



Understanding and Managing Congestion

For Transport for London

On behalf of
Greater London Authority

Final Version 1-0

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- Dr Rachel Aldred;
- Mr Terence Bendixson;
- Dr Adrian Davis; and
- Dr Lynn Sloman.

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Table of Acronyms and Abbreviations

AMV	All Motorised Vehicles
ANPR	Automatic Number Plate Recognition
ATC	Automatic Traffic Count
BPRN	Borough Principal Road Network
CAV	Connected and Autonomous Vehicles
CCTV	Closed Circuit Television
CCZ	Congestion Charging Zone
CEBR	Centre for Economics and Business Research
CLOCS	Construction Logistics and Community Safety
CPZ	Controlled Parking Zone
CSH	Cycle Superhighway
DfT	Department for Transport
DLR	Docklands Light Railway
ERP	Electronic Road Pricing
FORS	Fleet Operator Recognition Scheme
GLA	Greater London Authority
GPS	Global Positioning System
GVA	Gross Value Added
HGV	Heavy Goods Vehicle
HOV	High Occupancy Vehicle
JT/JTR	Journey Time/Journey Time Reliability
KPH	Kilometres Per Hour
LCAP	London Congestion Analysis Project
LOS	Level of Service
LGV	Light Goods Vehicle
LSTCC	London Streets Traffic Control Centre
LSTF	Local Sustainable Transport Fund
LTDS	London Travel Demand Survey
MaaS	Mobility as a Service
MTS	Mayor's Transport Strategy
MPH	Miles Per Hour
NMT	Non-Motorised Transport
PCN	Penalty Charge Notice
PHV	Private Hire Vehicle
PTP	Personalised Travel Planning
PT	Public Transport

RMP	Roads Modernisation Plan/Programme
RODAT	Real-Time Origin Destination Analysis Tool
RUC	Road User Charge
SCOOT	Split Cycle Offset Optimisation Technique
SITS	Surface Intelligent Transport System
SPVM	Seconds Per Vehicle Mile
SRN	Strategic Road Network
T-Charge	Toxicity Charge (Emissions Surcharge)
TDM	Transport Demand Management
TfL	Transport for London
TLRN	Transport for London Road Network
TOD	Transit Oriented Development
WPL	Workplace Parking Levy

Summary

With its reputation as a world class city, more and more people are choosing to live or work in London, which also attracts a high number of UK and overseas visitors every year. A growing population and increased economic activity – while themselves indicators of the Capital's success - have led to a greater burden placed on London's roads and as a result the amount of delay experienced across all areas of London has increased, traffic speeds have fallen and with them network reliability has worsened.

Increasing road congestion contributes to worsening air pollution, delays vital bus services and freight and makes many streets unpleasant places for people to walk and cycle. For businesses, congestion costs money as workers spend time queuing in traffic, it is difficult to make deliveries on time, and an unreliable road network harms the reputation of London as a centre for commerce. INRIX estimated the cost of congestion in London in 2016 at £6.2 billion¹, and a study by CEBR forecasts that this will increase to £9.3bn by 2030².

Without further action, traffic is expected to continue to rise across much of London, despite a falling car mode share, with 8.6 million more kilometres forecast to be travelled by road on an average day in 2041 compared to 2015. Over the same period, the amount of space available for use by general road traffic is expected to reduce by 3%; more in Central London³.

Conflicting demands on the transport network and on road space necessitate important and sometimes difficult decisions on how best to make use of this limited resource and balance the needs of its users. As has been the case in many other developed cities, transport policy in London has become increasingly focused on sustainable modes and the draft Mayor's Transport Strategy sets an ambitious target of an 80% sustainable mode share for trips (walking, public transport and cycling) by 2041. The policies and proposals which are intended to achieve this reflect the Healthy Streets approach described in the draft MTS: further investment in public transport promotion of active travel and reduced traffic on London's streets.

In this report, we have reviewed the recent trends in traffic and congestion, and explored the likely reasons for these patterns. The picture is a complex one and our understanding is in part constrained by the conventional indicators of congestion and data available, which focus on vehicle speeds and delay. As the approach set out in the draft MTS is implemented, it will be important to develop indicators which measure person-based delay and the experience of people walking and cycling.

The data shows that congestion has been worsening across a variety of indicators, including travel speeds and journey reliability. This is a pattern which has also been mirrored in other towns and cities in the UK. It can also be seen that there has been a small but notable reversal of the trend in falling traffic volumes and vehicle activity across London in recent times. An interesting feature of this trend is the evidence of changing vehicle composition, with falling private vehicle activity offset by growth in light goods vehicles (LGVs) and private hire vehicles (PHVs). There are of course particular features of congestion in Central, Inner and Outer London and this report considers these and suggests the interventions which are most appropriate for each.

The contributory factors to traffic and congestion are multiple and varied, and unpicking the relative impact of individual factors is challenging. Analysis has identified recurrent demand on the network as the principal cause of congestion, with excess demand and events such as roadworks, accidents and breakdowns playing a notable but lesser role. As such, while it remains important to continue to invest in managing the network efficiently to minimise the impact of works and improve the response to incidents, this approach can ultimately not be expected to

'solve' traffic congestion. Interventions must therefore focus on managing the demand for travel and promoting modal shift.

A shift to active, sustainable and space-efficient modes provides the long-term, strategic solution to London's congestion problems, and the recommendations made in this report focus primarily on practical steps that will help ensure they are achieved in the most effective way possible. Significant modal shift cannot happen overnight, so this report also recommends measures that can be taken to manage congestion while long-term changes are taking effect.

This report contains 22 recommendations for action by TfL, the London Boroughs, Central Government and other stakeholders. The key proposals are summarised below:

- Prioritise the efficient use of space in the allocation and re-allocation of road space. The most space-efficient means of moving people – walking, cycling and public transport – should be prioritised over low-occupancy private transport;
- Adopt the policy of introducing variable, distance-based road user charging at a London-wide level. A scheme should be designed to optimise its air quality, carbon and congestion benefits, while giving due regard to equity impacts. Revenue from the scheme should be used to improve public transport, walking and cycling;
- Review the present Congestion Charge exemptions and discounts, removing them unless their social value strongly outweighs the adverse impact that exempting vehicles has on congestion levels in the Zone;
- The London Plan should focus new residential development in areas with excellent public transport, and support high quality, high density developments with low or zero parking in these locations;
- Review the present regulatory regime for PHVs, including a potential change to the law to allow TfL the power to limit the number of vehicles licensed;
- Continue with the delivery of bus priority schemes to support reliability of bus journey times and implement pilot schemes to explore the impact and attractiveness of express service operation, bus rapid transit and demand-responsive services on appropriate corridors;
- Implement workplace parking levies in Metropolitan Centres or borough-wide;
- Support freight by developing a London-wide integrated system of consolidation centres; encouraging sustainable delivery methods such as cycle freight and exploring the potential for freight-only lanes; and
- Make further investment in intelligent traffic management including the Surface Intelligent Transport System.

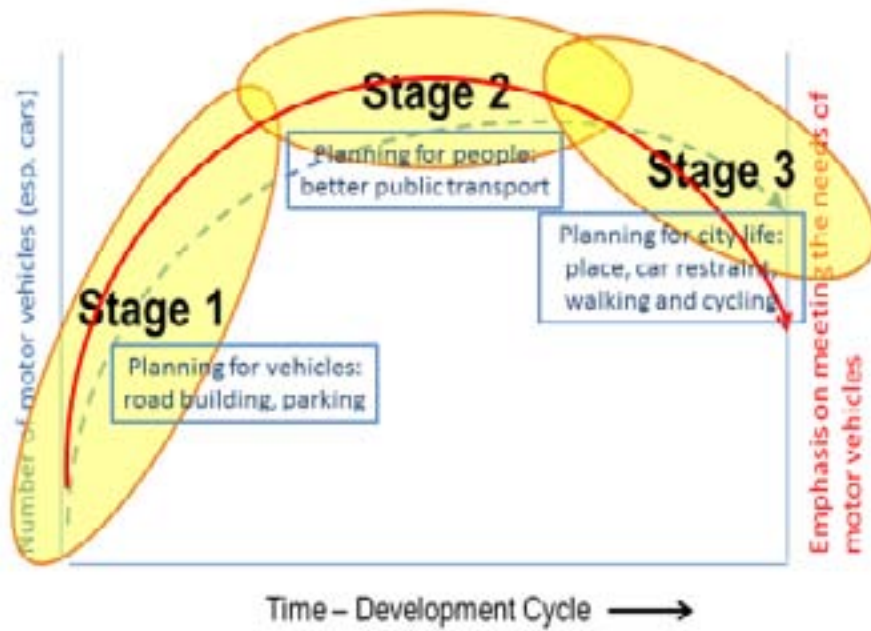
1. Introduction

- 1.1 This Study has been commissioned from Integrated Transport Planning Ltd (ITP) by Transport for London (TfL) on behalf of the Greater London Authority (GLA). It has been commissioned to identify the key causes of increased road congestion in Central, Inner and Outer London over the last 5 years and to identify a set of prioritised actions to address London's congestion problems. The Study was developed between June and November 2017.

