution levels are still higher than anywhere else in the UK.

1.2. There is strong medical evidence to suggest that at current air quality levels, pollution causes major health problems to Londoners. The effects include premature death, serious respiratory and cardio-vascular illness, and potentially much larger numbers of cases of ill health from exacerbation of asthma and other respiratory symptoms. The number of these health impacts caused by air pollution each year is high. The Department of Health estimates that (based on pollution levels in 1995-96) between 12,500 and 24,000 premature deaths occur each year in the UK as a result of air pollution, at least 1,600 of which will be in London. The main pollutants of concern for Greater London are particulate matter (PM_{10}), ozone and nitrogen dioxide (NO_2).

1.3. Growing concerns about these health effects have led to recent UK and European Union (EU) air quality legislation, namely the Air Quality Strategy (AQS) for England, Wales and Northern Ireland and the EU's Air Quality Framework Directive. This legislation has introduced target levels (also known as objectives) for air quality, set to protect human health. The UK legislation sets objectives for 2005 and 2010, which Local Authorities are obliged by law to work towards. The EU legislation sets legally binding air pollution targets to be achieved by 2005 for particulate matter (PM_{10}) and targets to be achieved for nitrogen dioxide (NO_2) by 2010.

1.4. Current projections of air quality predict that London will meet the AQS objective for PM_{10} and NO_2 across most areas. However, without additional action, there are likely to be significant areas of London where levels of pollution are greater than the AQS objectives. The likely scale of the problem can be seen in Figure 1 below – the red and yellow areas show where London is likely to miss the AQS objective for annual average NO_2 in 2005. PM_{10} exceedences are also predicted along the main roads.

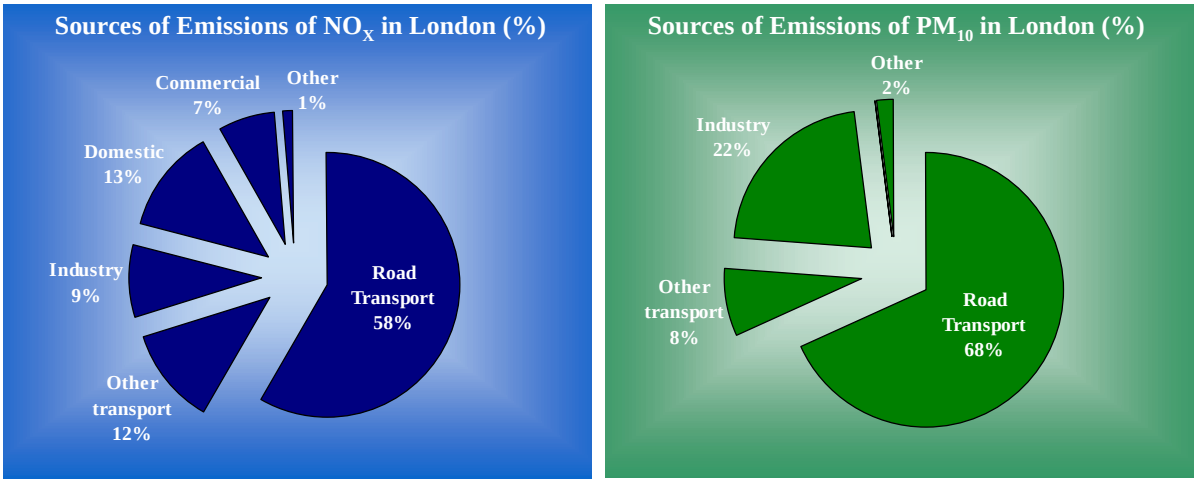
Figure 1. Forecasts of Air Pollution (NO_2) in London in 2005.



The map shows annual mean concentrations. Levels above 40 μgm^{-3} (a unit of air pollution concentration) exceed the UK Government's air quality objective – the major areas of concern are in central and inner London, Heathrow, and across the major road network.

1.5. More needs to be done to reduce air pollution in London, and it is clear that action must be taken to address road transport emissions. Indeed, road transport is the single most important source of emissions, as seen in Figure 2 below.

Figure 2. The Current Contribution of Road Transport to Air Pollution in London.

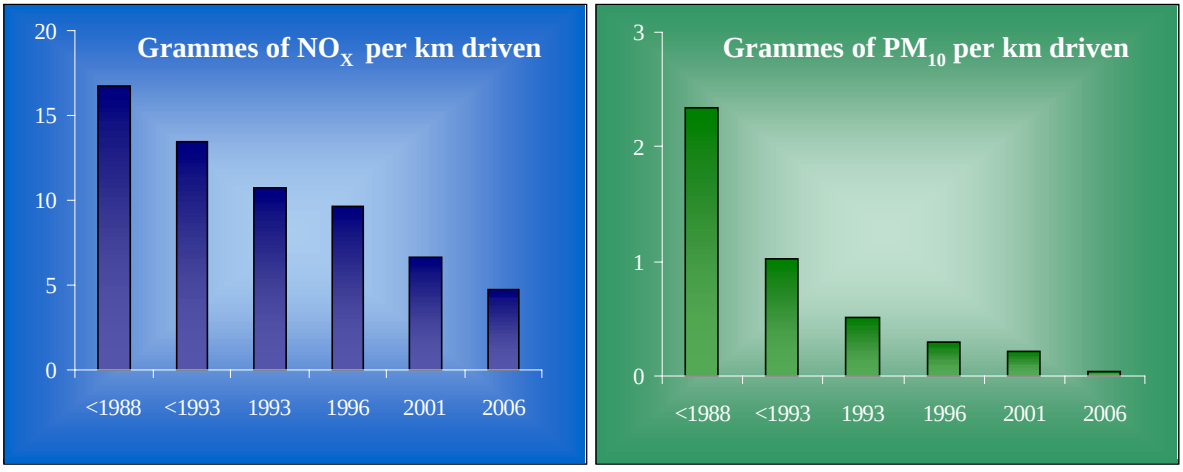


Based on 1999 data. Note: the emissions improvements are presented in this document in terms of NO_x, whilst air quality concentrations are presented in terms of NO_2. NO_x refers to a generic group of chemicals (oxides of nitrogen), one of which is NO_2 (nitrogen dioxide). NO_x emissions are predominantly NO (nitric oxide) and NO_2 (nitrogen dioxide), but NO is readily oxidized in the atmosphere to NO_2. The values show only primary emissions. Note the height of emissions above ground also impact on the air quality concentrations. There is a greater contribution to air quality from ground level sources such as vehicles, when compared to emissions from industry, which are typically from tall stacks.

1.6. The Mayor's Transport Strategy and Draft London Plan set out measures that aim to reduce traffic in central London, and measures to stop traffic growth in inner and outer London. However, there is a limit to how much can be achieved through this action alone. As well as reducing the number of vehicles on the road, it is possible to improve air quality by increasing the proportion of modern, cleaner vehicles.

1.7. Modern vehicles have much lower emissions due to European vehicle legislation. The legislation sets maximum allowable emission levels for new vehicles, known as 'Euro standards'. The legislation was initially introduced in 1993 (Euro 1) and the emissions standards were tightened in 1996-1997 (Euro 2) and in 2001 (Euro 3). Legislation is also in place for further controls in 2006 (Euro 4) and potentially in later years. The emission levels from these standards are presented in Figure 3, showing the benefits of this legislation. The faster adoption of cleaner road vehicles therefore offers the greatest opportunity for reducing emissions in London.

Figure 3. Emissions from Vehicles of Different Vintage (Euro Standard).



Values shown are emission factors for a 'generic' large bus or coach travelling in London.

2. What is a Low Emission Zone?

2.1. One of the more promising options to introduce greater numbers of cleaner vehicles, and reduce the numbers of older, more polluting vehicles on the road network, is through the introduction of a **low emission zone** (**LEZ**). An LEZ is a defined area that can only be entered by specified vehicles meeting certain emissions criteria or standards, e.g. certain Euro standards. An LEZ prohibits older vehicles from operating in an area, and so accelerates the turnover of the vehicle fleet. Although traffic volumes do not necessarily change, a higher number of the vehicles travelling in an area are cleaner vehicles with lower emissions, and this leads directly to air quality improvements. Low emission zones for freight vehicles have already been successfully implemented and run for many years in Scandinavia, in Stockholm, Gothenburg, Malmo and Lund, where they have led to improvements in air quality levels. They are also being widely considered by other UK and European cities.

2.2. Previous work in London[1] has concluded that, provided it could be effectively implemented and enforced, an LEZ could make a significant contribution to improving air quality and would help London meet the UK and EU air quality targets. Indeed, an LEZ was considered to be the only single way of meeting, or making significant progress towards, the targets by the legislative timetables.

2.3. To investigate this further, a Feasibility Study was commissioned to consider the effectiveness and viability of low emission zones for London (the Phase II Low Emission Zone Feasibility Study). The aim has been to provide:

> *'Information to allow the Mayor, in conjunction with the Association of London Government (ALG), London boroughs and the Government, to determine whether low emission zones would work towards meeting London's air quality targets and should be taken forward to implementation.'*

2.4. This document summarises the results of this feasibility study. It discusses how an LEZ might be implemented and operated in London, how it would be enforced and what air quality improvements it would achieve. It also assesses the wider costs and benefits of introducing such a scheme. The results presented are based on a detailed analysis of different options. A more detailed technical summary, and the full study report, are available at the London LEZ web-site (www.london-lez.org).

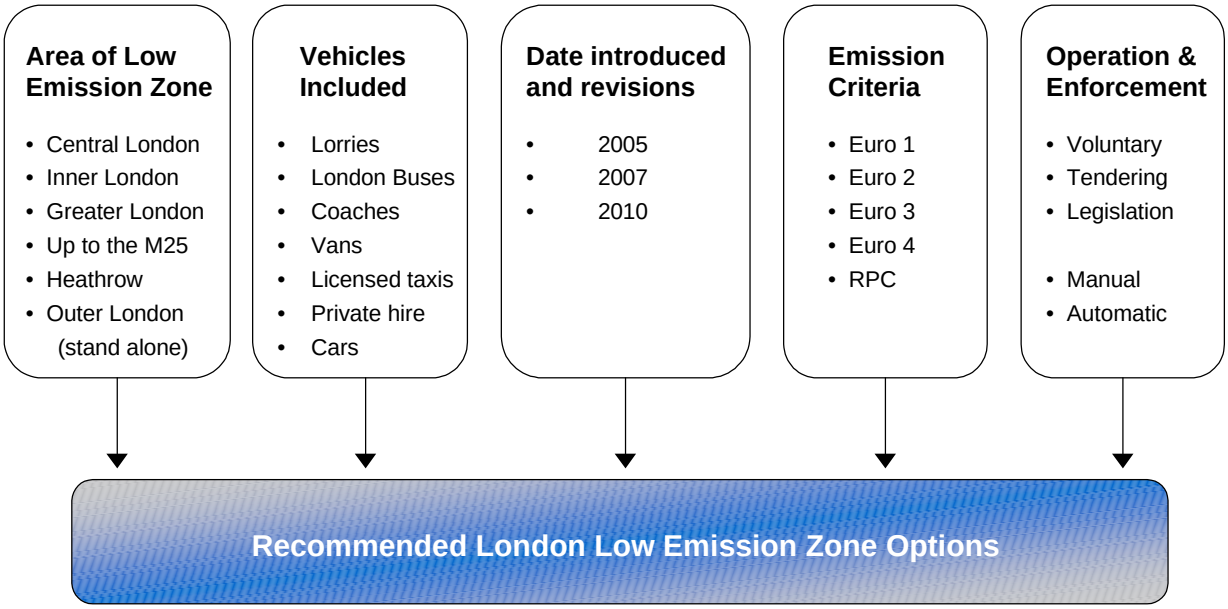
3. Which options have been considered?

3.1. The study has considered a large number of different LEZ options for London, differing in the area covered by the zone, the type of vehicles included in the scheme, the emissions criteria, the date of introduction, and the operation and enforcement methods, shown in Figure 4.

3.2. The consideration of all the variables in Figure 4 leads to a huge number of alternative options for a low emission zone in London. One of the principal parts of this study has been to sift through and identify the recommended option, or options. With this in mind, the study has been undertaken in three phases, each considering a smaller number of options, in progressively more detail.

[1] The 'Westminster Study'. Cloke J, Cox J A, Hickman A J, Ellis S D, Ingrey M J and Buchan K (MTRU) (2000). A Low Emission Zone for London. TRL Report 431.
The London Low Emission Zone Feasibility Study (2002): Phase I Report of the Steering Group. Association of London Government/Greater London Authority. Published by the ALG, February 2002.

Figure 4. Options for a London Low Emission Zone.



Private hire refers to private hire vehicles, i.e. 'mini-cab' services. Licensed taxis are 'black cabs'.
RPC = Reduced Pollution Certificate. The RPC scheme enables vehicles with modifications that reduce PM_{10} emissions (to a required emission level) to benefit from reduced vehicle excise duty (road tax) rates. This typically requires the fitting of a diesel particulate filter.
Note: the convention for writing Euro standards is to use roman numerals (e.g. Euro I – IV). Within this report, in order to make the distinction between standards easier to differentiate, we have used numbers (e.g. Euro 1 – 4).

3.3. The findings of the study, and the recommended options, are summarised in the following sections.

4. What area would the zone cover?

4.1. The areas considered for the London low emission zone are shown in Figure 5. The analysis has considered:

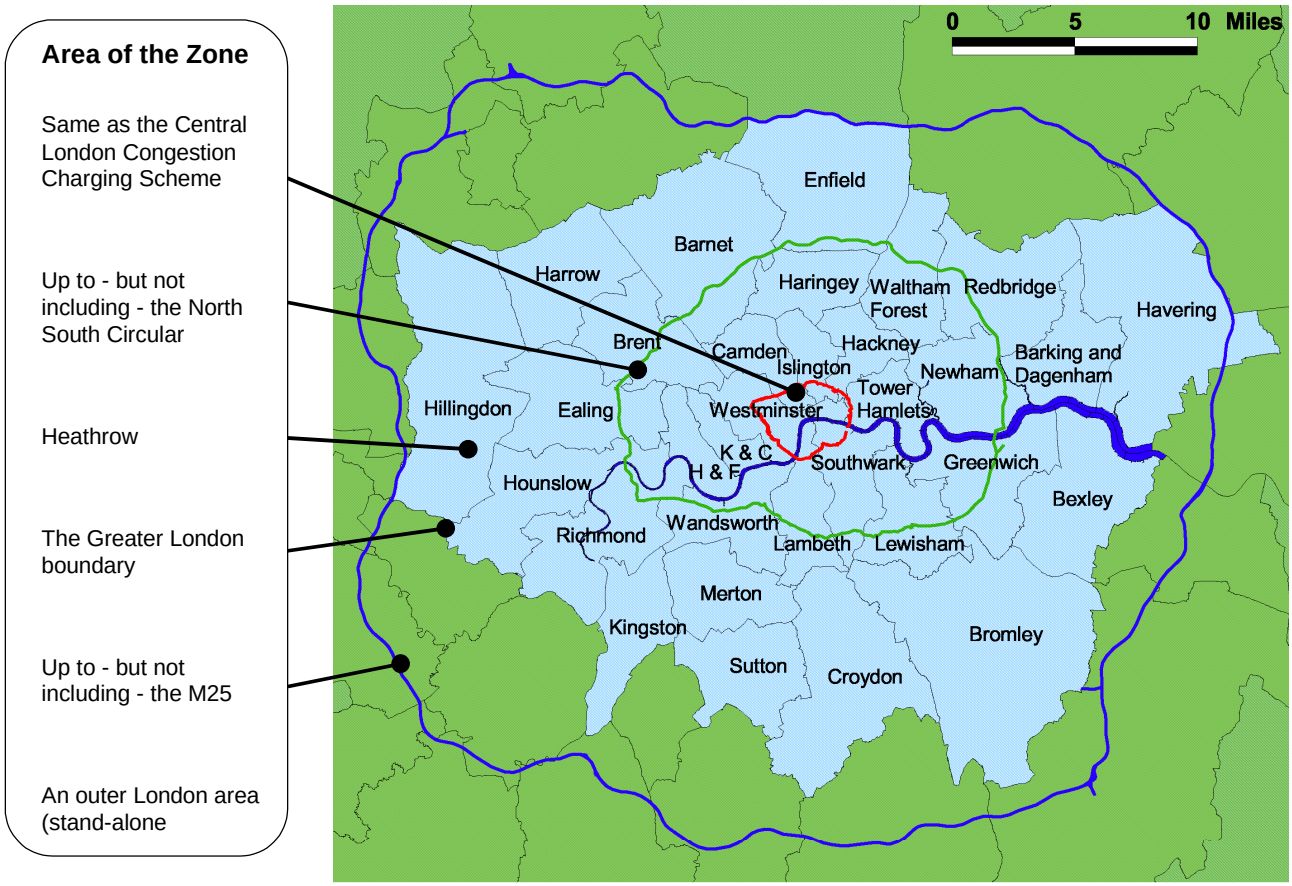
- A zone consistent with the Central London Congestion Charging Scheme (CCS) area;
- A zone up to but **not** including the North/South Circular (NSC);
- A zone consistent with the Greater London boundary area (GL);
- A zone up to but **not** including the M25 (M25);
- A zone targeted at the Heathrow area; and
- A stand-alone zone for an area of outer London (e.g. a town centre).

4.2. The study has found that only a London wide scheme (GL boundary and up to, but not including, the M25) would achieve sufficient air quality benefits. Introducing an LEZ in central or inner London, or an outer town centre, would only lead to small air quality benefits, and would not address many of the air quality hot spots across the road network that exceed the air quality objectives in 2005 (see Figure 1).

4.3. The introduction of a low emission zone in central London (in the CCS area) or inner London (up to the North/South Circular) could also lead to potential problems from vehicles switching to alternative routes around the LEZ. This could increase congestion on these routes and offset the air quality benefits of the LEZ, by increasing air pollution around the perimeter of the zone. The study has confirmed such effects would not be a problem for a London wide scheme, because most 'through trips' across London already use

the M25 (because of current levels of traffic congestion in London). A London wide LEZ would include the Heathrow area and any stand-alone schemes in outer London. It would also lead to improvements in emissions from compliant vehicles using the M25 and roads outside London for their journeys.

Figure 5. The Areas Considered for a London Low Emission Zone.



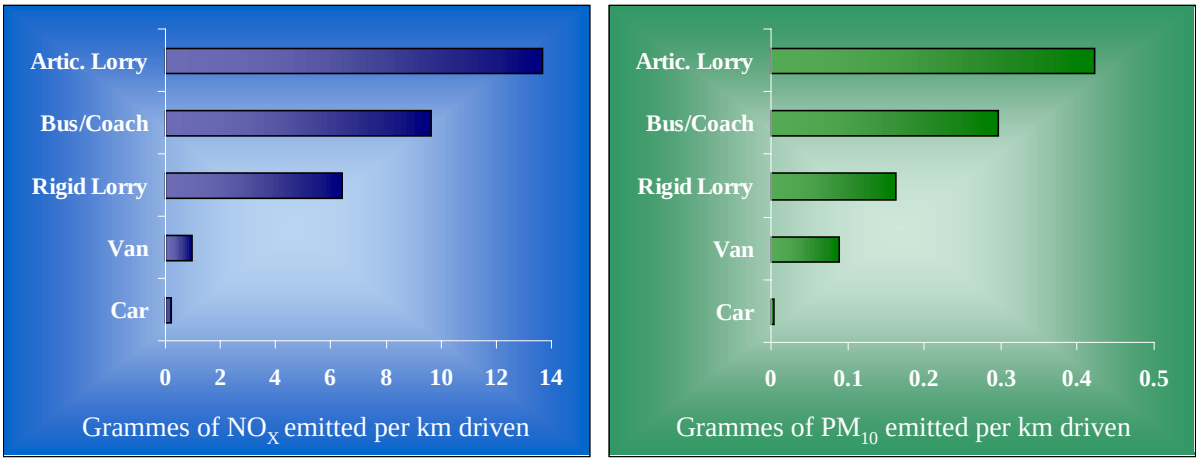
4.4. However, it is only recommended that a London low emission zone should extend up to the Greater London boundary. Extending the zone up to the M25 would make the implementation and enforcement of a London LEZ much more difficult because this would require the agreement of non-London local authorities to include a part of their areas in the scheme.

Conclusion 1. A London low emission zone could be extended to a number of different areas. The study recommends that should a low emission zone go ahead, the most appropriate option would be a London wide scheme, consistent with the Greater London boundary.

5. Which vehicles would be included?

5.1. As Figure 6 below shows, heavier vehicles, such as lorries, buses and coaches, have much higher emissions than cars - per vehicle kilometre driven. These vehicles have therefore been identified as a priority for a London low emission zone, as it is possible to have a large impact in reducing emissions by tackling a relatively small number of vehicles.

Figure 6. The Emissions from Different Vehicles (at average London speeds).



Articulated lorries (Artic.) are those with a separate cab that is attached to a trailer. Rigid lorries are a single integrated unit. The figures show emissions from vehicles meeting Euro 2 emissions standards, i.e. manufactured between 1997 and 2001, at average London speeds. Note the figures show emissions from petrol cars and diesel vans, rather than the average for these vehicle classes.

5.2. It is also important to consider the costs of targeting different vehicles. This is necessary to ensure that any action represents good value for money. The study has considered the costs of targeting each of the individual vehicle types above, and the resulting emissions benefits that any action would achieve. We have considered how much it would cost for operators to purchase new or second hand vehicles, or fit abatement equipment to vehicles, to comply with different emissions criteria. This analysis, called a cost-effectiveness assessment, has allowed us to rank the benefits of targeting different parts of the vehicle fleet, with different emission criteria. It provides information on how much it costs to avoid one tonne of emissions when tackling different vehicles of different ages. The relative costs per tonne avoided have been used to investigate which vehicles would produce the largest emissions reductions in London for least cost.

5.3. The study has found that it is most cost-effective to target lorries, coaches and buses. For these vehicles, retrofitting options are generally the more cost-effective option (e.g. rather than replacing vehicles). Including these heavier vehicles is therefore seen as the priority for an LEZ. Targeting vans (light goods vehicles) has a lower cost-effectiveness, i.e. it costs more to achieve the same amount of emission reductions from these vehicles than for the heavier vehicles in the fleet. Finally, the study has found that, in general, targeting cars is the least cost-effective option.

5.4. It is also important to stress that the cost-effectiveness changes with the age of the vehicle targeted. It is much more cost-effective to tackle older vehicles. This reflects the higher emissions from these vehicles, as shown in Figure 3 above. An LEZ that removes the older, highly polluting tail of the vehicle fleet (in particular for heavy vehicles) would therefore achieve greatest air quality improvement for least cost.

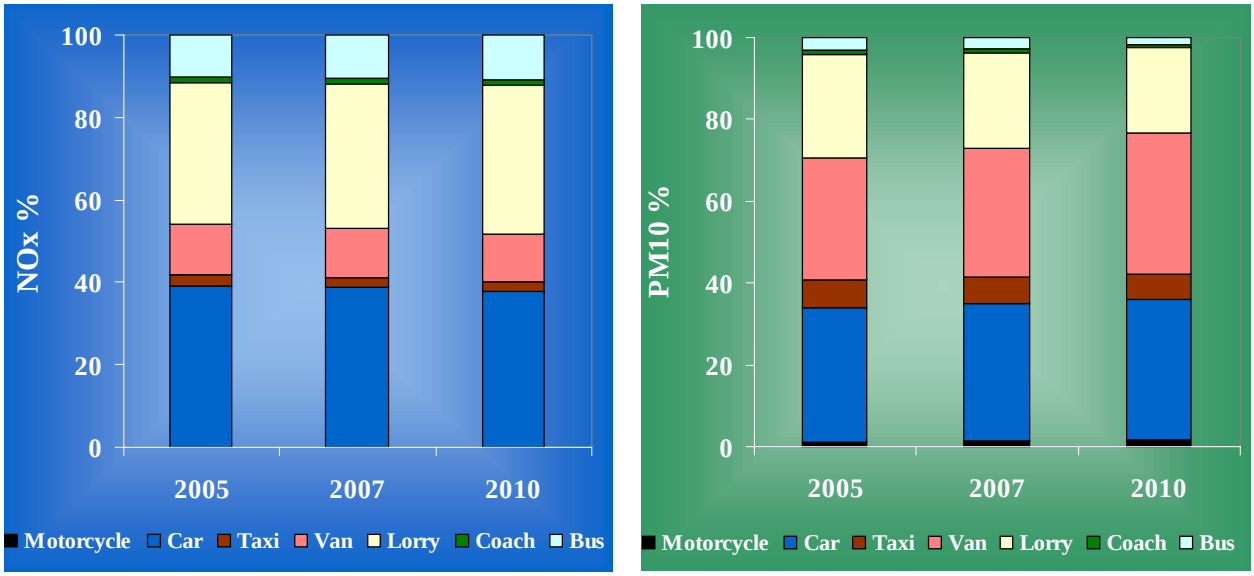
5.5. Whilst not as cost-effective as targeting lorries, the study has found benefits from including vans in a London low emission zone. However, it was felt that further investigation of the socio-economic impacts of including vans in the scheme would be needed before the study could definitively recommend these vehicles for a London LEZ. There remains a serious gap in our knowledge about the role of these vehicles and further investigation of the socio-economic effects of including vans in any LEZ is highlighted as a key research recommendation from the study. For these reasons, the study recommends two alternative options for the London low emission zone, one with, and one without, the inclusion of vans in later years. The study recommends that action is needed to target older pre-Euro vans, irrespective of whether vans are subsequently included in an LEZ, as these vehicles have much higher emissions than vans manufactured in later years (i.e. Euro 1 onwards).

5.6. Including private cars in a low emission zone would involve different issues to including freight vehicles or public transport vehicles. Firstly the sheer number of vehicles involved in a car-based scheme would be enormous – potentially affecting hundreds of thousands of vehicles. This has implications for the enforcement and certification of the scheme. Secondly, targeting cars would have very significant inequality

effects, because this would predominantly affect low-income households: almost half the cars owned by households in the lowest income group are over 10 years old, compared with less than 20% of those owned by the highest income group. As a low emission zone aims to exclude older vehicles, it would predominantly affect car ownership for low-income groups and would potentially exacerbate social exclusion. Finally, the cost-effectiveness of including cars is extremely low, and the total costs from a car based low emission zone would be extremely large. A low emission zone with strict emission criteria for cars could lead to potential costs to motorists of up to a billion pounds, i.e. it would be significant in respect to London's total economy. Due to these reasons, the study does not recommend that cars are included within a potential London low emission zone as to do so would involve extremely high costs and would only achieve low emissions reductions.

5.7. However, it is also important to look at the total contribution of different vehicles to road transport emissions in London. This is important because there are many more cars than lorries on London's roads. The study has estimated the contribution from different vehicles to future road transport emissions in London for the years 2005 to 2010 (without an LEZ). This is presented in Figure 7.

Figure 7. Emissions from Different Vehicles in London (as a % of Total Road Transport Emissions).



Note: although the graphs show the emissions across London, a very different pattern emerges for different areas of London. Buses and licensed taxis are much more significant sources of emissions in central London.

5.8. It is clear that cars are responsible for a very significant proportion of London's NO_x emissions – indeed around 40% of road transport emissions in London are estimated to be from cars. This creates a problem. As discussed above, including cars within a low emission zone would be very difficult and would not be cost-effective. However, Figure 7 above shows that these vehicles are very important in terms of total emissions in London. The study has therefore investigated the potential emissions from cars in more detail. It has emerged that pre-Euro standard cars (built before 1993) have disproportionately high emissions relative to the rest of the car fleet. The analysis predicts that these pre-Euro vehicles will only comprise 0.9 % of the total car kilometres driven in London in 2007, but will be responsible for 4.5% of all NOx emissions from cars, and 1.7% of all road transport NOx emissions in London. These vehicles would also be cost-effective to target because of the low capital value of these vehicles (the same is not true for cars built in later years because their emissions have improved dramatically due to the EU legislation). The study therefore recommends that some action should be taken to address old cars alongside heavy vehicles and vans, though action to tackle these vehicles might be more appropriate through other measures comprising a *low emission strategy* rather than through a low emission zone. This might be possible through the introduction of a Government scrappage subsidy for these pre-Euro cars, or other actions to address the car fleet, for example the ALG and boroughs are due to commence a London-wide Vehicle Emissions Testing programme which will focus on cars and light duty vehicles.

5.9. The study also found benefits from targeting the licensed taxi fleet, particularly in central London. These vehicles can be tackled through existing regulation via the Public Carriage Office (PCO). The study has considered whether to include licensed taxis alongside the recommended scheme for heavy vehicles only (i.e. alongside lorries, buses and coaches). However, the relevant emission criteria for taxis would have to be different to heavy vehicles and instead the criteria applied to vans in later years would be more relevant (should these vehicles be included in the scheme). Therefore the study recommends that licensed taxis should be included in an extended scheme in later years (beyond 2006/7) within the LEZ, but recommends that emission criteria be applied and enforced earlier through the licensing process (outside of any formalised LEZ). The Mayor's Air Quality Strategy included proposals for emissions standards for licensed London taxis that would be consistent with this recommendation.

Conclusion 2. One of the most difficult questions to answer in the study has been 'which vehicles should be included in a low emission zone?' Should it go ahead, the study recommends the LEZ starts with a scheme that targets lorries, London buses and coaches, as these vehicles have disproportionately high emissions per vehicle and targeting them produces greatest emissions reduction for least cost. However, the study recommends that the scheme be potentially extended in later years to include vans and taxis (though taxis should be addressed earlier through the licensing process). The study does not recommend that cars are included in the scheme, but does recommend that some action is needed, alongside any LEZ, to target the removal of very old cars from the fleet (those built before 1993).

6. The legal basis and enforcement

6.1. A large number of implementation options, including voluntary schemes, negotiated agreements, licensing and tendering agreements, and mechanisms derived from the Road Traffic Regulations Act (1984) have been considered for a London low emission zone.

6.2. The study has concluded that the most appropriate legal basis for the LEZ would be a Traffic Regulation Order (TRO). This would be based on powers from the Road Traffic Regulation Act 1984, which allows traffic authorities to put forward orders prohibiting, restricting or regulating road traffic, and the Environment Act 1995, which extended these powers to include air quality objectives. The compliance of London buses, licensed taxis and private hire vehicles can be regulated (under similar emission criteria) under existing powers (London Buses and the Public Carriage Office within Transport for London (TfL)).

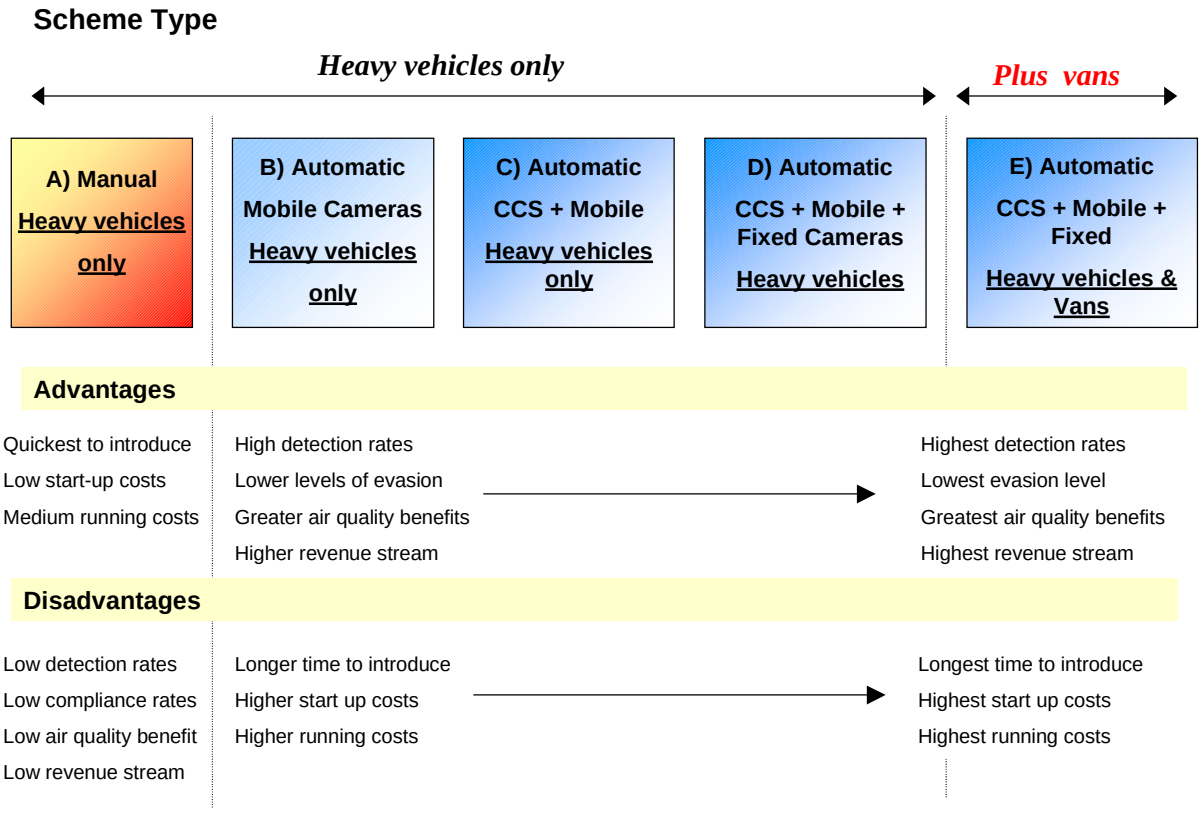
6.3. There are different ways this TRO could be enforced (see Figure 8). The exact scheme chosen, its legal basis, and the methods used to enforce the scheme, would have a very large impact on the compliance rates, the costs of setting up and running a low emission zone, and the levels of revenue. Different options would be needed for different types of vehicles. The advantages and disadvantages of different operational approaches are shown in Figure 8 below. One of the key choices in an LEZ enforcement strategy is whether to use only the TRO and derived enforcement mechanisms (where offenders are therefore pursued through the courts and the criminal justice system) or to seek additional powers to decriminalise the offence and administer penalty charge notices through a civil process.

6.4. For a scheme that only covered heavy vehicles, i.e. **lorries, coaches** and **buses**, it would be possible to use manual enforcement methods for the low emission zone. This would involve the issue of permits, with manual checks by relevant officers. This would be similar to the approach already used for the London Lorry Ban. Any non-compliance, i.e. operating in the low emission zone with a vehicle that did not meet the necessary emission criteria, would be a criminal offence, but enforcement would not require the involvement

of Police Officers (as civilian officers could carry out roadside monitoring and observe vehicles). Such a manual approach would be likely to result in low detection rates, i.e. it is likely there would be higher levels of evasion than with other systems – so it would achieve lower air quality benefits. However, the scheme could be set-up quickly and at low cost.

6.5. Higher detection rates would be achieved by automatic enforcement methods, which would lead to lower levels of evasion and greater air quality benefits. Automatic enforcement would use cameras to detect vehicles driving in the low emission zone that did not meet the necessary emission criteria. Using automatic enforcement requires wider powers than with a manual scheme, in order to decriminalise the offence and to issue, and keep the revenue from, Penalty Charge Notices (PCN). This would require the introduction of Department for Transport (DfT) Regulations or a joint London Local Authority/Transport for London Bill. The decriminalisation of the offence would facilitate the use of automatic detection techniques, such as Automatic Number Plate Recognition (ANPR), electronic tags with gantries (where electronic tags are issued to permitted vehicles, and overhead gantries with microwave 'readers' which check vehicles for these tags), and analogue and digital cameras. The study has concluded that the most promising automatic approach would be to introduce ANPR systems, similar to the Central London Congestion Charge Scheme (CCS) and build upon the existing CCS scheme and infrastructure.

Figure 8. Alternative Operational Schemes for a London LEZ.



6.6. A low emission zone that was extended to include **vans** would have to introduce automatic enforcement, because it would not be practical to manually enforce such a large number of vehicles. In order to achieve sufficient detection rates and good compliance it would need to have both mobile and fixed cameras, and potentially checks on parked vehicles by Borough parking officers.

6.7. If vans were planned for later inclusion in the scheme, then adopting an automatic approach from the outset would have the advantage of more effective enforcement. However, it would be possible to move from a manual system that initially targeted lorries, buses and coaches through to an automatic enforcement system that could allow the inclusion of vans. Such an approach would reduce the up-front costs and risks of any initial scheme. It would have some benefits in allowing a quick introduction of the scheme and an evaluation period before starting the second, expanded, automatically enforced phase. The introduction of

automatic enforcement would have the advantage that it would generate revenues from penalty charge notices (via the introduction of decriminalisation of the offence) and this would help offset the higher costs of the implementation. Phasing in the introduction of vans would also allow more time to collect the certification information for the very large number of these vehicles.

6.8. Irrespective of the approach adopted, a low emission zone would require a certification system to classify vehicles – so that it was possible to know whether or not vehicles driving in the zone complied with the emission criteria set down. It is recommended that any certification scheme should be based on age of first registration, as a proxy for Euro standard, though a database of exemptions would also be needed, e.g. retrofitted vehicles. Certification and classification should be considered on a national scale due to the very large number of vehicles that a London LEZ would affect (and also if low emission zones were to be implemented elsewhere in the UK). There would be an important role for Department for Transport Agencies in the certification process, as they hold much of the relevant data for a compliance database. The administration of the database and the processing of applications for re-classification could be undertaken by the scheme operator or on a national basis.

Conclusion 3. Should a London low emission zone go ahead, the study recommends that the legal basis should be a Traffic Regulation Order. A manually enforced scheme, targeting heavy vehicles only, would allow the quickest introduction of an LEZ, however, automatic enforcement using cameras would ensure higher compliance and greater revenues. An automatic approach would be needed if the LEZ were extended to include vans. It is recommended that the certification scheme for a low emission zone be based on age of first registration, as a proxy for Euro standard with a certification database for exceptions and retrofits.

7. When would it start?

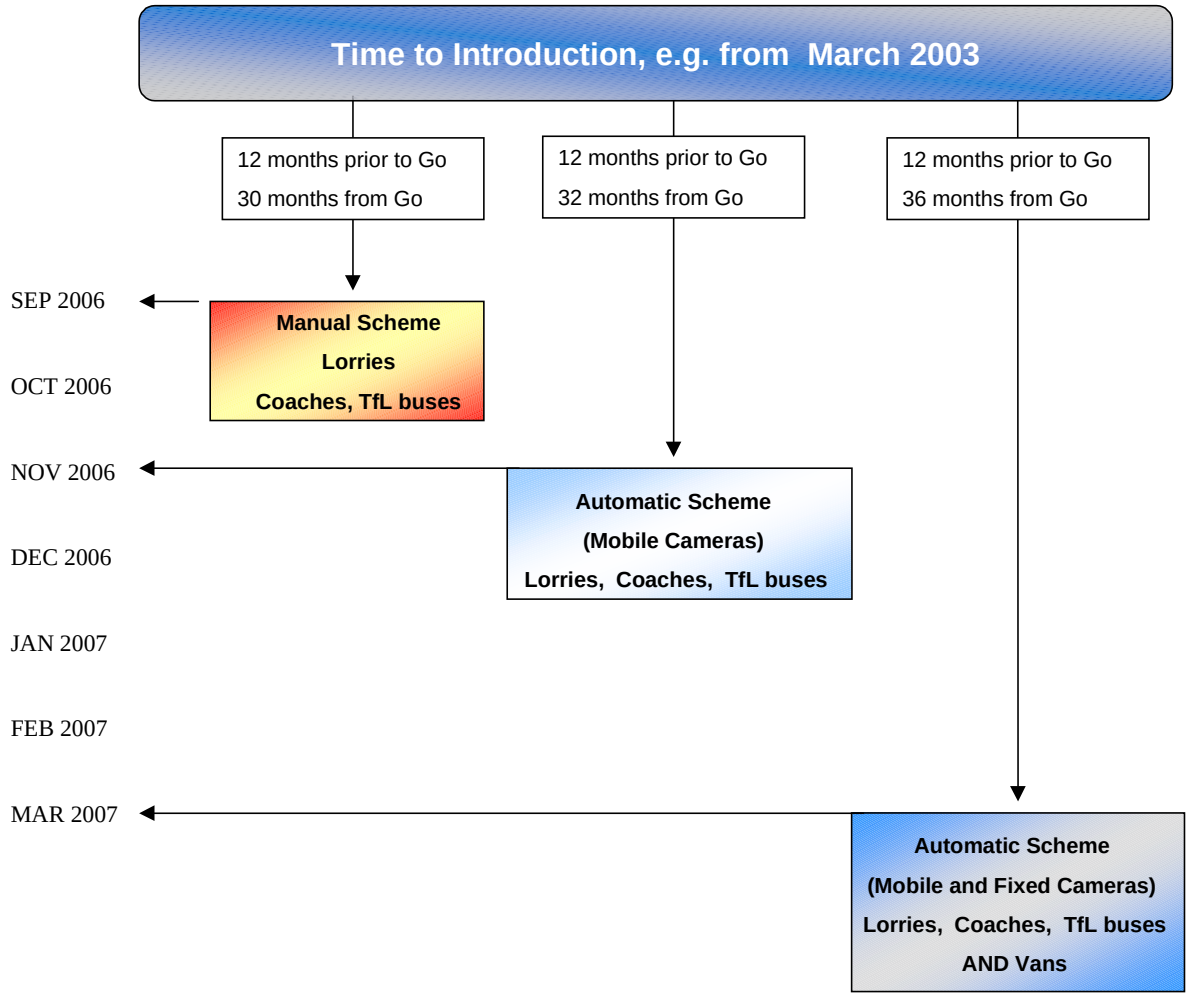
7.1. The time taken to implement different low emission zone schemes, following a 'go-decision', depends on the exact vehicle categories or enforcement methods chosen. The estimated times taken to introduce different schemes are shown in Figure 9 below.