Approach to transport governance and policy in London

- 1.2 The Mayor of London has a general duty to develop and apply policies to promote and encourage safe, integrated, efficient and economic transport facilities and services to, from and within London. TfL is responsible for delivering these services on the Mayor's behalf, whilst the London Boroughs also play an important role in implementation of transport policy at the local level.
- 1.3 TfL is also the statutory highway and traffic authority for the TfL Road Network (TLRN)⁴, and is responsible for the maintenance, management and operation of traffic signals throughout London. The TLRN comprises 5% of London's roads by length, these carrying over a third of the traffic. London Boroughs are the statutory authorities for the remaining 95% of roads in London. TfL has a network management duty under the Traffic Management Act 2004 which requires it to make sure road networks are managed effectively to minimise congestion and disruption and encompasses not only motorised vehicles but also people walking and people cycling.
- 1.4 The Mayor's Transport Strategy (MTS) is the principal policy tool through which the Mayor and TfL exercise their responsibilities for the planning, management and development of transport in London. TfL, on behalf of the Mayor of London, has recently carried out a public consultation on a draft MTS to replace the current Strategy (which has been in place since 2010).
- 1.5 Central to this draft MTS is its approach to streets and cars. The Mayor has set a target of 80% sustainable mode share for trips by 2041 (defined as walking, cycling and public transport). There are a number of policies and proposals in the draft MTS intended to help achieve this: it is described in the document as the Healthy Streets approach, meaning a less car-centric city with streets where people are encouraged to use sustainable modes of transport.
- 1.6 Although this is a transport strategy, it recognises the inextricable links between transport planning and town planning, as well as Healthy Streets and a good public transport experience, designing the city for 'good growth' in this context meaning well-connected, densified neighbourhoods, which also enable cycling and walking, is key to the Strategy.
- 1.7 Accordingly, the Draft MTS focuses on the benefits of mitigating the impacts of motorised traffic and congestion upon health in London; including air quality improvements and raising physical activity levels (through active travel). This emphasis of priority may not always align directly with achieving reduced levels of congestion for motorised vehicles, with trade-offs potentially required in order to re-prioritise other road users.
- 1.8 The development of policy to this point has followed a 'path of enlightenment', from vehicle-centric to health-centric. The car based focus of the 50s and 60s progressed to an emphasis on efficient movement of people, following the recognition that building more roads as a solution to traffic congestion was ultimately self-defeating. However, as with the car, enhancing the opportunity for personal travel leads to generated demand through greater numbers of person trips or longer distance travelled. This leads us beyond focusing on the transport network as an enabler of ever greater travel opportunities and towards enhancement of quality of life (on the following page).
- 1.9 In this report we will focus on transport interventions in the context of the performance of the overall transport system of the city and an understanding of transport strategy in London, rather than assume a 'blank slate'. The recommendations made at the end of the report for addressing motorised traffic congestion have been developed, and must be considered, in this context.

Transport policy evolution in London and around the world



Source: European Union, (2014). CREATE (Congestion Reduction in Europe: Advancing Transport Efficiency) Report Summary. Available here: http://cordis.europa.eu/result/rcn/198498_en.html

Stage one involves rapid urban economic growth leading to a fast growth in car ownership and use, and general support for policies to cater for this trend, commonly accompanied by a reduction in public transport investment.

Stage two involves the promotion of sustainable transport modes which aim to provide better alternatives to car use, particularly public transport. This stage normally leads to a reduction in the rate of growth in car use, followed by a decline in car use.

Stage three entails a policy focus on urban quality of life, achieved through cutting back provision for cars and other road traffic by explicitly reallocating road space to sustainable transport modes, increasing provision for public transport, walking and cycling, and promoting a high quality public realm. This is where current transport policy in London stands. Other 'Stage 3' cities include Copenhagen, Paris, New York, Vancouver and Seoul.

What is road based traffic congestion and how do we measure it?

- 1.10 An important question to address from the outset of the study, and one which already presents a challenge in establishing an adequate definition is **what do we mean by road based traffic congestion?** Within the remit of this study, we focus only on congestion among road-based, motorised transport modes, although there is a growing argument for focus on non-motorised modes. We recommend that these congestion patterns are investigated in another study.
- 1.11 Traffic congestion is a difficult concept to define, involving both physical and relative dimensions. In other words, it relates both to the physical way vehicles (and other road users) interact with each other, and also people's perception of congestion (e.g. 'the traffic is terrible today'), which in turn is influenced by their expectation of how the transport network will perform.
- 1.12 The most commonly used measures relate to the physical progress of vehicles through the network. These include vehicle speeds (e.g. average morning peak speed), travel time (minutes per kilometre) and ratios of observed speed to free-flow speed or hours of vehicle delay. These can all be measured and used as a means of monitoring changes in congestion over time and are used to set the context of this study. Other physical indicators which also have a strong bearing on traveller perception include those of typical journey time reliability, captured through measurement of the variability in journey times or unanticipated delays.

Summary: Common congestion and delay indicators

Average vehicle speeds

Average speed achieved by vehicles during a given period, measured in miles per hour or kilometres per hour.

Example: Average morning peak travel speeds in Inner London have fallen from 20.2kph in 2007 to 17.9kph in 2015.

Average delay

Expressed in seconds per vehicle mile (spvm) or minutes per kilometre, average delay compares observed journey time against journey time under free-flowing conditions, with the differential constituting average delay.

Average delay is now reported by DfT as part of its Strategic Road Network monitoring statistics, and also by TfL as 'excess travel rate'.

Example: Average morning peak traffic delay in Central London has increased by 50% in the past five years, rising from 1.4 minutes/km to 2.1 minutes/km.

Excess travel time

Similar to average delay, excess travel time also focuses on the difference between recorded travel speeds at different times of day and the free-flow travel speed (usually recorded in the middle of the night) is that of excess travel time.

Example: London's motorised congestion level stands at 40% (extra travel time above free flow time).

Journey time reliability

TfL measures journey time reliability as the percentage of journeys completed within an allowance excess of 5 minutes for a standard 30 minute journey during the AM peak.

Example: In Q1 2017/18, journey time reliability (JTR) on the TLRN in the AM peak was 88.4%, up 0.9 percentage points on the previous year.

DfT has recently moved to a 'Planning Time Index' which records the amount of additional time needed for 95% of travellers to arrive on time, as compared to free-flow speed.

Example: For the year ending September 2016, 69% of additional time was needed to be left compared to free flow time to ensure on time arrival. This is 1 percentage point higher than the year ending June 2016.

Recognising the shortcomings in common indicators

1.13 Each of the above indicators focuses on different aspects of what we mean when we refer to traffic congestion but it is important to recognise that there are a number of shortcomings in attempting to define a definitive measure:

- No single indicator is able to be a 'capture-all' metric to define the problem. Reliance on a single metric in describing network performance and in monitoring of changes risks painting an incomplete, or in some cases an incorrect, picture of travel conditions.
- The commonly referenced metrics of average delay or excess travel time both measure performance by comparison with free flow time. By nature of definition, these indicators are prone to issues relating to this moving baseline.

- The usefulness of peak hour traffic speed as an indicator is limited in that travel speeds provide insight into the performance of the road network from the perspective of individual vehicle movements, but give no information on how many vehicles are affected, the scale of motorists' exposure to congestion or any relativity on the scale of impact that the congestion is causing.
 - The most commonly referenced indicators focus solely on vehicle based congestion, failing to recognise the role of London's travel network in facilitating person based trips, many of which are served by road based public transport and therefore have the potential to heavily undervalue delay to vehicles with higher occupancy.
 - Because the MTS sets an ambitious mode share for walking and cycling, it means that we need to think about what we mean by 'congestion' for these modes and as we move forward, this will require better capture of the journey attributes of those walking and cycling, which have to date been less well represented in network performance statistics.
- 1.14 In Chapters 2 and 3, we review the observed trends in congestion, presenting these trends within the wider context of travel in London and highlighting potential pitfalls in interpretation of the information presented.

2. London traffic and congestion trends

2.1 In this chapter, we consider the key trends which provide the backdrop to observed travel patterns covering:

- Traffic volumes on London's roads;
- Traffic composition; and
- The scale of vehicle based motorised congestion.

2.2 It should be noted from the start that this is a complex picture with a number of strands - traffic levels, composition and congestion - which differ by area of London and time of day. The patterns in vehicular traffic and motorised congestion reported are also benchmarked at the end of the chapter to establish whether the trends observed in London are typical of those experienced in other UK and world cities.

Contextual trends

- 2.3 London has seen rapid and sustained population growth. Higher than historical levels of immigration from the EU and lower levels of out-migration to other areas of the UK have led to the population surpassing its previous all-time high of 8.6 million in 2015, and it is forecast to grow to over 10 million by 2041⁵. Over the past 20 years, this growth has been spread (in volume terms) broadly equally between Inner and Outer London, despite the fact that Outer London is approximately four times the area of Inner London. The forecast distribution of population growth in London over the next decade is focused on East Central and Inner London, and South Inner and Outer London, which can be expected to be reflected in future travel demand patterns⁶.
- 2.4 We must also not overlook London's status as a major attractor of trips, with workers and visitors travelling in from outside its boundaries. Therefore, when considering the demand for travel within London, it is important to recognise the larger 'daytime population' of Greater London, estimated at 9.8 million in 2015⁷, including non-resident visitors. The non-resident population has also been growing and this group have an important impact on travel patterns, making more trips per person (journeys to and from London included) and accounting for around 25% of trips made in London⁸.
- 2.5 Employment is one of the key factors which generates a need to travel. There has been a marked increase in job growth between 2011 and 2016 following the 2008 market crash and subsequent recession. This growth in jobs is forecast to continue, reaching almost 7 million jobs by 2041⁹. The locations people travel to and from for work are also important to consider. Central and Inner London is home to only 50% of those employed in Zone 1, with the remainder residing in either Outer London or even further afield. The future location of employment also has an impact, with most employment growth estimated to be in Central and Inner South East London¹⁰.