7.2. Should an LEZ be taken forward, there would need to be a period of 6 to 12 months to consult on, and if appropriate, formally make the decision to proceed (the 'go decision'). From the time of this 'go decision' it would take between 2.5 to 3 years to implement a low emission zone in London. Therefore, the first LEZ that could be introduced in London would be too late to help meet the initial air quality targets in 2005. The quickest approach would be to introduce a scheme targeting only heavy vehicles using the manual enforcement approach described in the last section (with London buses targeted through TfL licensing powers). Introducing a scheme with automatic enforcement would take longer and would also involve a larger number of (complex) tasks, many running in parallel. This might increase the risk of delays in the scheme timing.

7.3. The study has also investigated the merits of pilot phases starting in a small area in early years, and then widening out after the scheme has been demonstrated. The study found that a pilot approach would appear to have few benefits. A pilot would be used to test certain elements of an LEZ, such as the legislation, or be implemented in a small area. A partial implementation, or an LEZ covering a small area only, would not lead to any significant reduction in emissions. Moreover, it would delay the introduction of the full low emission zone scheme, delaying the air quality improvements that this would achieve.

7.4. Irrespective of the year of first introduction, or the exact scheme introduced, the study recommends that progressively tighter emissions criteria should be set for a low emission zone in later years. This is essential to capture the future benefits of European emissions legislation (described in the introduction) which continues to tighten the emissions standards for new vehicles. This would ensure continued benefits over and above the natural turnover in the fleet (i.e. over and above the baseline). It would also follow the pattern of future air quality targets, which become stricter in later years, and so ensure the low emission zone continued to improve air quality in London over time. Operators need to know about future emissions criteria in later years, so that they can build this into their future purchase strategies.

Figure 9. Earliest Time to Introduction of any London LEZ.



It is stressed these time-scales are estimates. While some elements are fixed, many elements could lengthen or shorten according to the level of resources, co-ordination, and the partnership taking the scheme forward.

7.5. Whilst the introduction of a London LEZ would take around three years to implement from the go-decision (and would therefore be after 2005), there is a potential benefit from this delay. Euro 4 vehicles will start to be manufactured in 2006 (Euro 4 vans should be available at the start of 2006 and heavy vehicles available in late 2006). As shown in Figure 3, these Euro 4 vehicles are projected to have very much lower emissions than earlier vehicles. Therefore, the delay in the LEZ start-up could actually have emissions benefits by correlating with the introduction of these cleaner Euro 4 vehicles, i.e. because it is anticipated that the LEZ would stimulate some additional purchases of new vehicles in the fleet. The importance of this effect is determined by the behaviour of operators of non-compliant vehicles, specifically whether operators would retrofit, buy new vehicles, or buy second-hand vehicles. This is discussed in section 12.

Conclusion 4. The work necessary to set up the legal basis for a London low emission zone would make it extremely difficult to implement a fully operational scheme before the middle of 2006, and more realistically before late 2006. Therefore, the first LEZ that could be introduced in London would not be early enough to help progress towards the initial air quality targets for 2005. However, there is one advantage from a slightly later LEZ introduction, because it would tie in with the availability of Euro 4 vehicles, which have much lower emissions. Should an LEZ be introduced, the study recommends that it is progressive, i.e. it would apply tighter emission criteria with time. Such a scheme needs to be clear about future criteria, so operators can plan their vehicle purchases accordingly.

8. How much would the scheme cost?

8.1. The study has estimated the likely costs, to the relevant authorities, of setting up and running a Greater London LEZ. The costs of a London LEZ would depend on the class of vehicles considered, the enforcement method and the levels of compliance. The relative start-up costs, annual operating costs, and potential annual revenue streams generated are shown in Figure 10. The potential costs to operators are discussed in a later section.

8.2. A manually enforced scheme for lorries, coaches and buses would be the cheapest scheme to introduce (in terms of capital costs), but would have the highest levels of non-compliance and relatively high running costs, as this type of scheme would not generate significant revenues.

8.3. Automatic enforcement would increase the detection rates and the likely compliance rates. Using camera detection to enforce a low emission zone scheme would increase the start-up costs, because of the need for equipment. However, the penalty charges paid by operators caught driving non-compliant vehicles in the low emission zone could be treated as revenue under a decriminalised regime. These charges could therefore offset the scheme operational costs, though a decriminalised regime would involve more complex steps towards implementation.

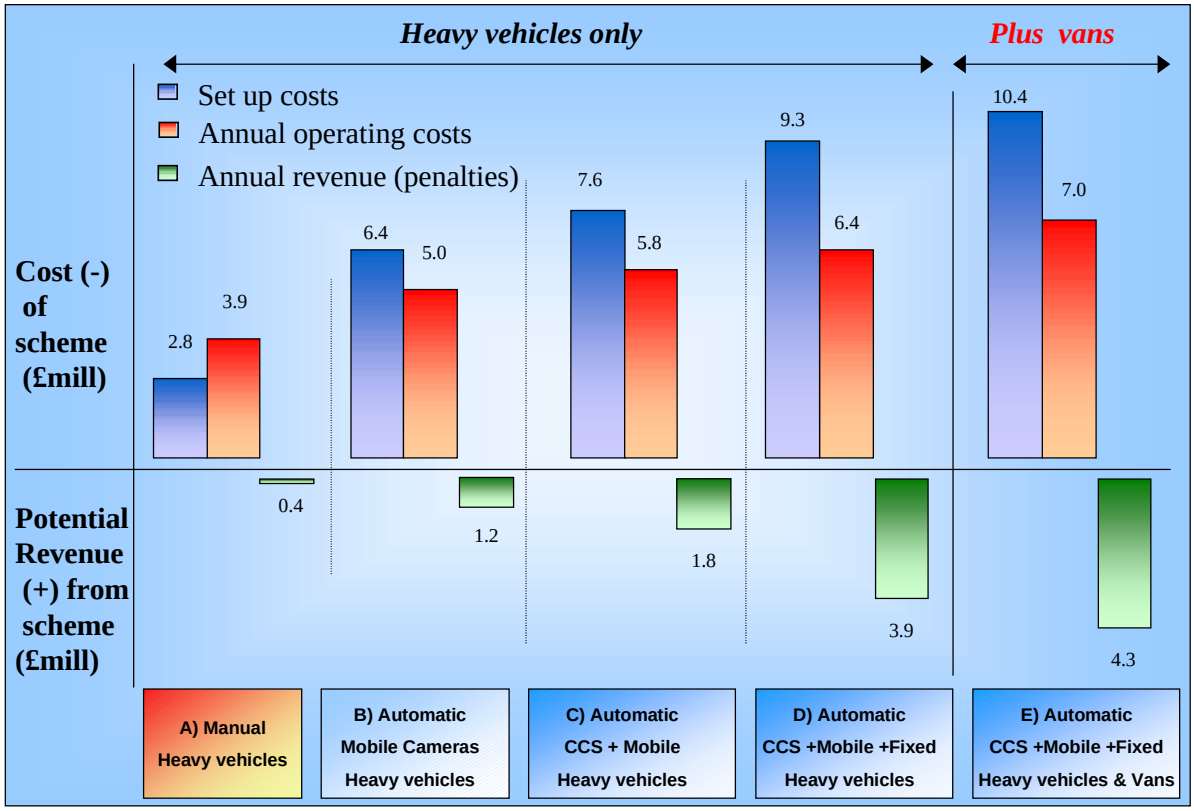
8.4. A number of automatic enforcement options exist for a scheme that only targeted **heavy vehicles.** Firstly the use of mobile cameras only, operated through-out Greater London and concentrating on key routes and junctions. Secondly, a combination of both mobile cameras and a large network of fixed cameras (a 'mixed' approach). Finally, the use of London CCS cameras and central processing systems, fed by additional information from a limited number of LEZ cameras in Greater London (mobile cameras and potentially a few additional fixed sites).

8.5. The introduction of a stand-alone camera network across London for an LEZ would be much more expensive to set-up but could catch a greater number of non-compliant vehicles. It would also generate a potentially large revenue stream. However, evidence from the implementation of the London CCS indicates that the costs of implementing a fixed camera scheme across all of London for an LEZ would be prohibitively high, at around £30 million to set-up and £10 million a year to operate. Building on the London CCS (which covers a relatively small area) would produce a scheme that was not quite as effective at detecting vehicle as fixed camera scheme across Greater London, but at considerably lower cost. Therefore, the study team has recommended that should an automatically enforced LEZ be taken forward, it should build on the existing Central London Congestion Charging Scheme (CCS) infrastructure, combined with the use of mobile ANPR cameras, and possibly a small number of additional fixed cameras outside this area on key London entry routes (e.g. motorways).

8.6. To ensure sufficient levels of compliance for a scheme that included **vans**, automatic vehicle detection and enforcement would be required. Once an automatic enforcement scheme is in place for heavy vehicles,

the additional costs of extending the scheme to vans are relatively low, shown in Figure 10. Parked vehicle checks by Borough parking officers would be a vital part of any scheme that includes vans, and could be cost neutral, as PCN revenues could cover officer effort.

Figure 10. Estimated Costs (£ Million) of the Recommended London LEZ Schemes.



Note: automatic enforcement and any revenues are conditional on a decriminalised regime being introduced. The revenues shown are those likely to arise initially on scheme introduction, but would be expected to fall in later years as compliance improved.

8.7. It is stressed that there is a trade off between the levels of non-compliance, the revenues generated, and the air quality benefits of a scheme. The estimated revenue streams in Figure 10 arise because it is thought that a small proportion of vehicle owners would continue to use their vehicles on an irregular basis in the zone and pay penalty charges, rather than invest in a new vehicle or abatement equipment. These vehicles would not be generating anticipated air quality benefits, which is the primary reason for introducing the scheme. It is also expected that operators would change their behaviour as the scheme progressed, i.e. compliance rates would increase in later years (which would be good for air quality), and so revenues would decline. When all capital costs and operating costs are considered, even with potential revenues in early years, it is clear that a London LEZ would not be self-financing, i.e. it would require funding.

Conclusion 5. A manually enforced scheme for lorries would have the lowest cost to set-up. However, automatic enforcement would ensure greater compliance, and in the short term, would raise revenues (under a decriminalised regime). An automatic scheme would be needed to include vans. The costs of introducing an automatic network of fixed cameras across London are prohibitively high. Therefore, should an automatic approach be adopted, the study recommends the use of the existing CCS infrastructure, combined with mobile ANPR cameras and possibly a small number of additional fixed cameras outside this area. It is stressed that none of the schemes considered would be likely to be self-financing.

9. What would be the emission criteria?

9.1. The emission criteria chosen will determine the number of vehicles not permitted to operate within an LEZ (without operators taking some action). The choice of emission criteria therefore dictates the costs and benefits of any scheme and is one of the key decisions in selecting the recommended option or options.

9.2. The most obvious way to set the emission criteria for a low emission zone is to use the Euro standards introduced by the EU (see Figure 3), i.e. to restrict vehicles over a certain age that comply with lower Euro standards. The age of vehicles of different 'Euro' vintage, at different future years, is shown in Figure 11 below. From this it is possible to estimate the age of vehicles affected by any potential emission criteria. For example, a low emission zone introduced in late 2006 that required lorries to meet an Euro 2 emission criteria would mean all lorries built before October 1996 would not be permitted to operate in the low emission zone. In effect, lorries over 10 years old would not be permitted to operate in London unless operators took some action, such as fitting abatement equipment, to meet an equivalent emission performance to a Euro 2 vehicle.

Figure 11. Age of Vehicles of Different Euro Standard (in years) as of Future Dates from 2006 to 2011.

Age of vehicles (years old) in future years

	2006	2007	2008	2009	2010	2011
Lorry						
Pre-Euro	14+	15+	16+	17+	18+	19+
Euro 1 (Oct/1993)*	11-13	12-14	13-15	14-16	15-17	16-18
Euro 2 (Oct/1996)*	6-10	7-11	8-12	9-13	10-14	10-15
Euro 3 (Oct/2001)*	0-5	2-6	3-7	4-8	5-9	6-10
Euro 4 (Oct/2006)*		0-1	0-2	0-3	2-4	3- 5
Euro 5 (Oct/2009)*					0-1	0-2
Van						
Pre-Euro	13+	14+	15+	16+	17+	18+
Euro 1 (Oct/1994)*	9/10-12	10/11-13	11/12-14	12/13-15	13/14-16	14/15-17
Euro 2 S (Oct/1997)*	5-9	6-10	7-11	8-12	9-13	10-14
Euro 2 L (Oct /1998)*	5-8	6- 9	7-10	8-11	9-12	10-13
Euro 3 (Jan/2002)	0-4	2-5	3-6	4-7	5-8	6-9
Euro 4 (Jan/2006)		0-1	0-2	0-3	0-4	0-5
Car						
Pre-Euro	14+	15+	16+	17+	18+	19+
Euro 1 (Jan/1993)	10-13	11-14	12-15	13-16	14-17	15-18
Euro 2 (Jan/1997)	6-9	7-10	8-11	9-12	10-13	11-14
Euro 3 (Jan/2001)	0-5	2-6	3-7	4-8	5-9	6-10
Euro 4 (Jan/2006)		0-1	0-2	0-3	0-4	0-5

Dates shown are when all new vehicles have to comply. The situation is, in reality, more complex because manufacturers also produce early compliant vehicles. For example, it is already possible to buy Euro 4 cars, though the legislated date for new vehicles to comply with this legislation is not until January 2006. *The requirements for all vehicles to meet the Euro 'standards' for heavy duty diesel vehicles, which includes lorries, buses and coaches, was actually introduced in the October of each year, whereas the requirements to meet the 'standards' for cars was introduced in January each year. The requirements for vans switch between the two dates. In addition, the standard for Euro 2 vehicles was introduced in different years for small (S) and large (L) vans.

9.3. Low emission zones in Swedish cities have introduced an age limit of eight years for lorries, i.e. beyond this time lorries are not permitted to operate in the zone unless owners do something to improve the vehicles emissions performance. A similar set of criteria was therefore initially considered for London, along with a range of other possible criteria based on Euro standards (using age as a proxy Euro standard). As with

Scandinavian schemes, a London LEZ would allow older vehicles into the zone if owners fitted abatement equipment or upgraded their engine to meet equivalent emission standards from modern vehicles.

9.4. The study has also investigated emission based standards that would require the fitting of certain abatement equipment. This includes the 'Reduced Pollution Certificate (RPC)' which relates to lorries. For the current RPC standard, this requires a vehicle to meet a very low PM_{10} emissions criterion similar to the levels expected from future Euro 4 vehicles (i.e. those built from late 2006 onwards). This usually requires the lorry to be fitted with a diesel particulate filter. It should be noted that a Euro 2 lorry with this technology has lower PM_{10} emissions than a newer Euro 3 vehicle (though not lower NO_x emissions).

9.5. Based on a balance of costs and benefits, the most promising emission criteria for an LEZ, to be introduced in 2006 (or the first year possible) for heavy vehicles (lorries, buses, and coaches), was considered to be an Euro 2 plus an RPC equivalent standard[2]. This criterion would allow all Euro 3 and Euro 4 vehicles into the zone, and all Euro 2 vehicles that had a Reduced Pollution Certificate or equivalent. All other vehicles would not be permitted to operate in the zone unless they took additional action to improve emissions performance (for example by fitting a new engine, using additional retrofit equipment, or through alternative fuel conversion). A more detailed description of these criteria, and the vehicles they apply to, is included in Box 1.

9.6. The study also recommends that this emission criterion should be tightened to introduce RPC equivalent standards into the Euro 3 fleet in 2010, so that the emission criteria for lorries, buses and coaches would be tightened to Euro 3 + an RPC equivalent standard[3]. This also means that in 2010 all Euro 2 vehicles would not be permitted to operate in the zone, even if they met the PM_{10} related RPC criteria, unless they took action to improve their NO_X emissions to an equivalent level to Euro 3 vehicles. This would involve fitting approved equipment (on the Clean-up Register) or alternative action. Alternative fuel vehicles (on the Powershift Register) that are certified to Euro standards could also easily be checked for compliance with the relevant emission criteria for both 2007 and 2010.

9.7. It is stressed that the current RPC only applies to PM_{10}. A NO_X based RPC criteria would simplify the approach for enforcing NO_X based criteria in later years (towards 2010). It could also result in much greater NO_2 benefits, at lower cost, due to promising retrofit technology (similar to the benefits from the current PM based RPC). The study therefore recommends that a NO_X based RPC criteria is investigated, as well as the extension of the current RPC scheme in future years, and the extension of the current RPC scheme to a lower vehicle weight limit above 3.5 tonnes. The GLA has commissioned further work to investigate the impact of a NO_X based RPC, focusing around selective catalytic reduction (SCR) as an after-treatment technology.

9.8. An issue has emerged with the use of Euro standards for low emission zone criteria, especially when compared with the Swedish LEZ approach. Introducing a set emission criteria relating to a Euro standard in a single year leads to a 'step change' in the number of vehicles allowed in the zone (because each Euro 'standard' comprises vehicles manufactured over several years). For example (from Figure 11), if the LEZ criteria moved from a Euro 2 to a Euro 3 emission criteria in 2010, all lorries between 5 and 9 years old would instantly not be permitted to operate in the zone unless they took additional action. The study has found that this 'step change' approach could have a number of detrimental effects for freight operators and increase costs. For example it would lead to potential problems due to peaks in the demand for retrofit conversion and equipment, a surplus of non-compliant vehicles all at once, and pressure on Government grant availability.

9.9. A possible way round the problems associated with a 'step change' in emission criteria would be to 'roll-out' the introduction of the recommended emission criteria in 2010 criteria before this year. This might, for example, introduce an RPC equivalent standard for Euro 3 vehicles alongside an age-based criterion (e.g. of 5 to 6 years old). This would mean that Euro 3 vehicles built in 2002 would have to be RPC compliant in

[2] This includes all vehicles over 3.5 tonnes. It is stressed that the current RPC scheme only applies to vehicles over 7.5 tonnes, and so all reference to RPC is 'equivalent to the emission criteria set in the RPC standard'. The RPC scheme is also not guaranteed to continue in later years and so all reference to the scheme should be considered as 'or equivalent to the current scheme criteria and with future certification based on relevant abatement equipment, e.g. as on the Energy Saving Trust Clean-up Register'.

[3] The introduction of a Euro 3 criteria was also considered but discounted, as a Euro 2 + RPC equivalent vehicle would actually have lower PM_{10} emissions than a Euro 3 vehicle (i.e. going from Euro 2 + RPC to Euro 3 would be detrimental for air quality).