Traffic and travel trends

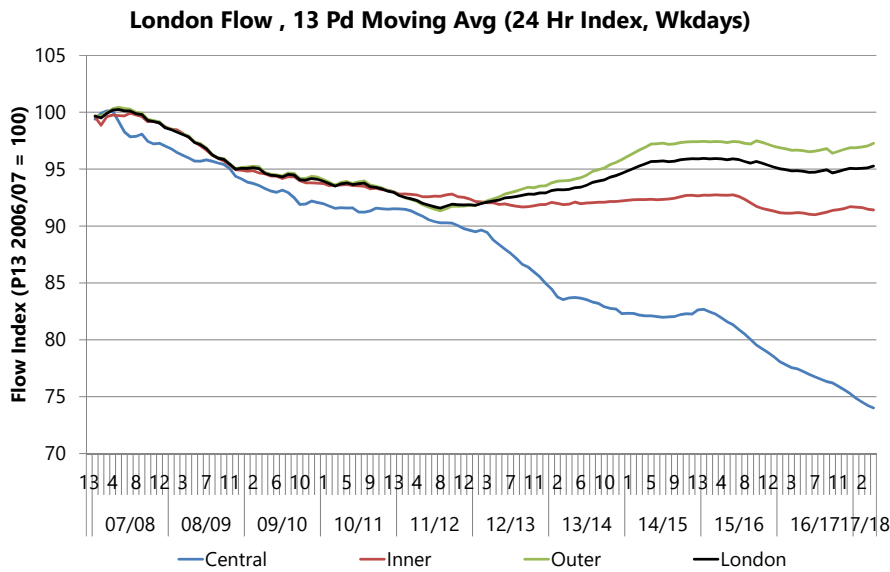
2.6 Whilst the demand for travel has grown due to the above drivers, the way in which those trips are made and the patterns of travel have also evolved.

Trends in motorised traffic

2.7 Traffic volumes in London have fallen over the past decade. Central London has seen significant falls year-on-year, with the observation that traffic volumes in the Congestion Charging Zone (CCZ) presently stand 25% lower than 10 years ago corroborated by different datasets. The Central London trend illustrated in Figure 2-1 relates to the CCZ only. In Inner and Outer London, the picture is less straightforward, with the beginning of 2012 marking an upturn in the

downward trend in traffic levels observed in previous years which may have coincided with an upturn in economic activity after the recession.

Figure 2-1: Indexed motorised vehicular traffic flows in areas of London



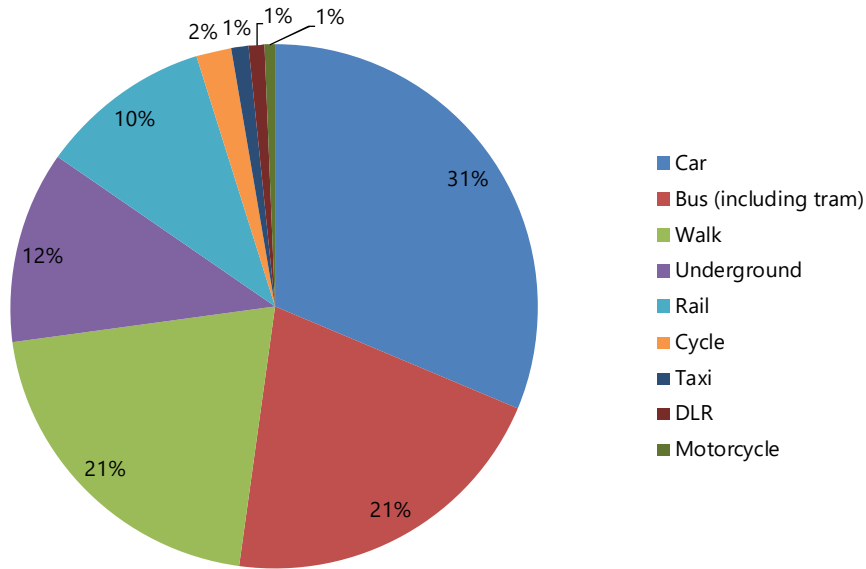
Source: TfL Automatic Traffic Count (ATC) data (2017)

- 2.8 Traffic levels in Inner London have remained broadly static in the last 5 years, whilst a jump in flow volumes seen in Outer London in 2013 has pushed up the pattern for the whole of London, a reflection of Outer London’s relative importance (it accounts for 70% of flow, compared to just 4% located in the central area).

Modal share

- 2.9 Since 2000, there has been a marked change in the overall modal share in London. Data from the MTS Supporting Evidence shows that car based trips have seen a fall, from 47% of total trips in 2000 down to 36% in 2015. Trips by public transport meanwhile have increased from 28% in 2000 to 37% in 2015. Trips by non-motorised modes (on foot and by bicycle) have largely remained stable in this period, though cycling has increased by 1 percentage point (reflecting a large percentage increase from the low base).
- 2.10 Figure 2-2 shows the modal share for journeys in London (as a whole) as of 2015. Car is the most commonly used mode, accounting for almost a third of journeys made in London, followed by bus and then walking trips. Rail services meanwhile, including Underground, Rail and DLR account for just under a quarter of trips, whilst cycling, taxi (including PHVs in the figure below) and motorcycle have more marginal modal shares.

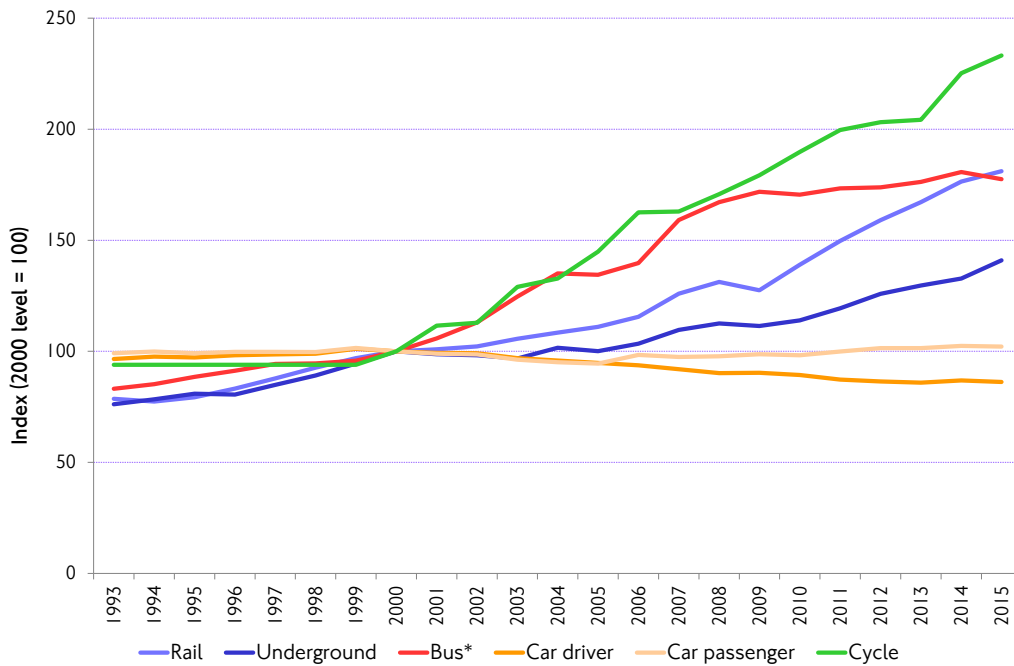
Figure 2-2: Modal share of daily journey stages in London.



Source: TfL Travel in London Report 9 (2016), Fig. 2.3, pg. 30

- 2.11 Figure 2-3 detailing trends in journey stages by mode relative to 2000 levels shows a strong growth in journeys being made by rail, Underground and bus. In the most recent period however, bus use has seen some decline (although latest bus data suggests a partial recovery in bus patronage in recent months).
- 2.12 Journey stages completed as car trips (as a driver) have fallen steadily since 2001, and now stand 13% lower than the 2000 level. However, a small increase of 1% of journeys is seen between 2013 and 2014, which then stagnates in 2015. Interestingly, whilst there has been a decline in car driver trips, there has been a slight uptick in the number of car passenger trips being made.

Figure 2-3: Trends in journey stages by mode relative to 2000 levels

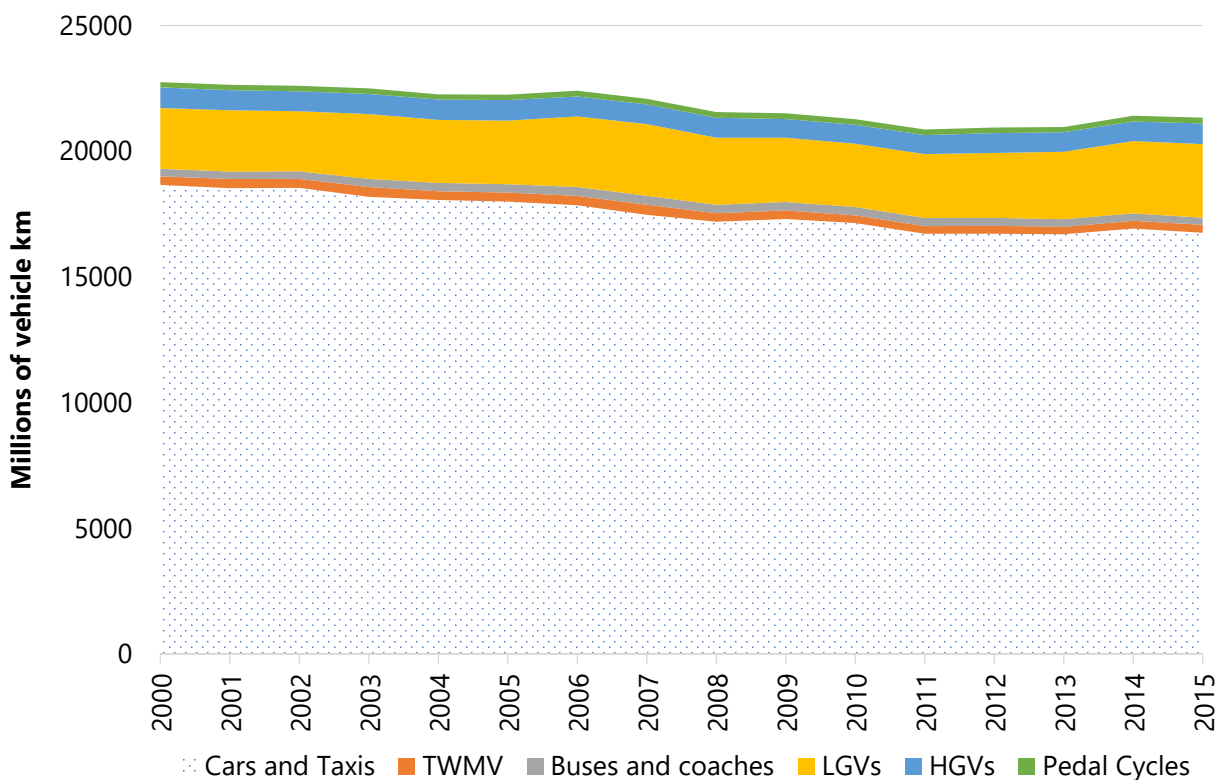


Source: TfL, MTS Supporting Evidence: Challenges and opportunities report (2017), Fig 12, pg. 28.

Traffic composition

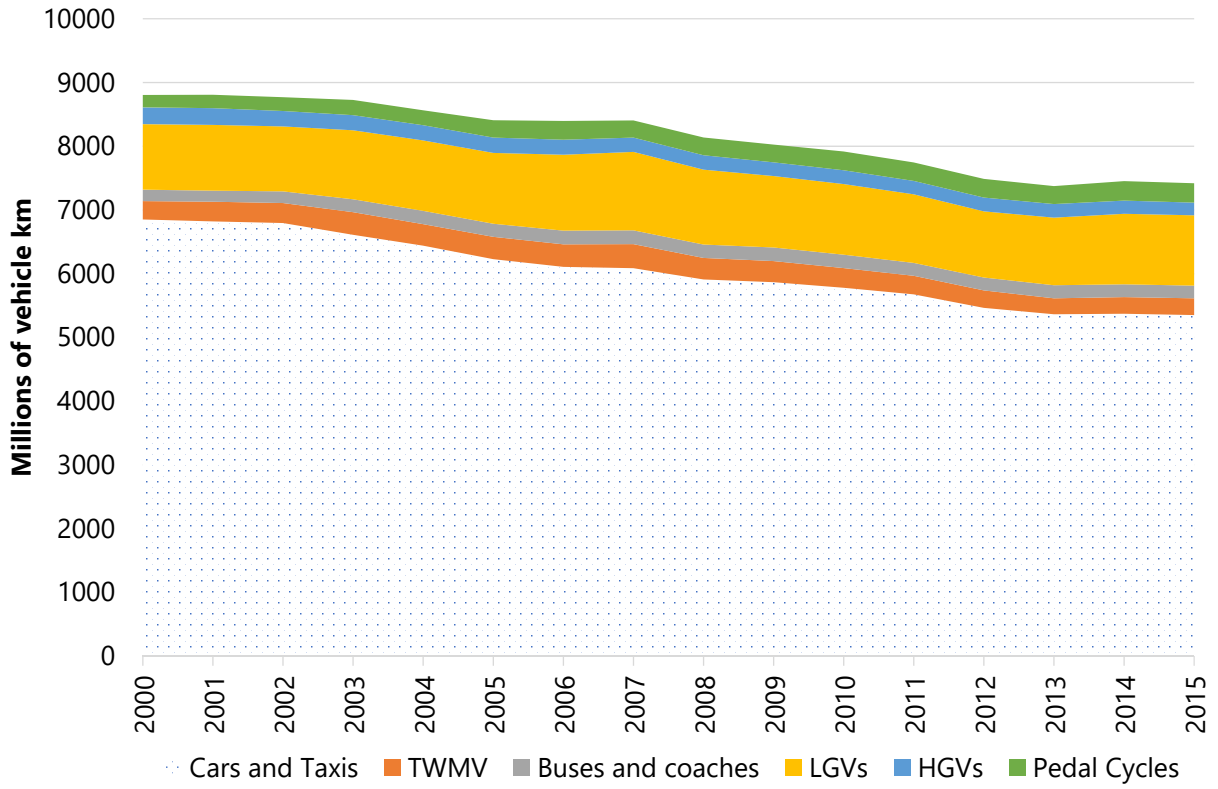
- 2.13 Different patterns of modal share also emerge when viewed across the different areas of London. Figures 2-4 to 2-6 show area based vehicle kilometres by mode for Central, Inner and Outer London from 2000 to 2015¹¹. Note that the definition of Central London used here differs from that in Figure 2-1 (above). The former relates to the CCZ; the latter to the boroughs of City of Westminster and City of London only. Some differences in trends shown, reflecting these different geographies and statistical variability associated with each indicator, are therefore to be expected.
- 2.14 These graphs suggest that the declining trend in overall vehicle kilometres observed across London was reversed in 2012/13 (borough-based definition), although unlike the indexed traffic flow data analysis above, this trend cannot be evaluated through to 2017/18. In Central and Inner London, the driving force behind this apparent recent increase has been due to car kilometres (including taxi and PHV) and, to a lesser extent, LGV kilometres. In Outer London, the rise has been attributable principally to LGV kilometres.
- 2.15 The DfT traffic data is unfortunately not able to differentiate between car, taxi and PHV. However, the prevalence of these vehicles combined is apparent across all three areas, and is particularly dominant in Outer London. These patterns are also reflected by relative car ownership levels across London; just 42% of Inner London households have a car by comparison with 68% of households in Outer London¹².

Figure 2-4: Outer London traffic composition (vehicle kilometres)



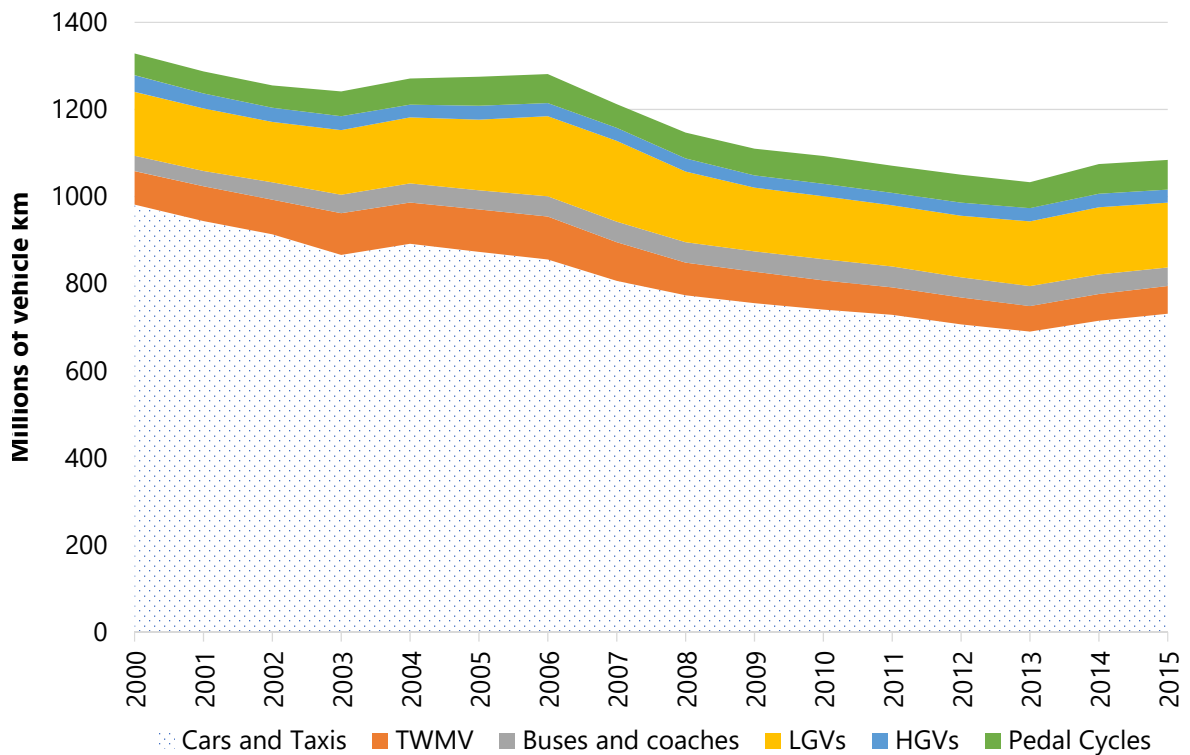
Source: DfT Traffic Data Analysis

Figure 2-5: Inner London traffic composition (vehicle kilometres)



Source: DfT Traffic Data Analysis

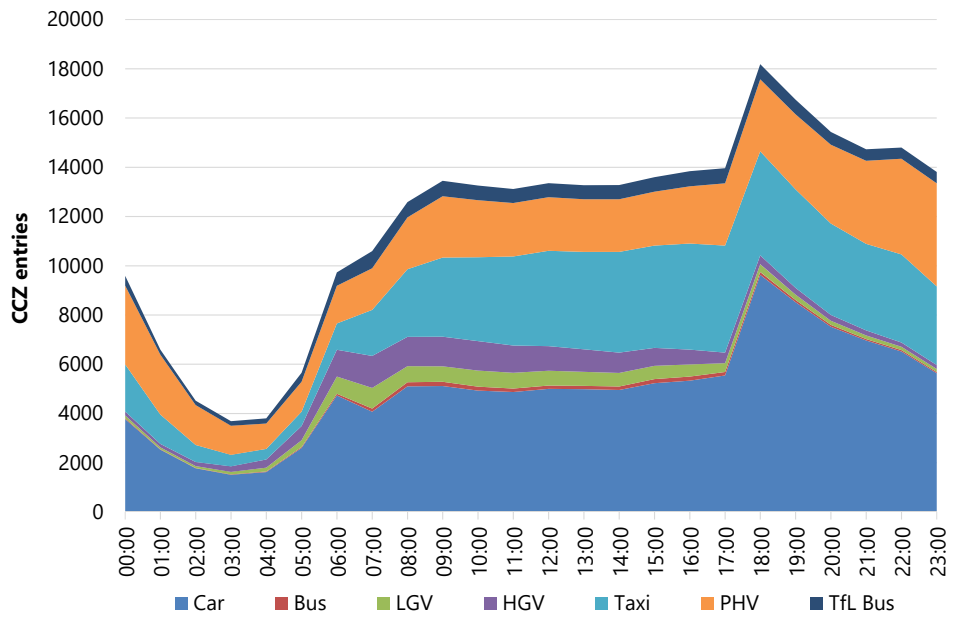
Figure 2-6: Central London traffic composition (vehicle kilometres)



Source: DfT Traffic Data Analysis

2.16 Further disaggregation by type of vehicle is possible in Central London. Figure 2-7 shows the composition and profile of CCZ entries over the course of a day (note that the number of entries does not relate directly to vehicle activity whilst in the Zone). Cars constitute less than half of entries during the charging period, with private vehicle numbers less significant than taxi and PHV numbers.