2007, Euro 3 vehicles built in 2003 would have to be RPC compliant in 2008, etc. This approach is outlined in more detail in Box 1. The criterion would therefore be a combination of Euro standard and age-based standard. Provided this rolling scheme was introduced early enough, it need not have fewer environmental benefits, and would mitigate the above problems that occur with a 'step change' approach. The study therefore recommends that this rolling approach be considered for emission criterion for later years.

Box 1. The Effects of the Emission Criteria: Vehicles permitted to operate in London

The recommended emission criteria would affect the vehicle fleet in the following way. In 2006/7, for lorries, coaches and TfL London buses, the recommended emission criteria is Euro 2 + RPC (or equivalent)/Euro 3. This would mean that new vehicles (Euro 4), and all vehicles built after late 2001 (Euro 3), would be permitted to enter/operate in the low emission zone. Euro 2 vehicles, i.e. those built before late 2001 (and therefore older than 5-6 years old) would have to fit abatement equipment (or take other action) to meet an equivalent emission criteria to the Reduced Pollution Certificate (which sets an emission criteria for PM_{10}) in order to operate in the zone. For most of these Euro 2 vehicles, the most cost-effective option would be to fit a diesel particulate filter. Older pre-Euro and Euro 1 vehicles, i.e. those built before late 1996 (and older than 10/11 years old), would not be permitted to operate in the zone unless they took action to reduce both NO_X and PM_{10} emissions (to meet Euro 2 +RPC/Euro 3 emission criteria). The number of older pre-Euro/Euro 1 vehicles still operating in 2007 will be low and are predicted to comprise 3-5% of the UK lorry km driven in 2007. They will also have a limited lifetime of use left. Nevertheless, retrofit technology or other action such as a re-engine or alternative fuel conversion would meet these emission criteria. It is stressed that this two-tier approach is similar to the Swedish zones, where vehicles must fit PM_{10} abatement equipment for vehicles older than 8 years of age and NO_X abatement equipment after 12 years to continue to operate in the zone.

In 2010, for lorries, coaches and TfL London buses, the recommended emission criteria is set at Euro 3 + RPC (or equivalent). This would mean that all new vehicles (Euro 4) would be permitted to operate in the LEZ. Euro 3 vehicles, i.e. those built before late 2006 (and older than 4-5 years old) would have to fit abatement equipment (or take other action) to be allowed to operate in the zone to meet an equivalent level (for PM_{10}) to the RPC standard. For most of these vehicles, the most cost-effective option would be to fit a diesel particulate filter. For vehicles built before late 2001 (i.e. older than 9-10 years old) then action would be needed to tackle both NOx and PM_{10} emissions to meet the required emission criteria. For Euro 2 vehicles that remained in the fleet (i.e. that had taken action to meet the RPC standard in 2007), this would require additional retrofit technology (or other action) to reduce NOx emissions. The most promising low cost technology is Selective Catalytic Reduction (SCR), which is currently at an advanced testing and demonstration stage. The number of these older vehicles still operating in 2010 will be low (e.g. only 6-12% of the UK lorry km driven in 2010).

An alternative approach for achieving additional benefits in earlier years (post 2006/7) is to roll out the Euro 3 + RPC criteria early to the Euro 3 fleet. This would be possible by introducing a combined age and Euro standard based LEZ. The proposed approach would be to introduce a rolling 5 or 6 year age based limit for heavy vehicles in 2007, beyond which time all vehicles would need to have RPC (or equivalent) certification. To illustrate, following the introduction of the initial Euro 2 + RPC criteria in 2006, the rolling scheme would introduce a 5 year age based limit in 2007, which would require all Euro 3 vehicles older than 5 years old to meet an equivalent emission criteria to the Reduced Pollution Certificate. This age based limit would be rolled forward (e.g. in 2008, all Euro 3 vehicles older than 5 years old would have to meet equivalent emission criteria to the RPC, etc.) This would continue until 2011, when all Euro 3 vehicles would have to meet equivalent emission criteria to the RPC in order to operate in the zone (as all Euro 3 vehicles would be older than 5 years old). Such a scheme would have the advantage of spreading the requirement for retrofit equipment and grants to support action over time, and would therefore smooth out the peaks that would occur with a single revised criterion in 2010.

For vans and taxis, no RPC equivalent standard exists, and it would be extremely difficult to maintain and enforce a similar scheme. Therefore, the recommended emission criteria have been simplified and are proposed as a 10-year age limit. Vehicles over ten years old would not be permitted to operate in the low emission zone unless they could demonstrate lower emission through the use of approved low emission technology, such as alternative fuels.

9.10. The study also investigated the potential emission criteria/age limits for vans for a London LEZ. These vehicles are not included in current Scandinavian schemes. The study recommends a different approach for these vehicles, should they be included, based on an age based criteria. A different approach is needed because abatement technology is less cost-effective and less available for these vehicles, and because the large numbers of vehicles would make a more complex scheme more difficult to certify and enforce. The study investigated a rolling age based limit and concluded this would be more appropriate than using emissions criteria based on Euro standard (as it would reduce a number of detrimental effects on operators).

9.11. The recommended criterion for vans is a ten-year rolling age limit. This is consistent with the PM_{10} and NO_X based criteria applied to heavy vehicles (see box 1) and represented the best balance of costs and benefits. Operators of vehicles older than this would no longer be permitted in London unless they took some action to improve emissions, for example approved alternative fuel conversions (on the Powershift Register)

to match against a relevant age-based limit. The greater complexity in including vans in a low emission zone, and the uncertainty over the socio-economic effects of including them, led the study to conclude that these age based limits should be introduced in later years, e.g. in 2010. It should be noted that the emissions improvement between Euro 1 and Euro 3 vans is modest when compared to lorries. Beyond removing very old (pre-Euro) vehicles, the main aim of targeting the van fleet is to introduce very modern vehicles (Euro 4), as these have significantly lower emissions. The aim of a van based LEZ is therefore to stimulate fleet turnover. Note as discussed in an earlier section, there is an additional recommendation put forward alongside the possible age based limit for vans. This is that some action would be warranted for pre-Euro vehicles, irrespective of whether vans as a whole are included in any LEZ.

9.12. The application of a similar age based emission criterion was also considered appropriate for taxis (licensed taxis) and private hire vehicles. The Mayor's Air Quality Strategy includes proposals for emissions standards for licensed London taxis. Following consultation with the taxi trade, the proposals for taxis have been revised. Although still subject to further consultation and agreement, the revised proposal sets out the introduction of an age restriction for licensing taxis that will start in March 2004 at 15 years old and be reduced annually until a 12-year age limit is reached (in March 2007). The 12-year age limit will then be maintained year on year. It is also proposed that a second element will address taxis that are of an older vintage, by requiring some form of emissions reduction equipment as a condition of licence. This is subject to appropriate quantities of equipment being available and installation being possible within any prescribed time-scale. The revised mayoral proposal would mean that pre-Euro taxis would no longer be licensed in London in 2007 (unless they were converted to run on the alternative fuel liquefied petroleum gas (LPG). It would also mean that Euro 1 vehicles would no longer be licensed in 2010 (unless converted to run on LPG). It is highlighted that the 12-year age based limit for licensed London taxis in the mayoral proposals is lower than the recommended LEZ criteria for vans (which is a 10-year age based limit in 2010). However, the mayoral proposal does address taxis that are of an older generation (but within the 12 year age limit), proposing emissions reduction equipment as a condition of licence. This would reduce the emissions from the older section of the licensed fleet and would improve the emissions performance of the taxi fleet to a level consistent with (or most likely in excess of), the recommended LEZ proposals.

9.13. As stated earlier, it is not recommended that cars are included within a London LEZ. However, as with the van fleet, the study recommends that action is needed to address pre-Euro vehicles, i.e. pre-1993 vehicles. It is recommended that these older cars should potentially be targeted through alternative action to a mandatory low emission zone, such as through scrappage of older vehicles or a low emission strategy (see section 5 on 'which vehicles').

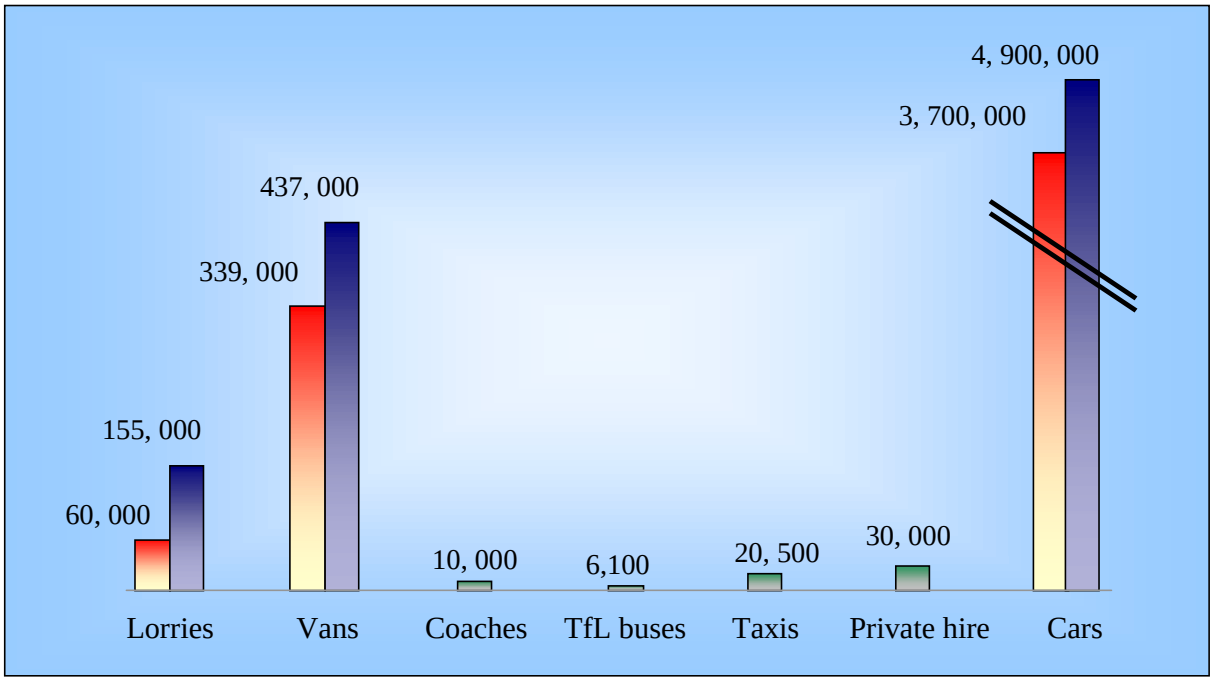
Conclusion 6. The emission criteria set for a London low emission zone will dictate the air quality benefits and the costs to operators. The study recommends that for lorries, buses and coaches the criteria are based on Euro standard (age) and other emission standards (RPC). The study recommends that vehicles should meet an initial criterion of Euro 2 plus RPC (or equivalent) in 2006/7. It also recommends that this criterion be tightened to Euro 3 plus RPC (or equivalent) in 2010. However, there are two additional conclusions put forward alongside this latter recommendation. Firstly that a NO_x based RPC scheme would help the implementation of the scheme and could lead to greater NO_2 improvements. Secondly that it would be beneficial to introduce the Euro 3 plus RPC criterion earlier than 2010 using a rolling approach over several years (applying the RPC criteria to Euro 3 vehicles based on age). The study recommends a different approach for vans, should these vehicles be included, based on an age-based criterion using a rolling ten-year-old age limit. A similar age-based standard is also recommended for licensed taxis and private hire vehicles.

10. How many vehicles would be affected?

10.1. The number of vehicles affected by a London LEZ depends on the area of the scheme, the type of vehicles included, and the emissions criteria that are set. It also depends on the timing of the scheme, because of the natural turnover in the fleet. The number of vehicles affected by different schemes has been one of the key factors that have influenced the emission criterion set out in the previous section.

10.2. A very large number of vehicles potentially operate in London during the course of any single year. While there is good data on London traffic flows, there is unfortunately no robust information on the numbers of vehicles operating in London. A major part of the study has been to estimate what these numbers might be – and so estimate the number of vehicles that could be affected by a London LEZ. The estimated number of vehicles travelling in Greater London each year is shown in Figure 12 below: note that a range of values is presented for lorries, vans and cars reflecting the uncertainty over the number of non-London registered vehicles, i.e. vehicles that travel into London from outside.

Figure 12. Total Number of Vehicles Operating in Greater London each year (2002).



The values for lorries, vans and cars show a low and high range. Values for other vehicles are presented as a central estimate only. The scale is linear for all vehicles except cars, the numbers of which far exceed other categories (denoted by the parallel lines). The number of vehicles operating in London in future years will be higher due to fleet growth.

10.3. The number of vehicles that operate in London each year is high, as it includes vehicles that only come into the Capital once a year, as well as vehicles that enter frequently. The current estimates suggest that between 60,000 to 155,000 lorries, 340,000 to 440,000 vans and between 3.7 and 4.9 million cars, might operate in London at some point during the course of a year, as well as a significant number of coaches, buses, taxis and private hire vehicles. Further data investigated within the project indicates that for lorries, the upper value presented (i.e. 150,000 vehicles in each year) is likely to be more accurate.

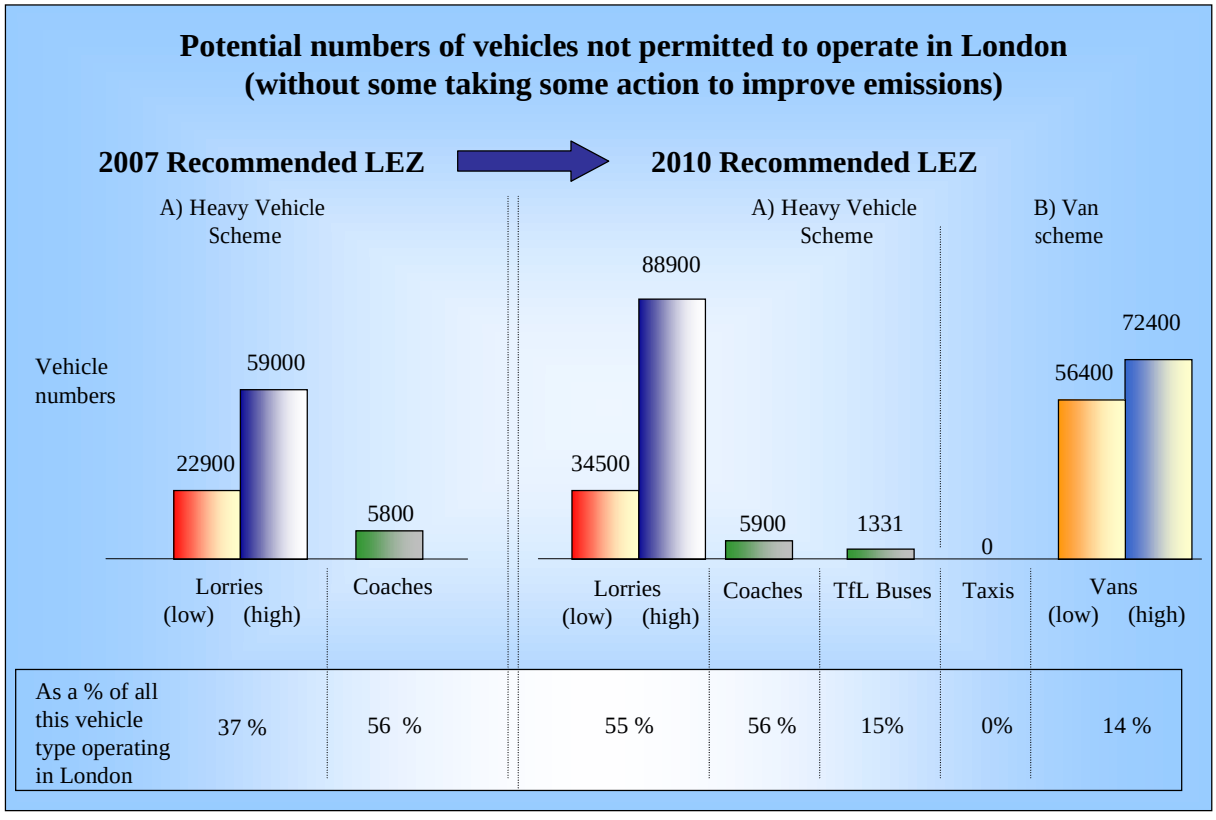
10.4. These numbers are very significant, because they mean that a large proportion of **all** vehicles in Britain operate in London during some point in the year. The estimates indicate that at least 14%, and probably more likely, around 36% of the British lorry fleet come into London each year. A higher proportion of coaches, possibly as many as half of all British vehicles, also operate in London during the course of a year. Finally, an estimated 14 - 18% of all British vans travel in London at some point during any year. These conclusions are some of the most important from the study. Any action in London to introduce a low

emission zone would have a large impact on the overall British vehicle fleet. The choice of emissions criteria set for any London LEZ must therefore consider the national level implications on the entire fleet.

10.5. The numbers above show the overall fleet size operating in London each year. Should a low emission zone be introduced, then it would affect a proportion of this fleet (according to the emission criteria and the year of introduction). Because high numbers of vehicles operate in London each year, the study has found that even relatively modest LEZ emission criteria would affect a significant number of vehicles, i.e. a significant proportion of the vehicles shown in Figure 12. The number of vehicles affected by the recommended scheme, and the relative proportion of the fleet operating in London affected by the zone, is presented in Figure 13.

10.6. Even with the recommended emission criteria, introduced in late 2006/2007, around 30% of lorries and potentially 40% of coaches otherwise operating in London (in the absence of the LEZ) would not comply with the emission criteria set down. However, for most of these vehicles, all that would be required to ensure compliance would be the introduction of relatively low cost retrofit technology for improving PM_{10} emissions. A similar, though slightly higher, proportion of the heavy fleet would be affected by the recommended criteria for 2010. The proportion of vans affected by the recommended low emission zone schemes is lower (around 12% of the vehicles otherwise operating in London would not comply with an LEZ introduced).

Figure 13. Numbers and Proportion (%) of Vehicles Travelling in Greater London each year that would not comply with the 'Recommended' London Low Emission Zone.



Note: the low and high values for lorries and vans reflect the range in number of vehicles operating in London. Due to existing mayoral strategies, all London buses would comply with the recommended London LEZ emission criteria for 2007. It is also assumed that the mayoral emission standards for licensed taxis would set a 12 year age based limit in 2007 as well as an additional element to target the emissions from the remaining older vehicles.

10.7. The study has also considered stricter emission criterion that might achieve greater air quality benefits. It has been found that these stricter schemes would have a much larger impact on the number of vehicles affected. For example, introducing an Euro 3 plus RPC emission criteria in 2007 (i.e. introducing the recommended emission criteria for 2010 earlier) would mean that almost 90% of the lorries and coaches otherwise operating in London would not comply with the LEZ. Because stricter schemes affect a very high

proportion of the fleet travelling in London in a given year, they would have very high costs for operators (see later section).

10.8. One interesting effect that has emerged during the study is that the early introduction of an LEZ could potentially have detrimental impacts in achieving stricter emission standards in later years. For example, a drive towards vehicle replacement in early years (pre 2007) is likely to lead to large-scale changes in the fleet and this may make later standards more difficult to achieve. The effect has occurred to some extent with London buses. The drive towards the Mayoral Euro standard and RPC policy (buses are required to meet Euro 2 + RPC or Euro 3 + RPC by 2005, i.e. the whole fleet will meet the RPC criteria) has influenced the natural replacement cycle in the fleet, and is predicted to lead to cleaner buses in London. Bus operators are already buying, or switching to, newer vehicles to comply with this policy. This is leading to an increase in the most modern vehicles currently available, which are Euro 3 technology. However, the EU is introducing new emission legislation in late 2006 (Euro 4), which will mean new vehicles are expected to have very much lower emissions (see Figure 3). Stimulating the bus fleet to upgrade now could make it more difficult to introduce large numbers of these Euro 4 vehicles in later years, i.e. it might become more difficult to move towards stricter emission criteria in later years, as there will be much higher numbers of relatively modern vehicles, but much lower numbers of very new vehicles. Interestingly, this effect means that the later implementation of the low emission zone (i.e. in late 2006 or 2007) may lead to greater benefits in 2010 or later, than if an earlier scheme was introduced in 2005.