Figure 2-7: Traffic composition entering the CCZ over an average day

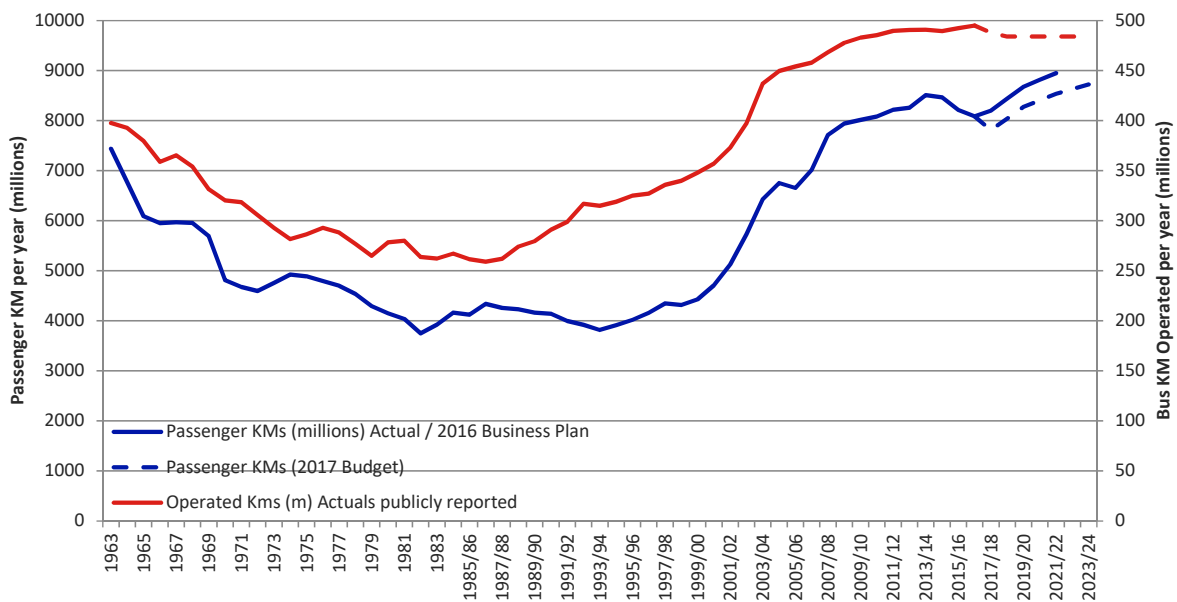


Source: TfL ANPR camera data analysis of entries and exits (2017)

Bus trends

2.17 The last twenty years have generally seen bus patronage increasing, with a significant rise since 2003. However, since 2015/16 there has been a decrease of passenger kilometres of over 2% (see Figure 2-8).

Figure 2-8: Bus passenger kilometres in comparison to operated kilometres



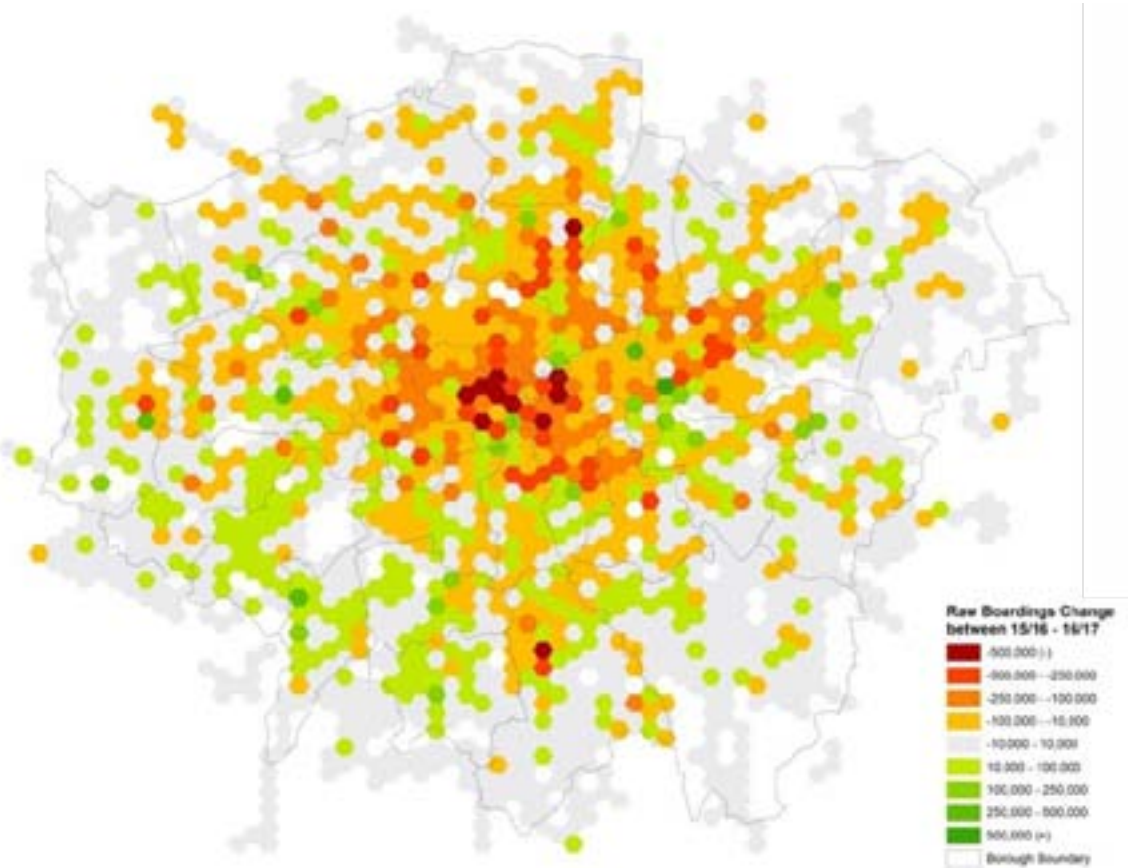
Source: TfL Surface Transport

2.18 Figure 2-9 shows that the most significant loss of bus boardings between 2015/16 and 2016/17 has been focused around Central London, with a number of areas seeing significant reductions in boardings, although the pace of decline has slowed recently. The decline has been less severe

towards the Outer London boroughs, where bus boardings have stayed relatively stable or have even increased in certain areas (although this has to be qualified by considering the relative density of the bus networks and lower starting points in terms of patronage).

- 2.19 This decline in patronage may be explained, at least in part, by a decrease in average bus speeds by around 0.5 mph in both Inner and Outer London between 2013 and 2017. Although various factors impact bus patronage, travel time is the most significant driver of customer satisfaction, and is therefore affected directly by the impacts of traffic congestion.

Figure 2-9: Change in bus boardings across London

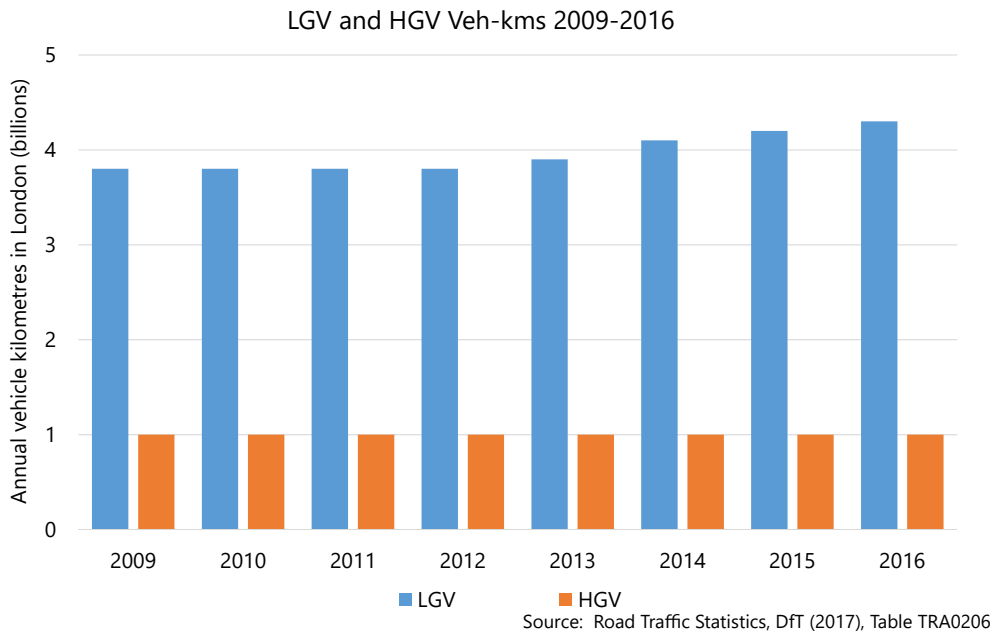


Source: MTS Supporting Evidence: Challenges and opportunities report (2017), Fig. 93, pg. 125.

Road freight trends

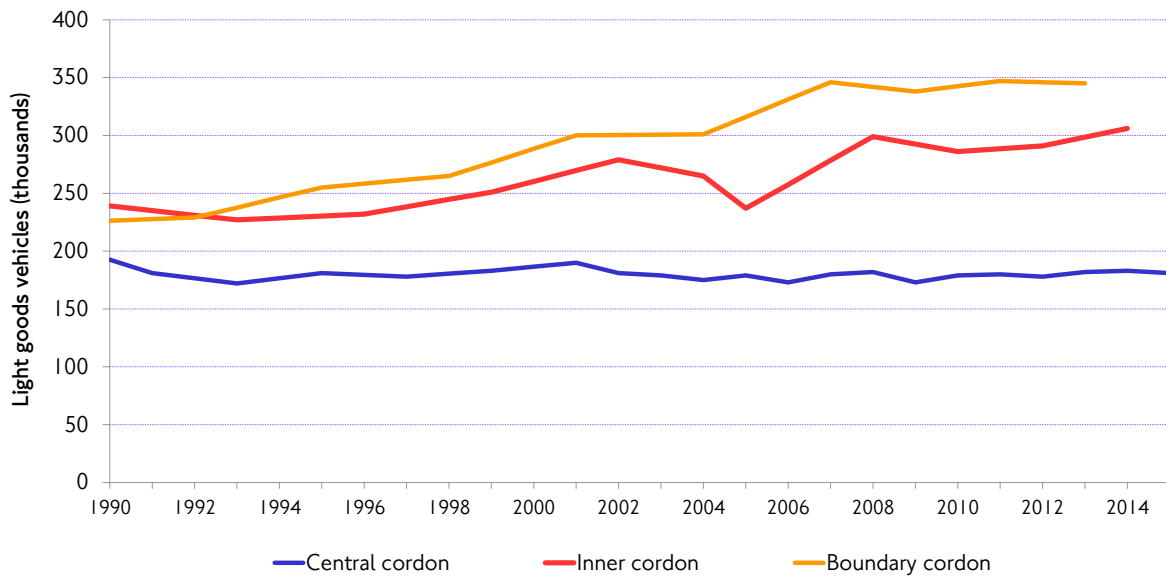
- 2.20 Freight vehicles account for around one fifth of traffic in London and about one third in Central London during the morning peak¹³. There has been a notable increase in the number of LGV kilometres in London, with a rise of 13% recorded between 2012 and 2016 (see Figure 2-10). HGV kilometres meanwhile have remained stable.

Figure 2-10: Annual vehicle kilometres in London for LGV and HGV



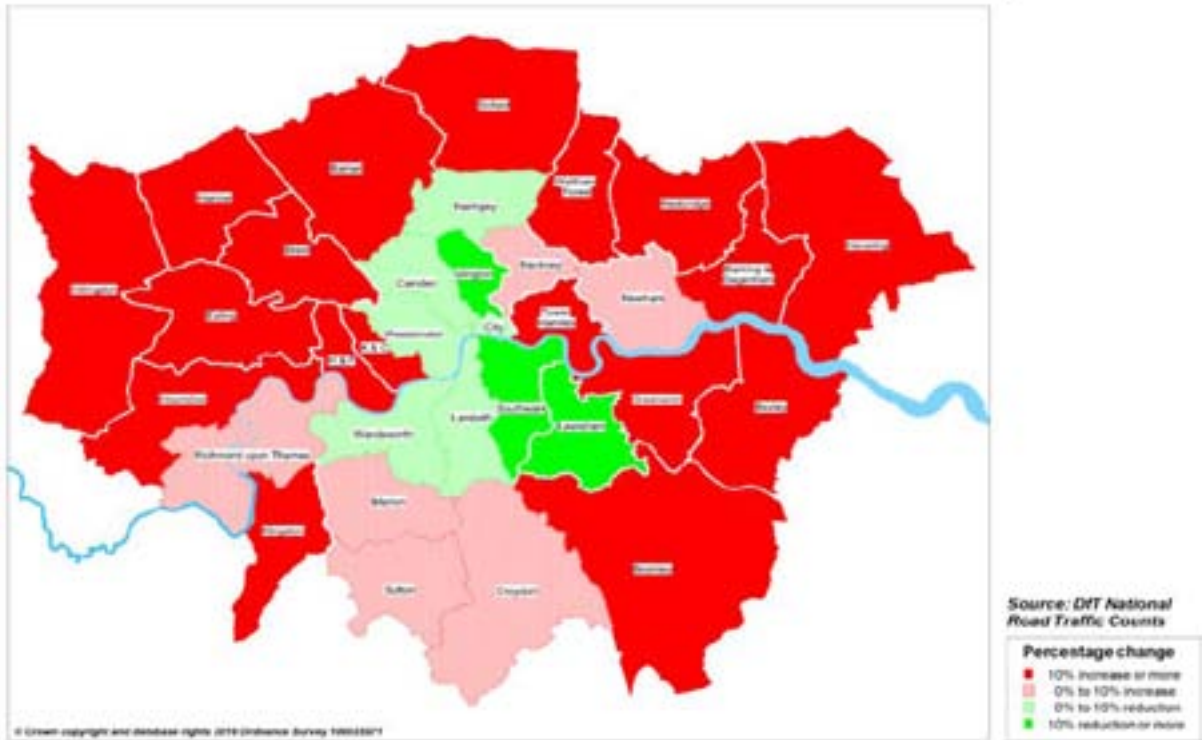
2.21 Figure 2-11 shows the daily number of LGV crossings at the three London cordons (Central, Inner and the London boundary). The number of LGV crossings increased significantly at the Inner and London boundary cordon between 2005 and 2007, although this growth has been gentler in more recent years. At the Central London cordon, the number of crossings has remained relatively stable, at around 180,000 vehicle crossings per year between 1990 and 2014.

Figure 2-11: LGV volumes crossing London area cordons



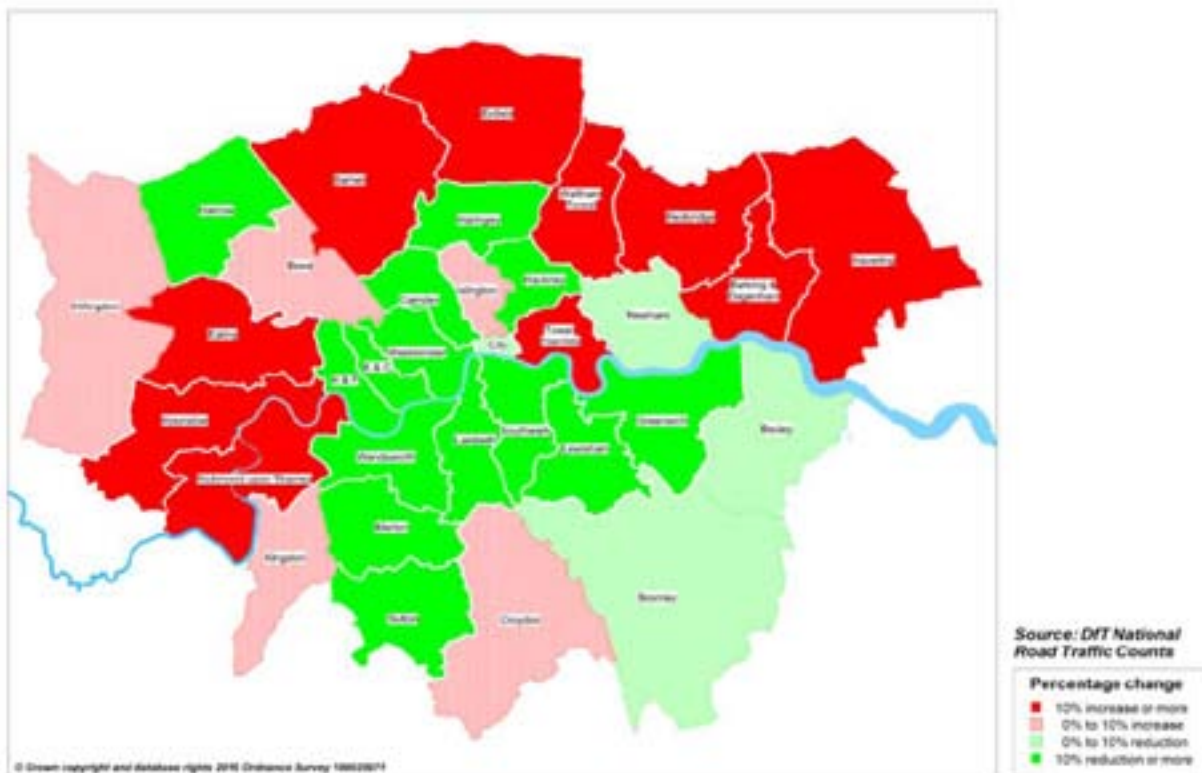
2.22 Looking at this trend in further spatial disaggregation (Figures 2-12 and 2-13), we see that many of the of the Outer London boroughs have seen increases in LGV traffic of more than 10% over the last twenty years, with particular growth in the boroughs north of the river.

Figure 2-12: % Change to LGV traffic across London, 1994-99 to 2015



Source: MTS Supporting Evidence: Challenges and opportunities report (2017), Fig 59

Figure 2-13: % Change to HGV traffic across London, 1994-99 to 2015



Source: MTS Supporting Evidence: Challenges and opportunities report (2017), Fig. 58, pg. 76.

2.23 The stable trend in HGV movements observed at a London-wide level is seen here to mask a shifting pattern of intensity, with the north London Boroughs again seeing the greatest increase in freight activity, tempering the falling activity levels in most boroughs south of the Thames.