Conclusion 7. The number of vehicles affected by a London low emission zone is potentially very high, as a large proportion of the national fleet operates in London at some point during any year. A London LEZ would therefore have a national impact. The recommended emission criteria set would have a significant effect on tackling the older, higher polluting, section of the vehicle fleet. Introducing stricter emission criteria would impact upon a prohibitively high proportion of the fleet.

11. What would be the air quality benefits?

11.1. The main pollutants of concern with respect to human health are particulate matter (PM_{10}) and nitrogen dioxide (NO_2). The UK and EU air quality legislation sets targets for these pollutants (see Box 2) that relate to different time periods – from an *hourly* average (mean) concentrations up to *annual* mean concentrations. It is important to note that the targets for different time periods present different challenges, i.e. some targets are more difficult to achieve than others. For **NO_2**, the most challenging target is for the annual mean concentration. For **PM_{10}**, the most challenging target in 2005 is likely to be daily (24 hour) mean concentration, but in 2010 is likely to be annual mean concentration. It is stressed that much of London will meet even the most challenging targets, without additional action. However, in the absence of additional measures, there are likely to be significant areas of London where pollution concentrations are higher than a number of the most challenging AQS objectives and EU limit values.

11.2. The study has assessed the air quality benefits of a very large number of potential low emission zones in London. The analysis has looked at both emissions (measured in tonnes emitted from vehicle tailpipes), and air quality concentrations (measured in $\mu g/m^3$) - the latter relates to the concentrations in the air we breathe (note, the UK and EU standards are set in respect of concentrations not emissions).

Box 2. Air Quality Targets

The UK Government (the Air Quality Strategy for England, Wales and Northern Ireland) and the EU (Air Quality Framework Directive) has introduced air quality targets for *concentrations* of pollutants, referred to as 'objectives' in the UK AQS and 'limit values' in the EU Directive, that are to be achieved by given dates. The UK Air Quality Strategy provides the key mechanism for implementing the EU Directive.

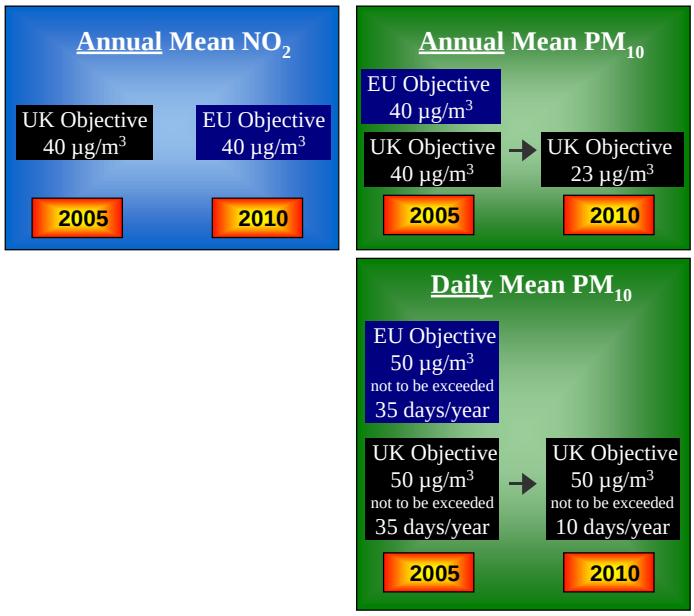
The most challenging target for **NO_2** is an annual mean concentration, set at 40 µg/m^3, to be met by end of 2005 (UK Air Quality Strategy). The same target (40 µg/m^3) is also set by the EU legislation, but has to be achieved by the later date of 2010 (i.e. the EU legislation is less stringent). In contrast, it is predicted that the short-term target for NO_2 (a 1-hour mean) will be met across all of London, even without additional action (i.e. in the absence of an LEZ).

For **PM_{10}**, the first target is an annual mean concentration of 40 µg/m^3 to be achieved by January 2005 under both the UK and EU legislation. This standard is tightened to 23 µg/m^3 in 2010 for London under the UK AQS (it is tightened to 20 µg/m^3 for the rest of the UK) and as an indicative EU Limit Value at 20ug/m^3.

The second **PM_{10}** target is a daily (24 hour) mean concentration of 50 µg/m^3, that should not be exceeded more than 35 times per year. This objective is to be achieved by January 2005 under both the AQS and the EU legislation. This standard is tightened (within the AQS) such that the 50 µg/m^3 concentration should not be exceeded more than 10 days each year in London by 2010.

It is predicted that the target for annual mean PM_{10} concentration will be achieved in 2005 across London, and the updated target for 2010 met almost everywhere in London, *without* any additional action (i.e. under business as usual). The 24-hour targets for 2005 and for 2010 are more challenging. However, it is stressed that there is some uncertainty over these future predictions of air quality (see later discussion) and different studies indicate that both PM_{10} targets in 2010 may actually be very challenging to achieve. Figure 14 summarises the most challenging targets for both pollutants under UK and EU legislation.

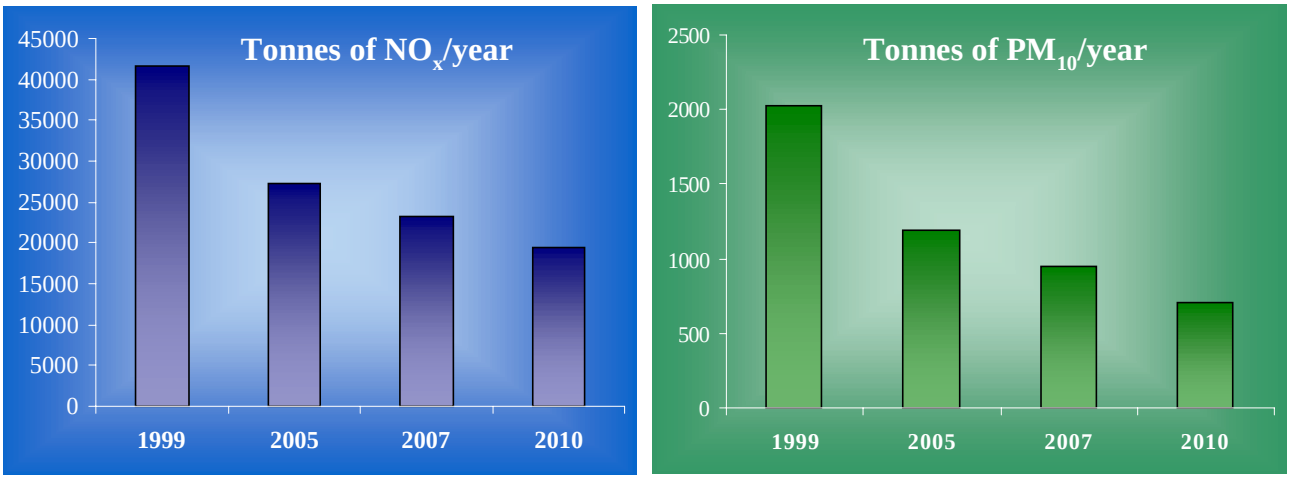
Figure 14. The Key EU and UK AQS Objectives in London.



11.3. Overall, this study has shown that a London LEZ would have less air quality benefit than indicated by previous studies, and less benefit than anticipated at the start of the study. The most important reason for this difference is due to new evidence on the emissions from modern vehicles. This new evidence suggests that the emissions improvements (particularly for NO_x) are lower than previously anticipated for some classes of vehicles, especially for diesel vehicles, through the different Euro standards. However, the anticipated benefits are also lower because of other actions already in place (for example the emission criteria set out for London buses in the Mayor's Air Quality Strategy – which is taken into account in the analysis presented).

11.4. The air quality benefits of any LEZ also have to be seen in the context of a significant decrease in emissions, year on year, as a result of the ongoing, normal replacement of older vehicles by newer vehicles in the fleet. By 2005, emissions from road vehicles will be significantly lower than they are today. This effect will continue in future years, and is particularly important from 2007 onwards, when Euro 4 vehicles are introduced into the fleet (as these are expected to be very clean). This can be seen in Figure 15 below, showing emissions from road transport vehicles in London in recent and future years.

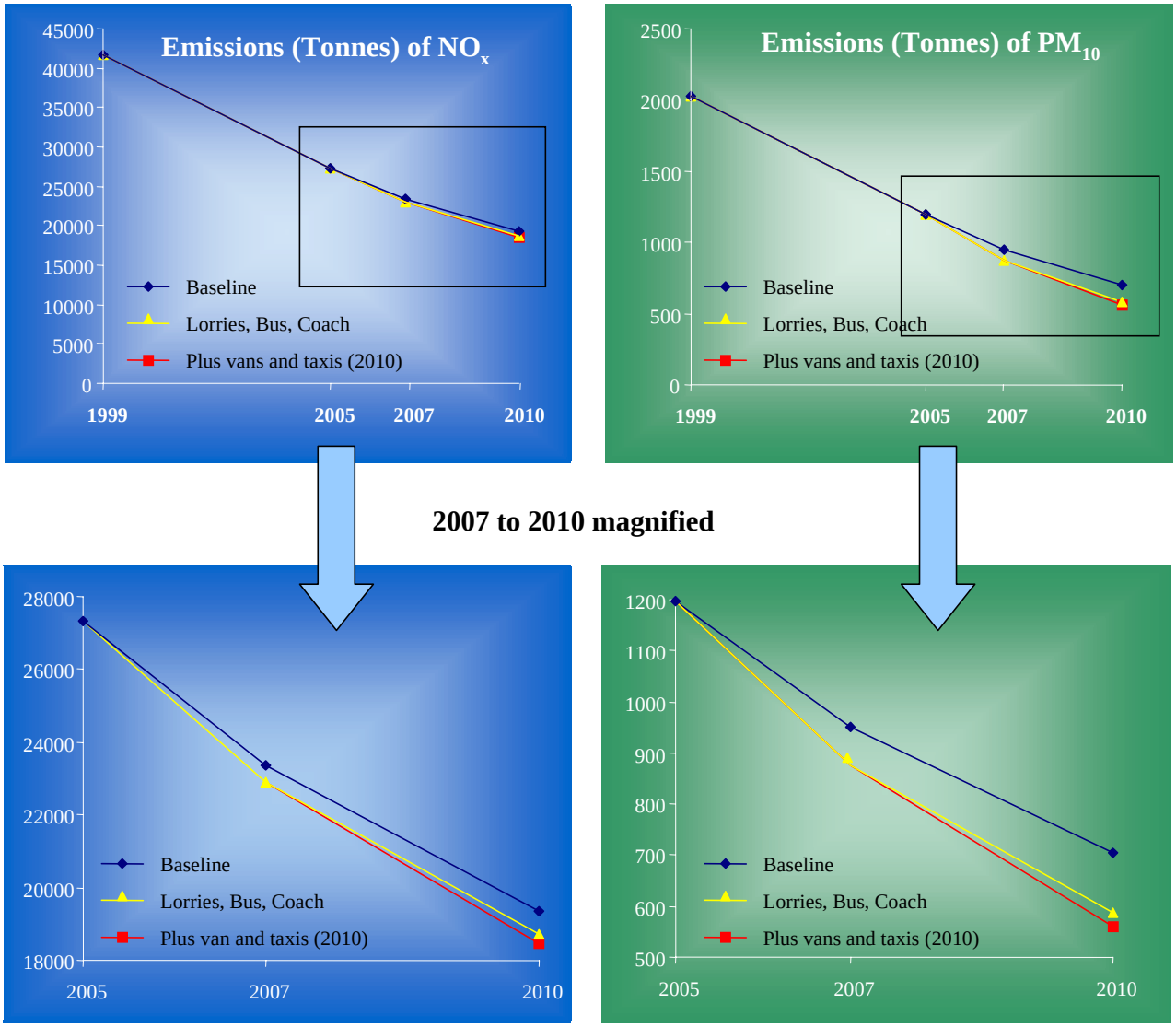
Figure 15. The Baseline Decrease in Emissions from Road Transport in London (Without an LEZ).



11.5. The aim of introducing a low emission zone is to increase the speed of this decline in emissions, i.e. to bring forward the uptake of modern cleaner vehicles in the fleet. The study has considered the potential emissions benefits of around 40 different LEZ schemes in London, looking at different areas, different emission criteria and different vehicles. The change in emissions in future years from the recommended scenarios is shown in Figure 16 below. It can be seen that the emissions reduction achieved with the recommended low emission zone is modest in relation to NO_x. At a London wide level, the recommended option would lead to a 1.5% reduction in NO_x emissions and a 9% reduction in PM_{10} emissions in 2007. The first option in 2010 (without vans and taxis) would lead to a 2.7 % reduction in NO_x emissions and a 19% reduction in PM_{10} emissions. Extending the low emission zone in 2010 to include vans and taxis would achieve a 3.8 % reduction in NO_x and a 23% reduction in PM_{10}. These estimates are all additional to the reductions that are likely to happen without the LEZ. However, emissions reductions are not the aim of a London low emission zone – it is to reduce the number of times the air quality targets are exceeded and to reduce the numbers of areas with high air quality concentrations.

11.6. Because the LEZ is aimed primarily at benefiting people's health, it is necessary to look at air quality concentrations ($\mu g/m^3$), rather than just emissions (tonnes), to really assess the impact and cost-effectiveness of a low emission zone. It is stressed that the relationship between emissions and the resulting air quality concentration is very complex. The effect emissions have on local air quality depends on the existing concentrations of other pollutants and on the meteorological (weather) conditions (wind speed, etc). An analysis of air pollution concentrations has found that a London low emission zone would have a greater impact in improving air quality concentrations than it would in reducing emissions, at least in relation to the specific air quality targets set by the UK Government and the European Union. This happens because many locations in London are likely to be close to the air quality target levels for future years. Even small changes in emissions can significantly affect the area of exceedence, so that an area that previously exceeded the air quality target could drop below the threshold level with the introduction of a low emission zone in place. The air quality benefits of the recommended London low emission zones are described below. They are presented separately for each of the two major pollutants of concern - NO_2 and PM_{10}.

Figure 16. The Change in Future Emissions from a Low Emission Zone in London.

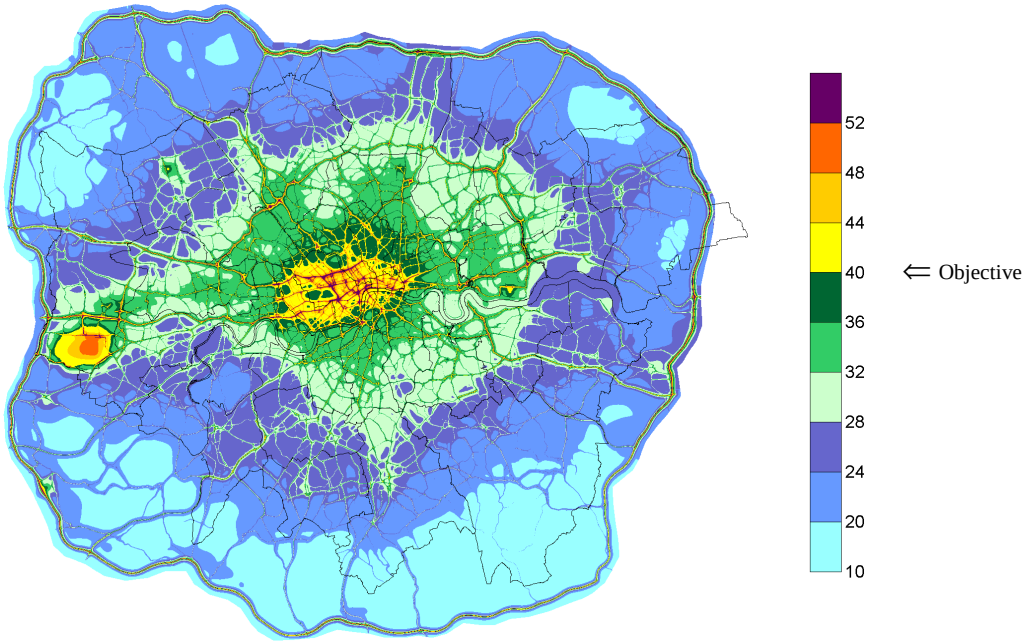


Note: the emissions shown assume that the LEZ would achieve very high compliance (i.e. no deliberate evasion).

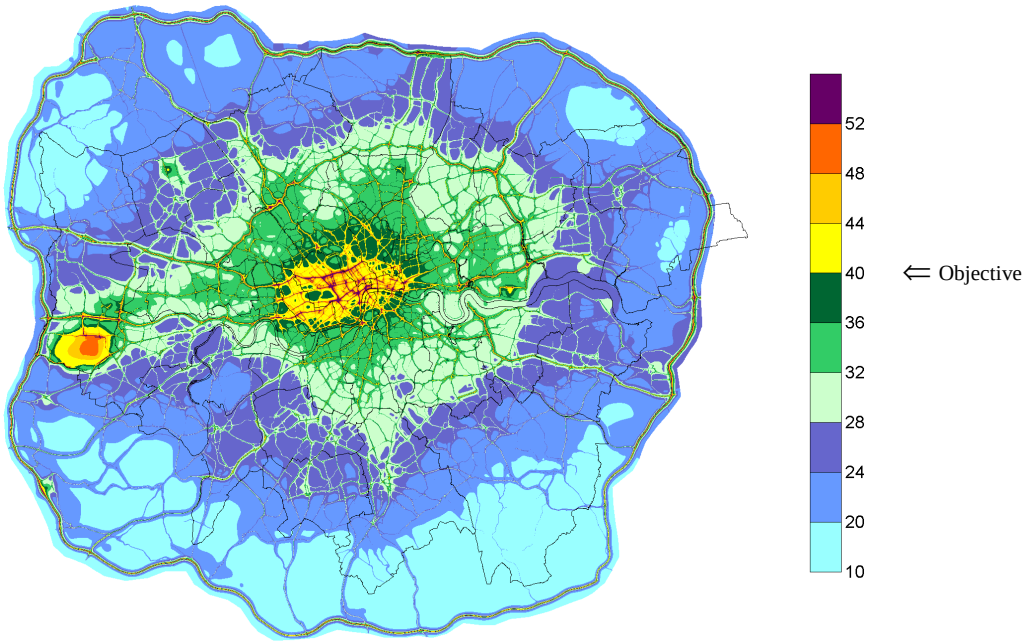
11.7. The study has shown that even the most ambitious LEZ (i.e. even with a stricter emission criteria) would not, on its own, achieve all the National Air Quality Strategy (AQS) or EU NO_2 objectives in London in 2005 or 2010. It would also lead to a significant increase in the costs of the scheme to operators (see later). For a more realistic low emission zone (which is recommended on the basis of the study findings), the absolute change in background annual mean concentrations above and beyond the baseline would be modest. However, the change in exceedence area is considerably higher (due to the reasons outlined in the previous paragraph). It should be noted that since the LEZ cannot be implemented before 2006, it could have no role in helping meet 2005 targets. The benefits of the recommended LEZ are presented below, by pollutant.

11.8. **For NO_2** the recommended low emission zone in 2007 would have a modest improvement in reducing absolute concentrations. This is shown in the air quality concentration maps for the 'with' and 'without' maps in Figure 17 below. However, a low emission zone would lead to a greater change in the area (km^2) in London that exceeds the air quality targets. The benefits are likely to be greater for some boroughs, particularly those in central and inner London. The recommended LEZ would reduce the total area (km^2) exceeding the NO_2 objective in 2007 by 4.7 % compared to the baseline (from an area of 91.4 km^2 to 87.2 km^2). The effects on individual boroughs will be higher, for example, there would be an estimated 9.3 % reduction in the area exceeding the target in Islington compared to the baseline. It is likely that the area to the east of inner London would benefit more than most of London, because there are higher flows of lorries in this area.

Figure 17. NO_2 concentrations in 2007 for the 'Baseline'



NO_2 concentrations in 2007 'With the Recommended Low Emission Zone'.