Licensed taxi and private hire vehicle trends

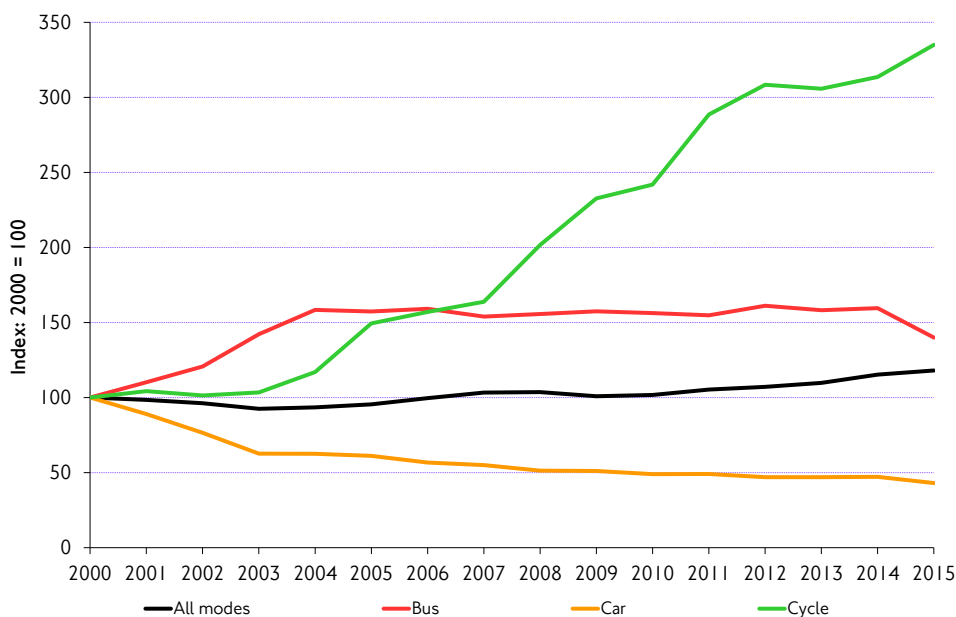
- 2.24 The number of licensed taxis has remained fairly stable in recent years after falling to its lowest level in 6 years in 2015/16 (21,813 vehicles, 24,888 drivers)⁶. In stark contrast, licensing data shows there has been a significant increase in the number of both licensed PHV drivers and licensed PHV vehicles, with licensed PHV vehicles growing from 52,811 in 2013/14 to 87,409 in 2016/17, an increase of 66%.
- 2.25 Unfortunately, there is little historic data on the movement of PHVs, as they have not previously been distinguished from cars in manual classified counts. Whilst the largest PHV operating companies keep their own monitoring data, this is commercially sensitive and is subject to rapidly changing patterns in market share.
- 2.26 In 2016 TfL found that PHVs constituted 12% of motorised traffic circulating in the CCZ between 06:00 and 20:00. The number of PHV trip entries to the CCZ (weekday) was also found to have increased by 56% between 2013 and 2015, set against a 14% decrease in taxis⁶.

Trends in non-motorised traffic

Cycling trends

- 2.27 There has been an increase of over 130% in cycling in London since 2006. This growth in cycling has been due, at least in part, to investment and development in London’s cycling network. The previous MTS set a goal of a 5% modal share for cycling by 2026, and the current draft MTS sets an 80% sustainable mode (on foot, cycling and public transport) share target for 2041.
- 2.28 Designing streets that support cycling is a key part of the Healthy Streets approach. London’s cycle network now comprises more than 100 kilometres of Superhighways and Quietways. By 2022, around 35% of Londoners should live within 400 metres of one or more of these cycle routes, with a target of 70% of Londoners by 2041.
- 2.29 TfL estimates that there are now more than 670,000 cycle trips per day in London. Figure 2-14 illustrates the growth in the number of people cycling in Central London in the weekday morning peak.

Figure 2-14: Trends by road based mode of transport for people entering Central London during the weekday morning peak (Year 2000 = 100)

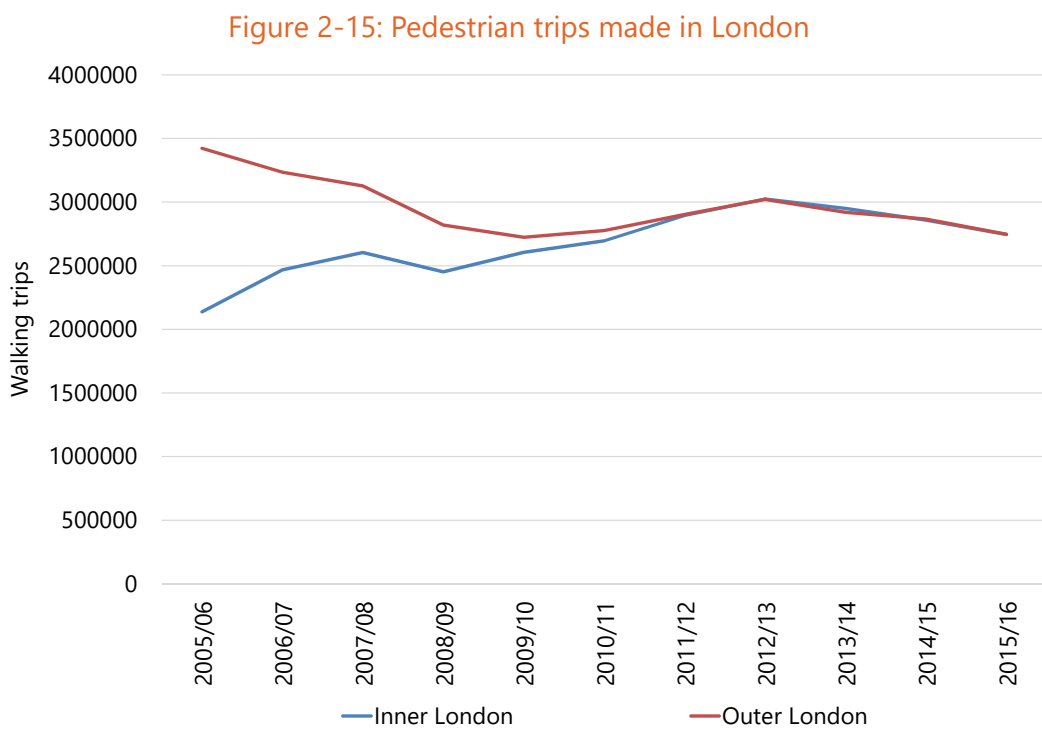


Source: TfL Travel in London Report 9 (2016), Fig. 7.9, pg. 203

2.30 This increase in cycling, particularly in Central and Inner London, has also been linked to the Santander (formerly Barclays) cycle hire scheme, following its introduction in 2010. The London scheme has been highly popular, and there has been a steady growth in cycle hire - rising to more than 40,000 users per day during the summer months in 2016. The most common journey purpose for those using these bikes is commuting, accounting for nearly two thirds of journeys starting and/or ending in the central zone¹⁴.

Pedestrian trends

2.31 Figure 2-15 shows the total number of pedestrian trips estimated to be made daily in Inner and Outer London. Though the proportion of journeys made on foot in London has remained steady since 2001, the Travel in London Report 8 indicates that between 2008 and 2014, there has been a 9.3% increase in walk-all-the-way trips in London. Again, walking trends are differentiated spatially. In Central London, walking accounts for 78% of all trips, in Inner London, 47%, whilst for trips within Outer London this figure is around 35%⁶.



Source: London Travel Demand Survey (LTDS) 2015/16

Vehicle based motorised congestion trends

2.32 The indicators commonly used to measure congestion in the UK were introduced in Chapter 1. Below we consider the observed congestion patterns from the perspective of excess delay, average traffic speeds and journey time reliability. Figure 2-16 shows the extent of travel delay (minutes per kilometre) across the London road network.

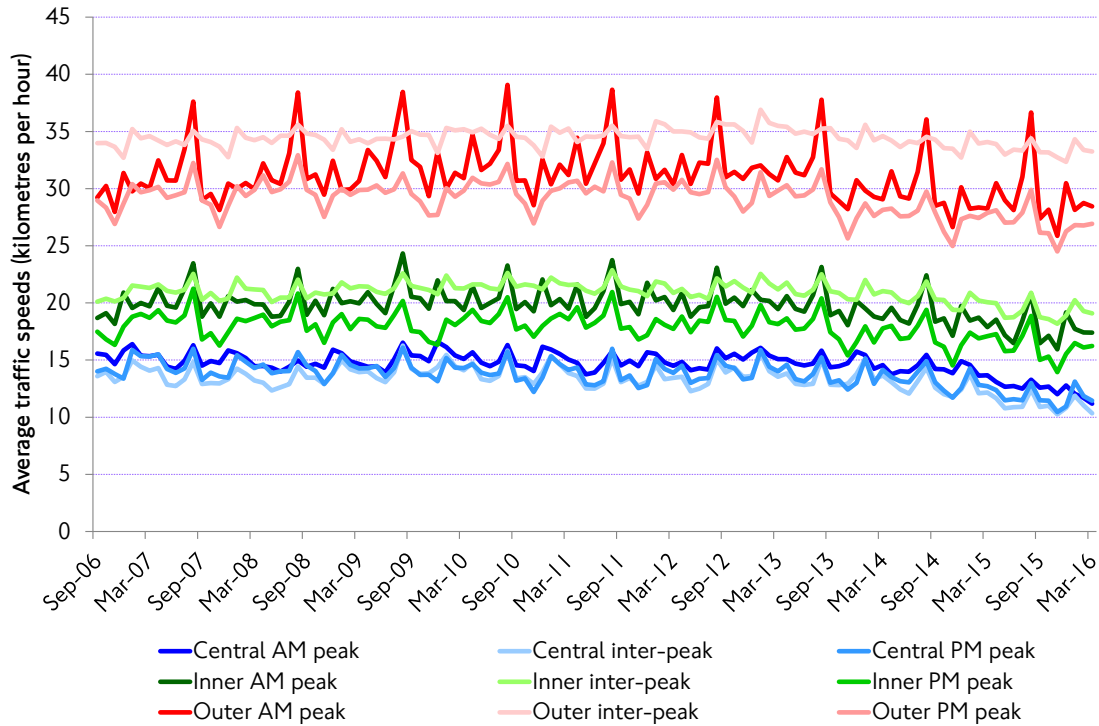
Figure 2-16: Excess delay (minutes per kilometre) across London



Source: MTS Supporting Evidence: Challenges and opportunities report (2017), Fig. 44, pg. 65.