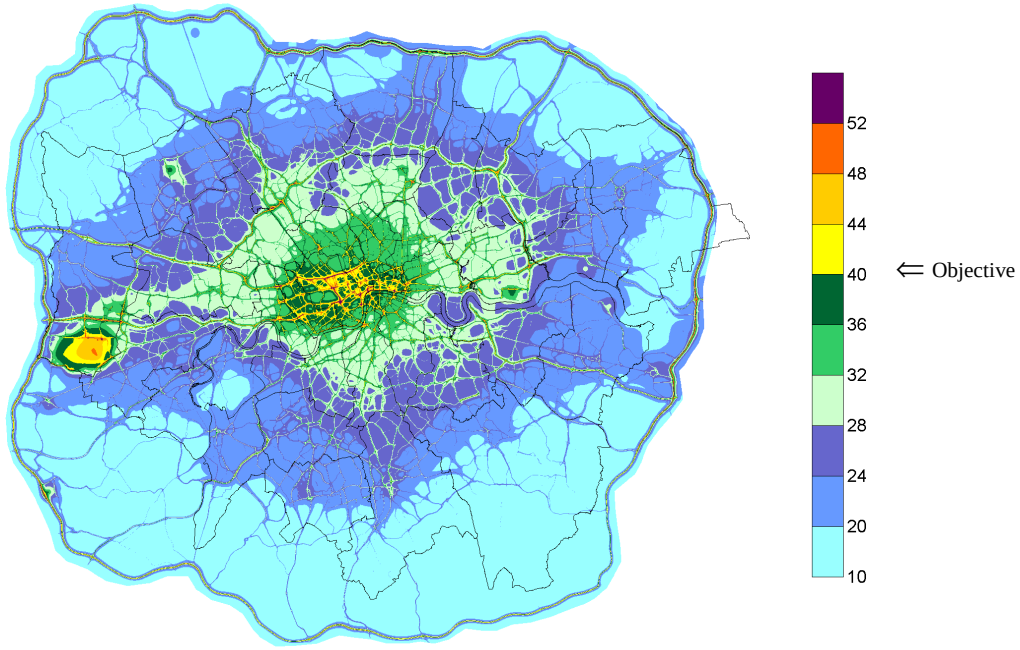


The top map shows the baseline annual average concentration, in μgm^{-3} (a unit of air pollution concentration) without the introduction of the low emission zone in 2007. The bottom map shows the annual average concentration *with* the recommended low emission zone in place in 2007. Areas that are red or yellow exceed the relevant air quality standard. It is assumed that there would be no evasion within the LEZ.

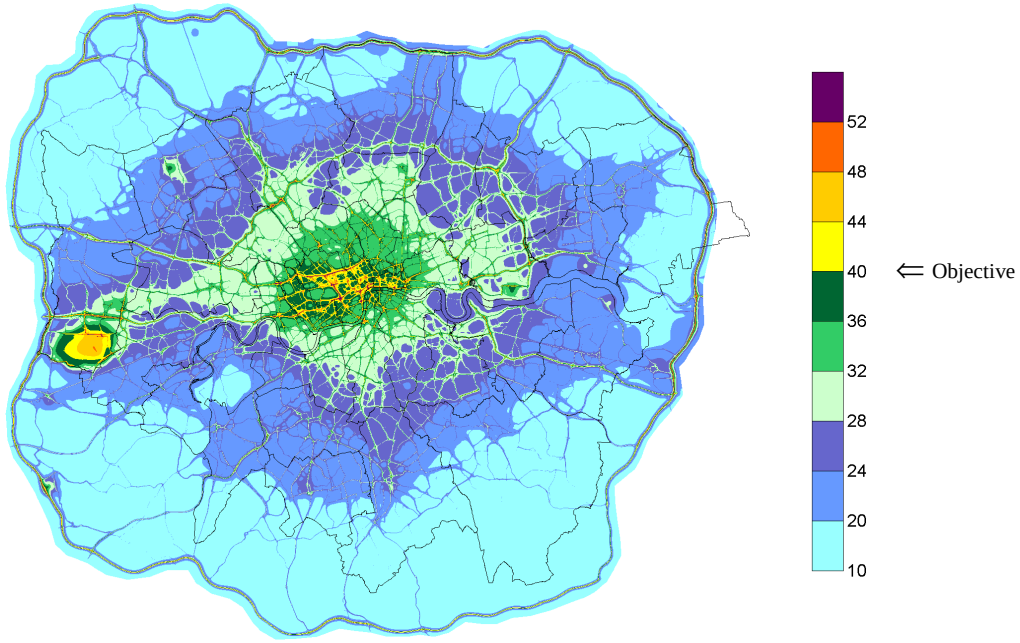
11.9. The same annual mean target for NO_2 still applies in 2010. There are two recommended LEZ scenarios in 2010, one with, and one without, vans and taxis. The change in absolute concentrations from the introduction of either LEZ would be low and the concentration maps are shown below in Figure 18, 'with' and 'without' the recommended LEZs. However, a greater reduction would occur in the area that exceeded the air quality target. For the recommended LEZ targeting lorries, TfL buses and coaches (but not including vans and taxis), the area (km^2) that exceeds the air quality target is estimated to fall by 12% in 2010 relative to the baseline. The predicted change in many boroughs is higher e.g. with a 16% fall in

Southwark. Including vans and taxis in the low emission zone, as well as heavier vehicles, again leads to a very small effect in reducing emissions, but it does lead to greater improvements in air quality than the heavy vehicle scenario, not least in central London where taxi flows are highest. It also has a greater effect in reducing the area exceeding the air quality target. For example, in Westminster, including vans and taxis would reduce the area exceeding air quality targets by 20% in 2010 – compared with 10% if only heavy vehicles were included.

Figure 18. NO_2 concentrations in 2010 for the 'Baseline'

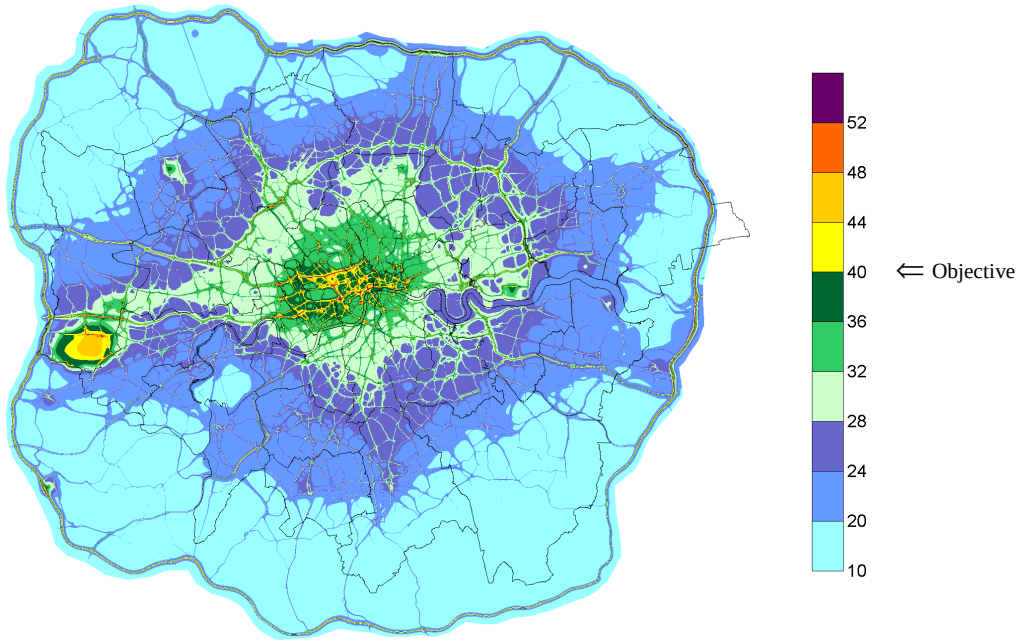


NO_2 concentrations in 2010 'With' the Recommended LEZ for A) Heavy Vehicles only



The top map shows the baseline annual average concentration, in μgm^{-3}. The bottom map shows the annual average concentration *with* the recommended low emission zones in place for A) lorries, buses and coaches only. Areas that are red or yellow exceed the relevant air quality standard. It is assumed that there would be no evasion within the LEZ.

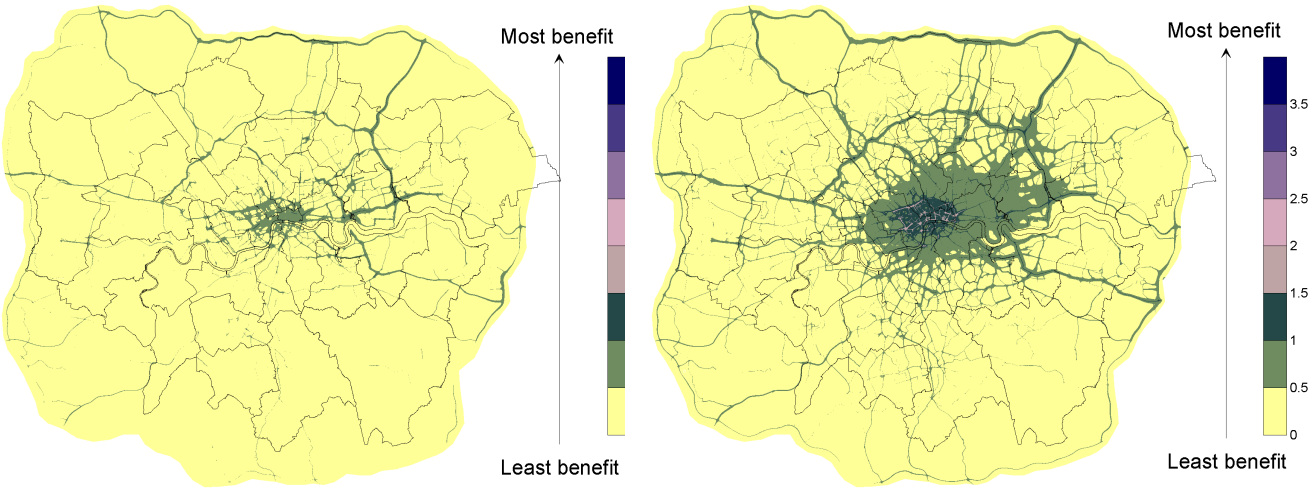
Figure 18 (cont.) NO_2 concentrations in 2010 'With' the Recommended LEZ for B) Heavy Vehicles, plus Vans, Taxis and Private Hire'.



The map shows the annual average concentration *with* the recommended low emission zones in place for B) lorries, buses and coaches, plus vans and taxis, in 2010. Areas that are red or yellow exceed the relevant air quality standard. It is assumed that there would be no evasion within the LEZ.

11.10. The difference in the 2010 maps between A) a heavy only scheme, and B) with vans and taxis also, can be seen more clearly if the incremental change in air pollution is considered. Figure 19 shows the incremental (net) benefit from the low emission zone across London for the two scenarios in 2010.

Figure 19 Incremental NO_2 benefits in 2010 'With' the Recommended LEZ for A) Heavy Vehicles only and B) Heavy Vehicles, plus Vans and Taxis.

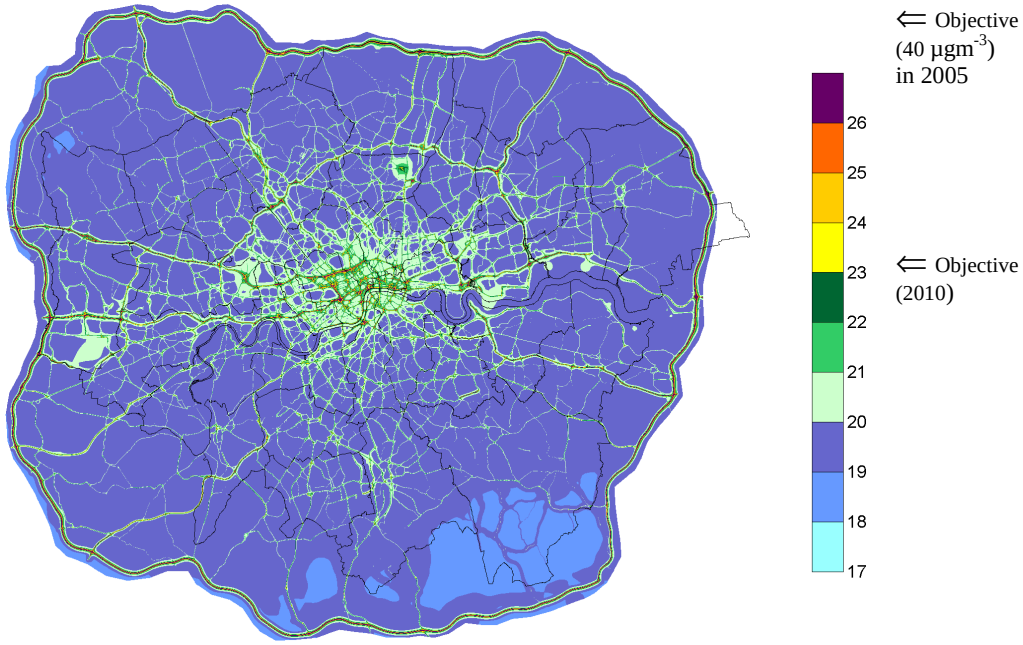


Note: the graphs show the incremental benefit from the low emission zone in μgm^{-3}.

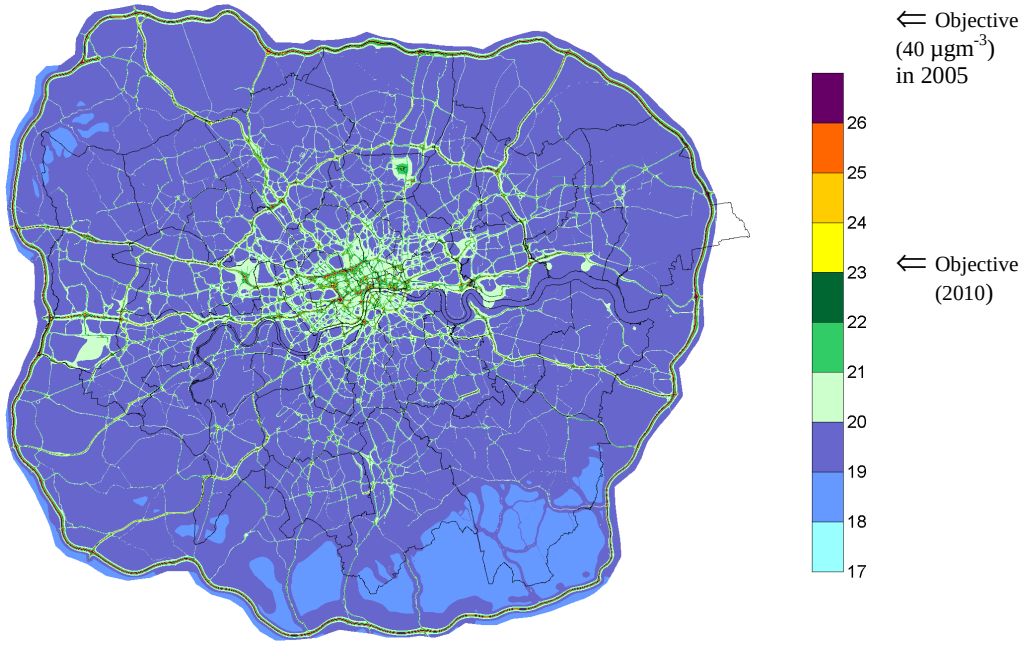
11.11. **For PM_{10},** London is likely to be closer to the air quality targets even without action from a low emission zone. Again, the benefits of a low emission zone on emissions, and on absolute pollution concentrations would be modest. A low emission zone would still, however, have a significant impact on reducing the areas exceeding air quality targets. For PM_{10} (see Box 2 above) there are two relevant air

quality standards. For the first of these, the **annual mean concentration,** London is expected to meet the relevant target at all locations in 2007 without additional action. The air quality concentrations 'with' and 'without' the low emission zone are shown in Figure 20.

Figure 20. Annual Mean PM_{10} concentrations in 2007 for the 'Baseline'



Annual Mean PM_{10} in 2007 'With the Recommended Low Emission Zone'.

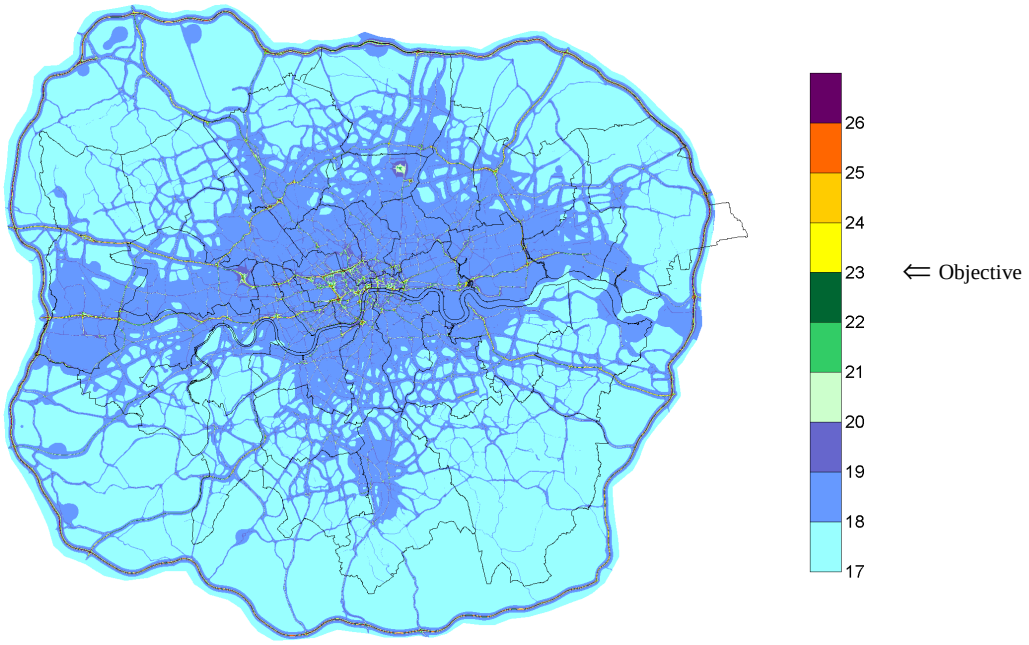


The top map shows the baseline annual average concentration, in μgm^{-3} (a unit of air pollution concentration) without the introduction of the low emission zone in 2007. The bottom map shows the annual average concentration *with* the recommended low emission zone in place in 2007. Areas that are red or yellow exceed the relevant air quality standard for 2010 for London. It is assumed that there would be no evasion within the LEZ.

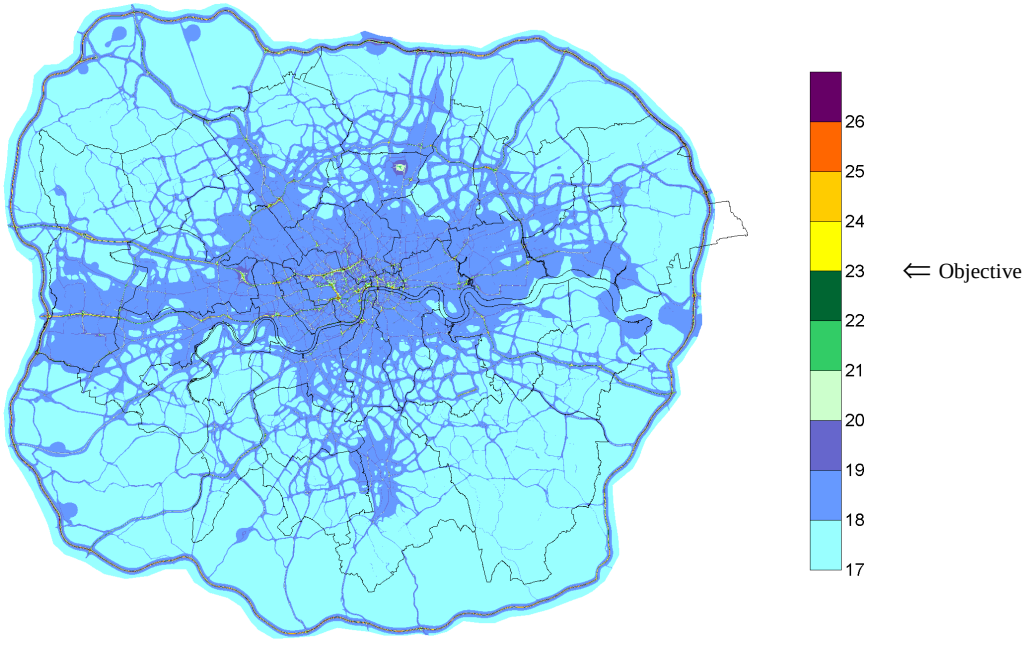
11.12. The **annual mean** concentration target for PM_{10} is tightened in 2010. A small area within the GLA is predicted to exceed this target (2.7% of the area), mostly limited to the direct vicinity of roads. The air quality concentrations 'with' and 'without' the low emission zone are shown in Figure 21. This shows that

the low emission zones have a small effect in reducing air pollution concentrations. However, they have a much greater effect in reducing the areas that exceed the targets. The first of the recommended options for a low emission zone in 2010 (without vans and taxis) would reduce the area exceeding the air quality target (annually) for PM_{10} by 32.6% (by 13.9 km^2), compared to the baseline. Including vans and taxis would increase this to a 42.9% reduction (by 24.4 km^2), compared to the baseline. Some care must be taken in considering the benefits of these reductions, as the benefits are mostly restricted to the areas occupied by the roads themselves and have less relevance in relation to exposure.

Figure 21. PM_{10} concentrations in 2010 for the 'Baseline'

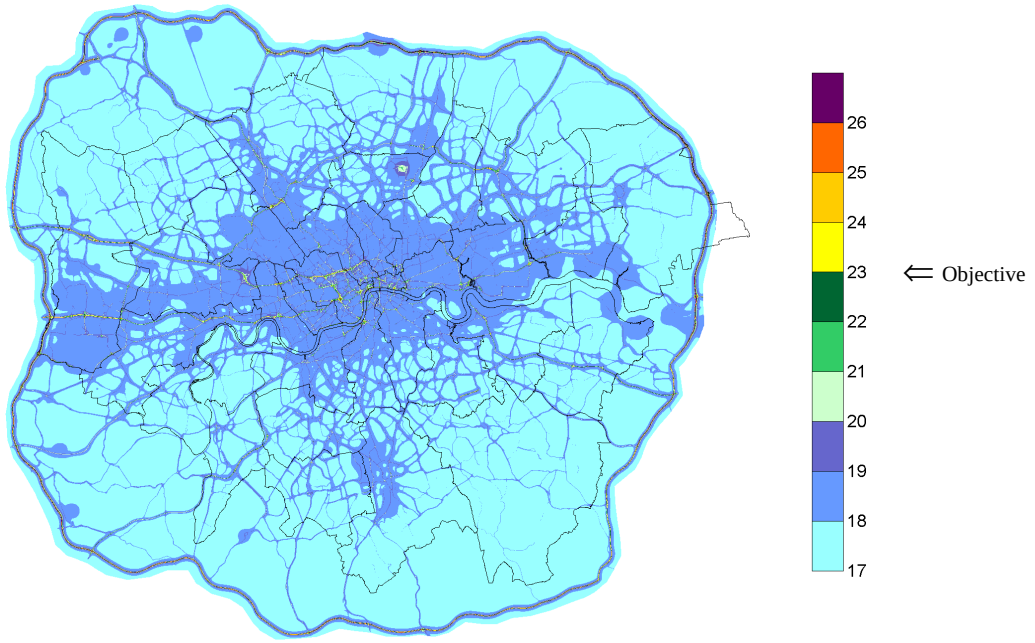


PM_{10} concentrations in 2010 'With' the Recommended LEZ A) Heavy Vehicles only



The top map shows the baseline annual average concentration, in μgm^{-3} without the introduction of the low emission zone in 2010. Areas that are red or yellow exceed the relevant air quality standard. The bottom map shows the annual average concentration *with* the recommended low emission zones in place for A) lorries, buses and coaches only. Areas that are red or yellow exceed the relevant air quality standard. It is assumed that there would be no evasion within the LEZ.

Figure 21 (cont.) PM_{10} concentrations in 2010 'With' the Recommended LEZ B) Heavy Vehicles, plus Vans and Taxis.



The map shows the annual average concentration *with* the recommended low emission zones in place B) lorries, buses and coaches, plus vans and taxis, in 2010. Areas that are red or yellow exceed the relevant air quality standard. It is assumed that there would be no evasion within the LEZ.

11.13. The second relevant target for PM_{10} is the **24-hour mean** concentration objective. In 2005, the target is a 24-hour concentration of PM_{10} (50 µg/m^3) that should be exceeded no more than 35 days in any year (note this target, and the approximate implementation date, are the same under both the AQS and EU air quality legislation). London is unlikely to meet this objective/limit value in 2005. However, it is not possible to implement a London LEZ within this timeframe. By the end of 2006 (the likely first date of implementing any LEZ) the air quality will have improved because of newer, cleaner vehicles entering the fleet. It is predicted that in 2007, London will be below the 35-day target everywhere except at the busiest roads (i.e. without any additional action). The recommended low emission zone would mean that in 2007, levels at even the busiest roads in London (e.g. Marylebone road) would be expected to meet the relevant air quality target. This would not happen in the absence of the low emission zone

11.14. The 24-hour target is tightened in 2010 under the UK Air Quality Strategy, and the number of days that exceed the 24 hour mean of 50 µg/m^3 is reduced - from no more than 35 days per year - to no more than 10 days per year for London. The areas exceeding this tighter target are again restricted to central London roadside locations. The indicative EU Limit Values are set for 7 days exceedence. The recommended low emission zones would mean that in 2010, levels at even the busiest roads in London would be expected to meet the relevant air quality target. For example, reducing the number of days exceeding the target at a central London roadside location from 10 days in the baseline to 8 days (heavy vehicle LEZ) and 5 days (with vans and taxis also included)).

11.15. It is stressed that the results presented are subject to a number of uncertainties. One of the most important of these is in relation to the underlying emission factors: these provide air pollutant emissions from different vehicles in different driving conditions (usually as grammes emitted per kilometre driven). The emission factors for existing vehicles in the fleet are based on measurement data, i.e. on experimental results. The factors for future vehicles (Euro 3 and especially Euro 4) are more uncertain, because they rely on *predictions* of emission levels, rather than measurements (as Euro 3 vehicles have only been recently introduced, and Euro 4 vehicles are still not available). The conclusions reached within the study are therefore subject to change, should differences in the emission factors for these vehicles emerge. Further research to investigate these emission factors, and their impact on the results here, is one of most important

research recommendations of the study. Any changes to these emission factors could significantly change the conclusions reached here (either positively or negatively).

11.16. There are also uncertainties over the forecasts of future air quality concentrations. PM_{10} is especially difficult to model, and is very dependent on the weather and assumptions about PM_{10} 'imported' into London from outside, and also how the concentrations of these imports will reduce in future years. Estimating future concentrations is therefore more difficult than for current modelling (not least because current models can check model output against actual monitored concentrations). For these reasons, the models are better at estimating differences between scenarios than estimating absolute values, though the latter are needed for comparing against future objectives. Other modelling work (described in Box 3) has indicated that the baseline levels of pollutants for PM_{10} in future years might be higher than shown for the current study results above, i.e. that London may be further away from the air quality objectives in 2010 without any additional action. This is important for the results shown above. The current study forecasts that in 2010, the baseline concentrations will be very close to the PM_{10} objectives – therefore, the small improvements predicted from the LEZ are sufficient to meet the standards (because the change is sufficient to move the concentration level below the objective level). Different baseline projections of future PM_{10} (with higher baseline concentrations) might therefore lead to lower reductions in areas exceeding the standards than predicted here.

Box 3. Investigating uncertainties of future air quality and LEZ benefits

The air quality modelling presented in this study is consistent with modelling in the Mayor's Air Quality Strategy and uses a combined modelling-measurement approach (the ERG London model). However, to test the uncertainty of the analysis, the three detailed air quality modelling runs presented here have also been assessed by Cambridge Environmental Research Consultants (CERC), using the ADMS Urban model, to provide a comparison of future air quality concentrations and anticipated LEZ benefits. In both cases, the same emission inventories were used, to ensure consistency with respect to the data input.

The two models show different baseline air quality concentrations for NO_2 and PM_{10} in future years (i.e. without the LEZ in place). In general, the ERG London model predicts lower air pollution concentrations in future years under the baseline conditions (with no LEZ) than the CERC ADMS model. To illustrate, the ERG model predicts that in 2007, 32.8% of 210 receptor points across London will exceed the objective for the pollutant NO_2. The CERC model predicted a higher proportion of receptors, at 51.5%, would exceed the objective. Similarly, for PM_{10}, the ERG model used in the study predicts an annual mean PM_{10} concentration of 21.4 $\mu g/m^3$ (baseline conditions with no LEZ), whilst the same analysis with the CERC model predicts a concentration of 22.8 $\mu g/m^3$.

The two models also show different levels of air quality improvements for the LEZ. Interestingly, the differences in the results are reversed (compared to the background predictions), so that the ERG model used in the study predicts greater air quality benefits with the recommended LEZ than the CERC model (i.e. the results are more pessimistic in respect of LEZ benefits). To illustrate, for the recommended scheme in 2007 (heavy vehicles) the ERG model results presented in this report predict that the annual mean NO_2 concentration would decrease on average by 0.6% with the LEZ in place. The CERC model analysis predicted a lower benefit on average of 0.4%. Similarly, for PM_{10} concentrations in 2007, the ERG model analysis presented in this report estimated that the annual mean PM_{10} concentrations would decline by 1.17% compared to 0.77% with the CERC model. The same pattern of background concentrations and results occur in the 2010 analysis.

In summary, the analysis presented in this report predicts lower base case concentrations of NO_2 and PM_{10} and a larger response to the LEZ scenario when compared to the different modelling approach. This is particularly important when considering the benefits of an LEZ in reducing the area of London that would exceed the objectives (because the predictions are very close to the objective and only small changes are required to significantly affect exceedence areas). The implication is that the background concentrations and exceedences of the air quality objectives may actually be worse than predicted in the study, but that an LEZ might be less effective than predicted in the study in helping to reduce these exceedences. It should be noted that there are other uncertainties that would also affect the future air quality levels and the LEZ effectiveness.

11.17. It is also important to stress that the health impacts associated with PM_{10} are greater than for NO_2. The study has found that different emission criteria for the proposed LEZ would lead to different effects in reducing the relative proportions of the two pollutants, i.e. some LEZ criteria would have a bigger effect on reducing PM_{10} concentrations and some on reducing NO_2. From the perspective of the air quality legislation, hitting the targets for both pollutants is equally important. However, an analysis of the potential health impacts in the study has shown that greater health benefits in London would be achieved with a low emission

zone that predominantly aims to improve PM_{10} concentrations. As seen in the earlier paragraphs, the recommended LEZ is forecast to lead to much greater improvement in PM_{10} concentrations than in NO_2 concentrations and therefore to lead to greatest health benefits. Moreover, there is some evidence that indicates that health impacts are primarily associated with smaller particles (i.e. a smaller size faction than PM_{10}). Transport emissions are responsible for a much greater proportion of these finer particulates than other sources. If the evidence/health based standards moves towards these smaller size fractions, this would mean that the benefits of the LEZs would be even larger than predicted here. Finally, there is evidence of a threshold level for the health impacts of NO_2 (i.e. a level below which no health impacts are expected to occur – this is the objective value set in the legislation). There is evidence that suggests no such threshold exists for PM_{10}. This means that there would be continued health benefits in reducing levels of PM_{10} below the air quality objective.

Conclusion 8. A London low emission zone would have modest benefits in improving overall emission levels and absolute air quality concentrations in London, but it would make a larger contribution to reducing exceedences of the air quality targets. The recommended LEZ would have greatest impact in targeting PM_{10} emissions and air quality exceedences, and is estimated to achieve a 20% reduction in total London PM_{10} emissions in 2010, and a 40% reduction in the area of London exceeding the relevant PM_{10} air quality target.

12. How would operators respond?

12.1. The study has investigated the likely response to a London LEZ by operators. It has undertaken face-to-face and telephone interviews, undertaken a questionnaire survey with hauliers/fleet operators, and held a number of workshops with industry trade associations and other relevant bodies. The survey work, while limited to a relatively small number of respondent companies, did include a range of company size and vehicle types, and including operators of both lorries and vans. The information from this stakeholder consultation has provided important technical input into the study.

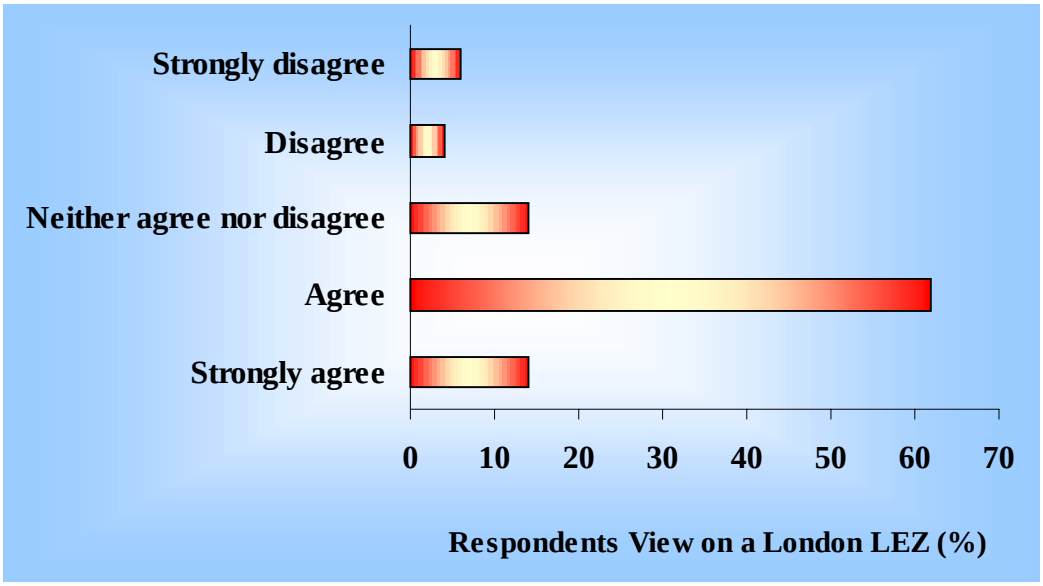
12.2. Feedback from operators indicates that most large fleet operators replace lorries every 5-6 years, but smaller fleet operators typically have longer replacement cycles. Importantly, vehicles that have specialist bodies (e.g. cement lorries, refuse trucks, and importantly coaches) have much longer replacement cycles as these vehicles are much more expensive to buy, and for a number of specialised vehicle types, tend to travel lower mileage each year.

12.3. When questioned, most respondents replied that they would comply with an LEZ in London. However, operators told us they would do so in a number of ways; by fitting exhaust treatment systems, by purchasing compliant vehicles (new or second hand), or by using their newer (compliant) vehicles in London and displacing the older vehicles in their fleets outside London. While there was a wide range of responses to the potential costs of an LEZ, a common theme was that smaller companies were more concerned about the impacts of costs on their business, as they typically had older vehicles and less capital to modify or change their vehicles.

12.4. The stakeholder work identified a significant knowledge gap over the role of vans in freight transport and in their wider contribution and importance to London's economy. It was particularly difficult to get input from smaller companies and owner-drivers within the study, and this has been highlighted as a key research recommendation. Indeed, we strongly recommend that further investigation of this sector of the fleet is made before vans are definitely included within any proposed London LEZ.

12.5. There was a broad level of support for the scheme from operators, as shown in Figure 22 below, which reports the results of the survey questionnaire. Operators stressed the need for adequate notification (as early as possible) of any forthcoming LEZ, so that they could take this into account in planning their vehicle replacement strategies.

Figure 22. The Attitude of Freight Vehicle Operators Towards a London LEZ.



A survey of 50 companies[4] asked ' Which of the following best describe your views on the low emission zone concept for London?' Answers were a mix of personal and company views.

Conclusion 9. Survey work has indicated that operators would be broadly supportive of a London low emission zone. Most operators would comply with the zone, though this might be achieved by transferring the older vehicles in their fleets outside London. Any LEZ would be more likely to impact on operators of specialist vehicles and smaller companies. More investigation of the potential impacts of any LEZ on van operators is needed.

13. What would be the cost to operators?

13.1. It is important to recognise that a low emission zone would have significant cost implications for vehicle operators. The study has clearly shown that the costs to operators are likely to exceed the costs of setting up and running a London LEZ (presented in an earlier section). Indeed, the total costs of many LEZ options to vehicle operators could be extremely high.

13.2. It is difficult to predict the exact costs from a London low emission zone with accuracy, not least because it depends on the behavioural response of vehicle operators. The study has undertaken stakeholder consultation and industry surveys to get some indications of possible behaviour. For many national/larger operators, with larger fleets, a low emission zone might not have a large impact, as many of these companies

[4] The survey was small but did include respondents from retail, manufacturing, commercial service providers, construction, waste, parcel carriers, distribution and logistics, general haulage and specialist freight transport. It included responses from members of the Freight Transport Association's South Eastern Regional Freight Councils, retailers who belong to the British Retail Consortium, and members of the Transport Association (an independent association for freight carrier companies). Companies from both inside and outside London were included.

only keep their vehicles for 5-6 years. This is close to, or below, the exclusion age recommended for the low emission zone. Even for operators with a mix of older and newer vehicles, there would be a zero cost option which would be to alter their fleet logistics so that their older vehicles were moved to other parts of the country, and their modern (compliant) vehicles were switched to London routes. The industry survey found that 25% of those questioned expected their companies to adopt such a strategy in response to a London LEZ. However, there is also a large number of operators who keep their vehicles for longer, or who work only or mainly in London, and for these operators there would be cost implications from an LEZ.

13.3. For relatively new heavy vehicles, it is possible to fit relatively low cost equipment that can improve vehicle PM_{10} emissions, such as a diesel particulate filter. Operators can also refit a new engine into an existing vehicle to improve the emissions performance to a similar level to modern vehicles. A new engine is an attractive option for operators of expensive specialised vehicles, such as coaches, but less cost-effective for more standard vehicle types. Government grants are already available for vehicle operators to fit abatement equipment or new engines, under the Energy Saving Trust's CleanUp programme. These grants would help offset the potential costs to operators from a low emission zone (though these have not been included in the cost analysis below, because it is not clear if these grants will be maintained in future years). Similar grants also exist for converting vehicles to alternative fuels (e.g. compressed or liquefied natural gas, liquefied petroleum gas, electric vehicles). Due to the lower duty levels that these alternative fuels attract, for some vehicles, this can actually save costs.

13.4. As well as the above options, an operator may decide to replace a vehicle – buying either a second hand or new vehicle. All fleet operators have a natural cycle of vehicle replacement and in any given year, around 10% of the vehicle fleet are replaced with new vehicles. Therefore it is also necessary to consider the effects of an LEZ against a background of natural vehicle replacement, because a number of operators would be about to replace their older vehicles anyway (or replace them within a short period of time). The attractiveness of buying a new or second hand vehicle, when faced with the introduction of an LEZ, will depend on the age of the existing vehicle. For relatively new vehicles, this is generally a more expensive option than retrofitting. For older vehicles (especially pre-Euro lorries), bringing forward the purchase of newer vehicles can actually lead to an economic benefit to the operator (i.e. from replacing the vehicle earlier than they might otherwise have done) because of the improved fuel efficiency and lower maintenance of a modern vehicle.

13.5. There is also a question as to whether all operators would seek to comply and take action in the light of an LEZ. It is clear that many operators might continue to run their vehicles and face the risk of prosecution. For many operators, particularly those that only come periodically to London, this may well be a cheaper option than upgrading their vehicle.

13.6. Nonetheless, the potential costs of a low emission zone would not be trivial for individual operators, particularly those that operate specialised vehicles, such as the coach fleet and certain specialised rigid lorries.

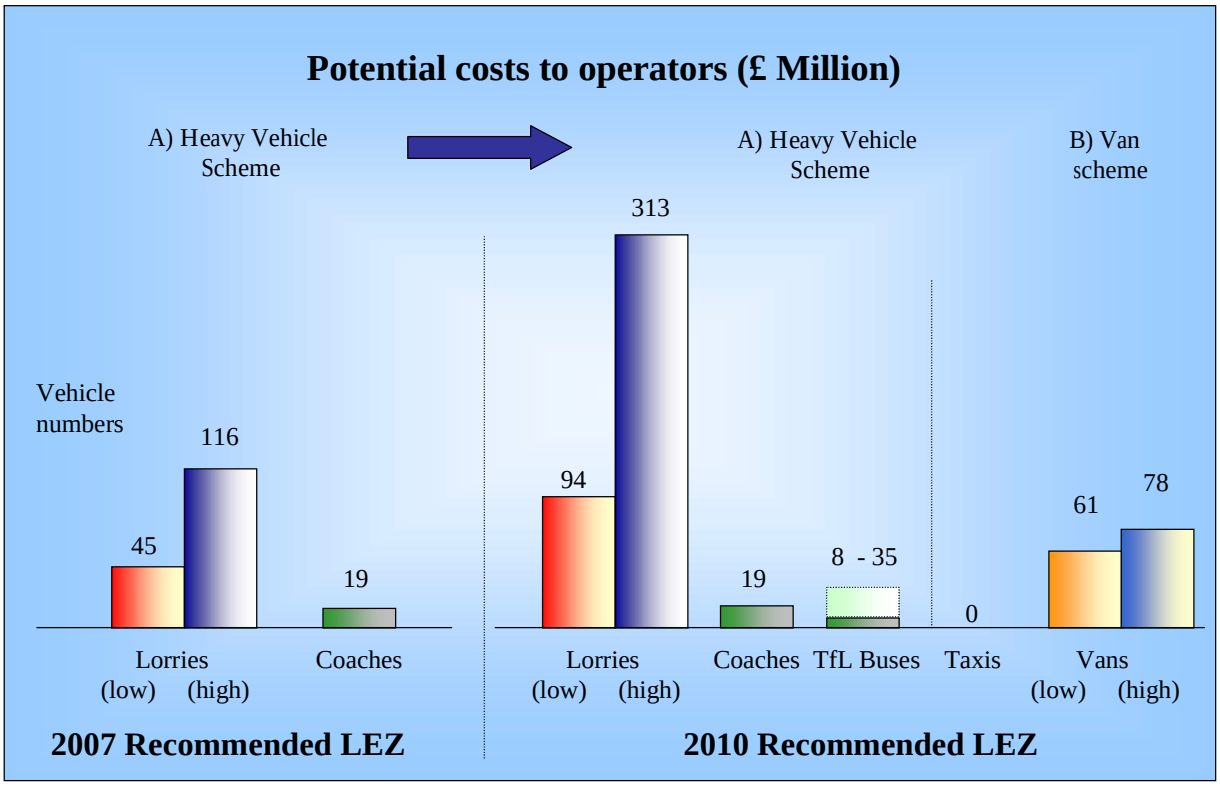
13.7. Moreover, it is clear that a London low emission zone would change the second hand vehicle market dramatically. It is almost certain that a London low emission zone would reduce the second hand (re-sale) value of older vehicles, i.e. those vehicles that did not meet the emission criteria set down for the LEZ. This would have an effect on both operators and leasing companies. Even for companies that regularly refresh their vehicle fleet, and therefore would be otherwise unaffected by a low emission zone, there would be a cost penalty from the low emission zone because they might recoup less for the sale of their older vehicles.

13.8. Given the extremely high numbers of vehicles potentially affected by a London low emission zone, the overall costs to operators would be likely to exceed the current levels of grant funding[5]. Note grant funding is only available for retrofit, re-engine or alternative fuel options – not for buying new conventional vehicles.

[5] TransportEnergy PowerShift grants have been available to fleet operators since 1996 and CleanUp grants since 2000. The budgets for these programmes have steadily increased over the years and for 2003-4, DfT have approved the allocation of up to £28 million across all TransportEnergy programmes (PowerShift, CleanUp, Best Practice and New Vehicle Technology Fund).

13.9. The potential costs to operators from the recommended low emission zone are shown in Figure 23 below. The analysis adjusts down the number of vehicles affected by an LEZ, assuming that some operators would the newer vehicles in their fleets to London (with the percentage of operators taking this action based on the survey results). It also takes into account the existing replacement cycle of vehicle operators. However, the numbers do not take into account the existing grants or duty rebates for retrofit equipment. Note that two values are presented for lorries to reflect the range in the numbers of vehicles operating in London. It is stressed that the costs for *individual* vehicles are not high – but the total costs are large because of the very large number of vehicles that operate in London each year.

Figure 23. The Potential Costs of the Recommended LEZ to Vehicle Operators.



The figure shows present value costs, taking account of the capital costs and changes in maintenance, fuel efficiency, etc over the lifetime of the vehicles. The low and high values for lorries and vans reflect a range of the number of vehicles operating in London. Figures assume full compliance with the LEZ (though the figures for freight vehicles are adjusted down by 25% to take account of fleet redeployment, in line with the industry consultation). The same assumption has been used for the coach fleet. The analysis assumes that all Euro 2 vehicles are retrofitted with abatement equipment to meet the emissions criteria, but does not include potential grants (CleanUp) or VED rebate for this action (as at present, these schemes are not guaranteed to continue to 2007 or beyond). The range in the values presented for TfL London buses in 2010 reflects the uncertainty over the potential responses available to the LEZ.

13.10. The potential costs to operators would be less if current Government grants continue or are extended. They would also be lower than shown above if the current Government vehicle duty rebates were maintained in future years. At present, lorry operators who achieve the RPC are entitled to a discount on annual Vehicle Excise Duty (VED) of £5 to £500 per year (depending on the type of vehicle).

13.11. The costs from a stricter low emission zone would be very much higher. For example, the introduction of a Euro 3 plus RPC scheme for heavy vehicles in 2007 would increase the costs to lorries, coaches and buses by an estimated £100 million to £300 million (over and above that shown for the recommended scheme). Similarly, the introduction of an 8-year age limit for vans in 2010 would increase the costs to operators by an estimated £100 million (over and above that shown for the recommended scheme).

13.12. The costs of a stricter scheme would be higher for two reasons. Firstly there are many more vehicles affected, and secondly, operators would need to take greater action (more expensive retrofit equipment or

new vehicles) to meet the stricter emission criteria. The recommended LEZ (above) would allow operators of most relatively new heavy vehicles to continue operating in the zone provided they took some action to improve emissions (i.e. it would preserve the asset value of the vehicle). A stricter zone would significantly reduce the value of these vehicles, or require expensive abatement options, and it is clear that a strict scheme would have a very large detrimental impact on vehicle operators.

Conclusion 10. The cost to vehicle operators is likely to be significantly higher than the costs of setting up and operating a London low emission zone. The exact costs would depend on operator behaviour. Existing Government grants, should these be continued, would offset some of these costs, though the numbers of vehicles affected by a low emission zone in London would exceed existing grant levels. The costs to operators would also be lower if the Government vehicle excise duty rebates could be maintained in future years. Introducing stricter emission criteria would result in extremely high costs to operators.

14. Other costs and benefits

14.1. The principal benefits of improved air quality in London would be the improved health of Londoners. The recommended London LEZ would make a modest contribution to reducing the most severe health effects of air pollution, reducing the number of deaths and serious cases of hospitalisation. It would also reduce the possible number of less severe respiratory illness by several thousand cases each year.

14.2. While the primary focus of an LEZ is to improve air quality, there are a number of other environmental benefits. As well as having lower emissions, modern vehicles are also quieter. It is also possible that, in later years, the introduction of a low emission zone would also lead to reductions in the emissions of the greenhouse gas carbon dioxide (CO_2), through the introduction of more modern, fuel efficient engines. However, some of the retrofit technology could also increase fuel use and CO_2 especially in earlier years.

14.3. The study has evaluated the economic value of the health benefits from the recommended London low emission zone. These benefits arise from lower NHS costs, the reduction in lost time at work, and the value of health impacts avoided to individuals. These benefits have been compared against the total costs of the scheme (both the operational and operator costs) to look at the relative costs and benefits.

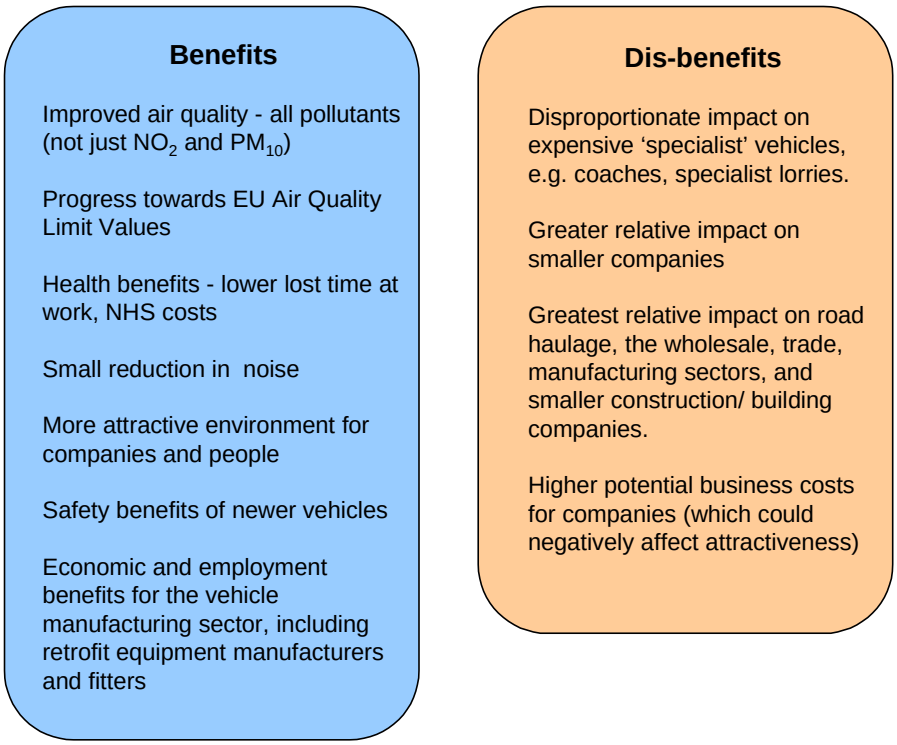
14.4. The benefits of health improvements have been estimated to be £26 million from the recommended LEZ in 2006/7 in the first year of introduction alone, and just under £100 million in total (based on the net improvement to the vehicle fleet). The benefits for the two recommended schemes in 2010 are £32 million (heavy only) and £40 million (including vans and taxis) in the first year of introduction, and £122 million and £143 million respectively in total.

14.5. However, these benefit values only include the economic benefits from air quality improvements in London - there would also be benefits outside London from cleaner vehicles affected by the London LEZ, travelling around the M25 and on routes to London. Moreover, there would also be benefits from associated reductions in other pollutants, e.g. carbon monoxide and hydrocarbons. The analysis has shown that the economic benefits of the recommended London LEZ far outweigh the costs of scheme set-up and operation. For the recommended heavy vehicle schemes, the benefits are likely to be broadly similar to the overall costs of introducing an LEZ (including costs to vehicle operators). The extension of the scheme to include vans increases the costs, relative to the benefits achieved, when compared to the heavy vehicle scheme alone[6].

[6] It is stressed that the health and economic benefits vary with the two pollutants of concern (PM_{10} and NO_2). The medical evidence strongly points towards PM_{10} as the main cause of health impacts. Therefore options that achieve greater reductions of this pollutant

14.6. The study has also assessed the potential socio-economic effects from a London LEZ, summarised in Figure 24 below, along with other benefits. It is stressed that the impact of any LEZ is likely to have a disproportionate impact on certain fleet operators, notably those with specialist vehicles, rather than the larger conventional fleet operators. These specialist vehicles are much more expensive to purchase and therefore tend to have longer replacement cycles, i.e. they are operated for longer before being replaced. Ideally, existing and future grants should be prioritised towards such vehicles. An alternative, which is present in the Swedish scheme, is to allow specialist vehicles to operate for longer periods in the zone, provided they have some abatement equipment fitted (i.e. provided they have PM_{10} abatement equipment).

Figure 24. Potential Socio-economic Effects from a London Low Emission Zone.



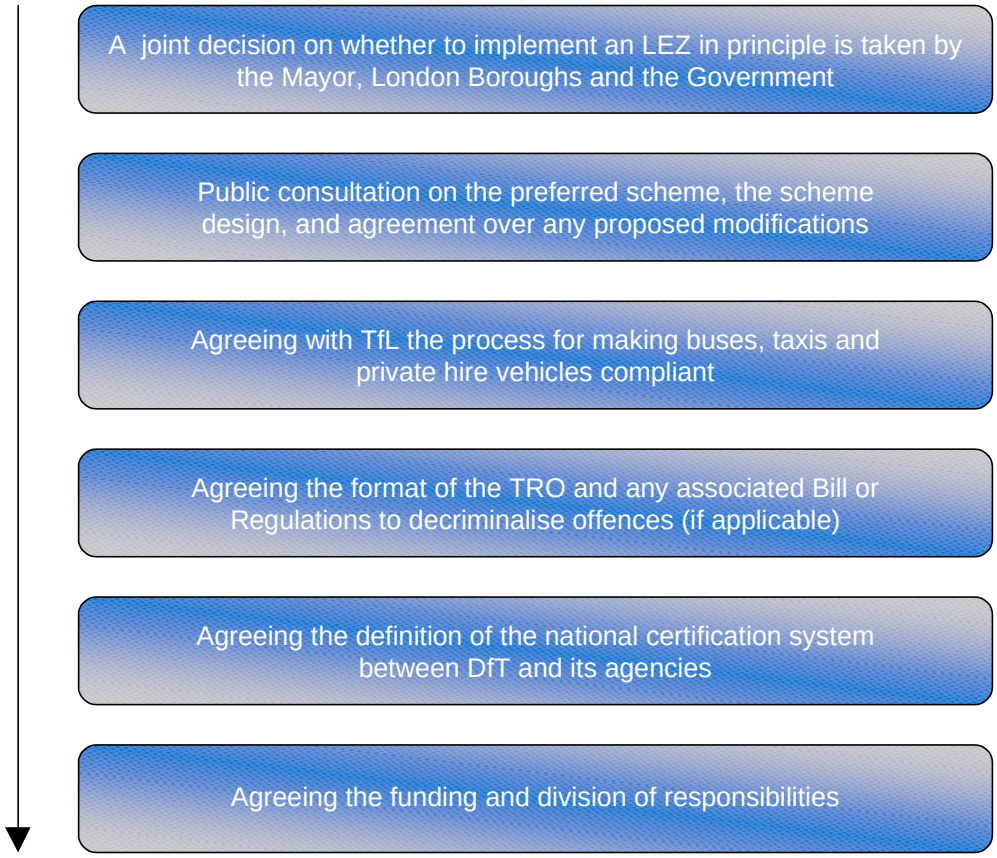
Conclusion 11. A London low emission zone would lead to improved health of Londoners. It would also have small benefits in reducing noise. In later years, it could potentially lead to reduced emissions of the greenhouse gas CO_2, though it could lead to slight increases in early years. The economic benefits of these environmental improvements would more than offset any costs of introducing and operating the scheme, and are likely to be broadly similar to the overall costs (including the costs to vehicle operators). The recommended heavy vehicle LEZ has greater benefits, relative to costs, than a scheme including vans. A number of wider socio-economic effects have also been identified, both positive and negative.

would have greater benefits in improving the health of Londoners, and have a much higher economic benefit. It would be possible to only target PM_{10} reductions with an LEZ, and this would reduce the costs (particularly of the 2010 scheme), whilst still maintaining similar economic benefits. However, the aim of the London LEZ is to help progress towards the air quality objectives for both pollutants. Any changes in the evidence relating to the health effects of NO_2 (positively or negatively) would affect the choice of recommended options.

15. What are the next steps?

15.1. A number of key tasks have been identified, that would need agreement and collaboration, towards the introduction of any LEZ implementation. These are shown in Figure 25 below.

Figure 25. Steps Towards LEZ Agreement.



15.2. Finally, a number of areas have been identified as warranting further research and investigation. These are:

- The potential for considering older cars in a low emission zone, or targeting these vehicles through alternative action.
- The assessment of the socio-economic effects on van owners and operators from an LEZ, particularly on small companies and owner-drivers.
- Further consideration of extending the current PM_{10} based RPC schemes forward in time, to all heavy vehicles, and to include NO_X.
- The consideration of a 'rolling' scheme for heavy vehicles after 2007, based on a 5-6 year age limit for these vehicles (beyond which time the vehicles would need to meet the RPC criteria).

Glossary

ALG. Association of London Government.

ANPR. Automatic Number Plate Recognition.

CO_2. Carbon dioxide. A greenhouse gas.

CNG. Compressed natural gas. An alternative transport fuel.

CCS. Central London Congestion Charging Scheme. In the text this refers to the area consistent with the CCS.

CRT. Continuously Regenerating Traps. A type of Diesel Particulate Filter.

CPZ. Controlled Parking Zone.

CleanUp. The EST's TransportAction CleanUp Campaign aims to improve air quality in pollution "hotspots" by encouraging the fitting of emissions reduction equipment to the most polluting vehicles.

DEFRA. Department for Environment, Food and Rural Affairs.

DVLA. Driver Vehicle Licensing Agency.

DfT. Department for Transport.

DPF. Diesel Particulate Filter.

EC. European Commission.

EU. European Union.

Euro (1-5). European Commission emission standard legislation, relating to Euro standards I to V.

EGR. Exhaust Gas Re-circulation.

EST. The Energy Saving Trust.

GL. Greater London.

GLA. Greater London Authority.

GOL. Government office for London.

HGV. Heavy Goods Vehicles, i.e. lorries. In the text, this refers to vehicles >3.5 tonnes.

LBTC. London Boroughs Transport Committee.

LEZ. Low Emission Zone.

LGV. Light Goods Vehicles. Light commercial vehicles such as vans.

LLB. London Lorry Ban.

LLCS. London Lorry Control System.

LNG. Liquefied Natural Gas. An alternative transport fuel.

LPG. Liquefied Petroleum Gas. An alternative transport fuel.

LSA. Local Service Agreement.

LSP. London Service Permit.

LDV. Light duty vehicles = light goods vehicles and cars.

LTS. London Transportation Study (and model).

MACs. Minister Approval Certificates. This is an alternative to the Certificate of Conformity.

NSC. North-South circular. Usually in the text this refers to the area bounded by, but not including, the North-South circular.

NO. Nitric oxide.

NOx. Oxides of nitrogen (includes NO and NO_2).

NO_2. Nitrogen dioxide.

PCN. Penalty Charge Notice.

Pre-Euro. Vehicle made before the introduction of European legislation on emission limits for new vehicles was introduced.

Powershift. EST programme that promotes cleaner vehicles and can offer grant support to help with the purchase of vehicles which are proven to offer emissions benefits and which have been shown to be technically viable. These include vehicles running on natural gas (CNG and LNG), liquefied petroleum gas (LPG) and electricity (including hybrids).

PCO. Public Carriage Office. The PCO (part of Transport for London) is responsible for licensing taxis in London.

PM_{10}. Particulate matter less than 10µm aerodynamic diameter.

RTRA. Road Traffic Regulations Act.

RPC. Reduced Pollution Certificate. The RPC scheme enables vehicles with modifications or particulate traps fitted to reduce particulate matter to benefit from reduced VED.

SCR. Selective Catalytic Reduction.

Steering Group. The LEZ Steering Group is jointly chaired by the Association of London Government (ALG) and Greater London Authority (GLA). This Steering Group comprised representatives from GLA, ALG, Transport for London (T*f*L), the London Boroughs, the Department for Transport (DfT), the Department of Environment, Food and Rural Affairs (DEFRA), the National Society for Clean Air (NSCA) and the Energy Saving Trust.

TEC. The Transport and Environment Committee of the ALG.

TEU. Traffic Enforcement Unit.

T*f*L. Transport for London.

TLRN. Transport for London Road Network.

TRO. Traffic Regulation Orders.

VET. Vehicle Emissions Testing (scheme).

VED. Vehicle Excise Duty.

VIN. Vehicle Index Number.

VCA. Vehicle Certification Agency.

VI. Vehicle Inspectorate Agency

VMM. Vehicle Market Model

VRM. Vehicle registration mark

Working Group. This Group comprised representatives from GLA, ALG, Transport for London (T*f*L), the London Boroughs, the Department for Transport, and the Department of Environment, Food and Rural Affairs (DEFRA).


Association of
London Government


MAYOR OF LONDON


Transport
for London


Department for
Transport


defra
Department for Environment
Food and Rural Affairs