- 2.33 The figure provides insight into the scale and spatial coverage of road based traffic congestion in London. Across an average weekday, large parts of the road network experience delays of more than one minute per kilometre, particularly in Central and Inner London, where the density of roads is greatest. Additionally, a number of corridors which link Outer, Inner and Central London also experience delays of more than one minute per kilometre.
- 2.34 Figure 2-17 shows the trend in average traffic speeds by area of London since late 2006, when Trafficmaster data first became available. There are clear and expected patterns associated with seasonality and the prevailing average speeds for each of Central, Inner and Outer London, reflecting the density and characteristics of the different networks. The overall trend however, is remarkably stable between 2007 and 2012, potentially due to recessionary impacts, after which average vehicle speed can be seen to take a downward path. This fall in traffic speed is observed in all parts of London since 2011/12, but is particularly strong in Central London.

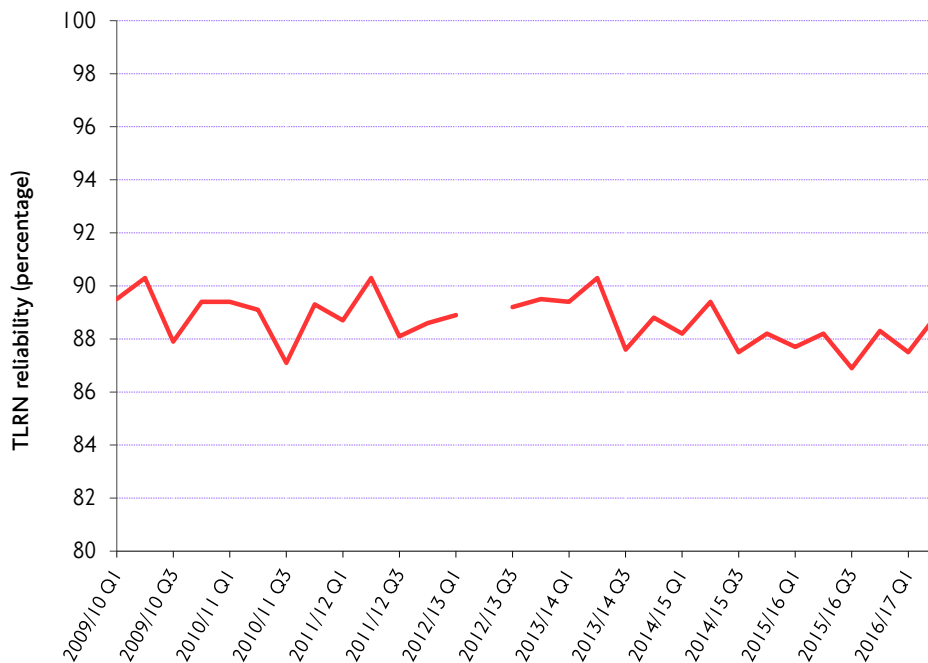
Figure 2-17: Average traffic speed (kilometres per hour) by area of London



Source: TfL Travel in London Report 9 (2016), Fig. 6.5. pg. 163

- 2.35 TfL’s journey time reliability metric considers the relationship of actual measured journeys (using ANPR cameras) to a nominal average journey time that is representative of motor vehicle journeys by road in London. This is measured quarterly on a road corridor basis, covering most of the TLRN in London, and is aggregated to a London-wide index.
- 2.36 Figure 2-18 details the available trend for AM peak journey time reliability from the start of 2009/10 and shows a similar pattern to that of the speed trend in Figure 2-17, with a relatively stable performance between 2009/10 and 2012/13, before deteriorating in the following years, with some evidence of a recovery in the first quarter of 2017/18.

Figure 2-18: AM peak journey time reliability on the TLRN. Percentage of journeys completed within an allowable ‘excess’ of a normalised average journey time



Source: TfL Surface Transport

Looking forwards: the evolution of vehicle technology

- 2.37 Recent years have seen so-called disruptive technologies change the shape of travel, such as real-time travel information, on demand services and journey sharing, and we can anticipate continued changes going forwards as rapid advances in technology offer new opportunities, and in the likely progression to the introduction of connected and autonomous vehicles (CAVs) on our roads. These trends present new opportunities, and technological advances. If well managed and regulated, they could be harnessed to enhance the efficiency of the transport network and improve mobility.
- 2.38 Some have suggested that the adoption of CAVs could have considerable positive impacts on congestion. One study from the University of Texas suggested that if 90% of cars on motorways were self-driving, road capacity would effectively be doubled and delays would be more than halved, largely through better headway management¹⁵, although efficiencies may be expected to vary within the urban context by comparison with motorway journeys.
- 2.39 If the introduction of CAVs is not well-managed however, the greater ease of private transport, and potentially lower costs (from shared ownership models and the lack of a need to learn to drive) could lead to increased overall vehicle kilometres as a result of falling motorised travel costs, increased access to on-demand travel and greater numbers of empty journeys.
- 2.40 The transition period of CAVs plus conventional vehicles could be especially challenging. While CAVs may be lower emitting, they will also take up road space and potentially add to road danger. It is important therefore to consider them in any road user charging and parking scheme so that they are used optimally and not, for example, used in preference to sustainable modes or run without passengers.

Comparison of congestion trends with other cities

- 2.41 The London trends can be compared to experiences across different cities, both in the UK and internationally, although care is needed when making direct comparisons to cities which may have very different network and travel characteristics.

UK comparisons

- 2.42 A number of GPS service providers are making use of the data they collect to provide network performance statistics which allow comparison on a common basis across different cities and countries. London was ranked as the most congested city in the UK in 2016 under INRIX's classification, showing a peak of an average 73 hours per person per year spent in vehicle congestion, and an average of 12.7% of total drive time spent in congestion.

Table 2-1: Percentage of drive time spent in congestion for UK cities

City / Conurbation	Percentage of Total Drive Time in Congestion (peak and non-peak hours)
London	12.7%
Aberdeen	12.3%
Bournemouth	10.8%
Luton	10.7%
Manchester	9.9%
Edinburgh	9.8%
Hull	9.4%
Bristol	8.8%
Guildford	8.6%
Birmingham	8.5%

Source: ITP adapted from INRIX: UK Traffic Scorecard Report (2017), Table 15, pg. 29

- 2.43 This would suggest that London motorists experience more congested driving conditions than those in other UK cities. Given London's relative size and scale of travel and economic activity compared to other parts of the UK, this may not be considered greatly surprising.
- 2.44 Recent analysis of travel speeds in local authority areas across the UK found a marked reduction in mean vehicle speeds during the AM peak on locally managed A roads. Notably, this fall in motorised traffic speed has been most pronounced since recovery from the economic downturn, generally placed from 2012 onwards.
- 2.45 The pattern of falling travel speeds on London's roads in recent years is therefore not unique in a UK¹⁶ context, and the driving factors behind this general trend warrants further investigation.

International comparisons

- 2.46 Again, drawing on the comparator data provided by global data providers, we can gain an appreciation of London's traffic conditions by comparison with those experienced around the world. The INRIX scorecard suggests that in terms of the percentage of total drive time spent in congestion, London sits second only to Moscow on the list of the most congested cities in Europe, and ranks as the seventh most congested city in the world.
- 2.47 The value of such comparisons is again limited by the explanatory power of the indicator used. The proportion of time motorists spend in congested conditions bears no relation to the number of travellers served by the transport network, or indeed even the number of motorists experiencing the traffic congestion. A review of the evolving trends in congestion experienced in major international cities suggests similar trends to that seen in London. Toronto has seen a 12% reduction in vehicle speeds on arterial roads between 2011 and 2014, whilst travel delay has also increased by 131% (metric based on night free flow speeds)¹⁷.
- 2.48 Reports from New York¹⁸ and Paris¹⁹ also show a decline in general traffic speeds. This decline has been around 20% in New York between 2010 and 2015. Bus speeds have also shown a slight decline in the same period across New York¹⁸.

Summary: Motorised road traffic congestion is increasing and traffic composition is changing

The amount of delay experienced on roads across all areas of London is increasing, traffic speeds are falling and with them network reliability has been worsening. The trend in Central London is particularly notable.

Analysis of the traffic trends identifies that since 2012 there has been a reversal to the trend of falling traffic volumes and vehicle kilometres travelled across London as a whole. Within these trends, however, there has been a rapid change in traffic composition, with increasing light goods vehicle movements and private hire vehicle numbers and activity. Traffic within non-motorised modes has been growing, with a large increase in cycling and walking, particularly in Central London.

Benchmarking of the traffic trends observed in London against those experienced elsewhere in the UK and worldwide shows that falling traffic speeds are a common phenomenon in other places. However, it should be noted that considering network performance through the narrow lens of the most common congestion measurements (i.e. delay to motorised traffic) may present an incomplete picture.

The contributory factors leading to the rise in congestion will be explored further in Chapter 3.

3. The causes of congestion

3.1 Congestion patterns are reflective of a range of different underlying causes and complex interactions between vehicle numbers, driving patterns, infrastructure, recurring and unplanned factors. In this chapter we consider the commonly identified influencing factors behind congestion levels, distinguishing between:

- ‘Demand-side’ factors, relating to the number of people and vehicles using the network, their patterns of travel and the purpose and mode of trips; and
- Supply-side’ factors including network changes and the impact of policy.

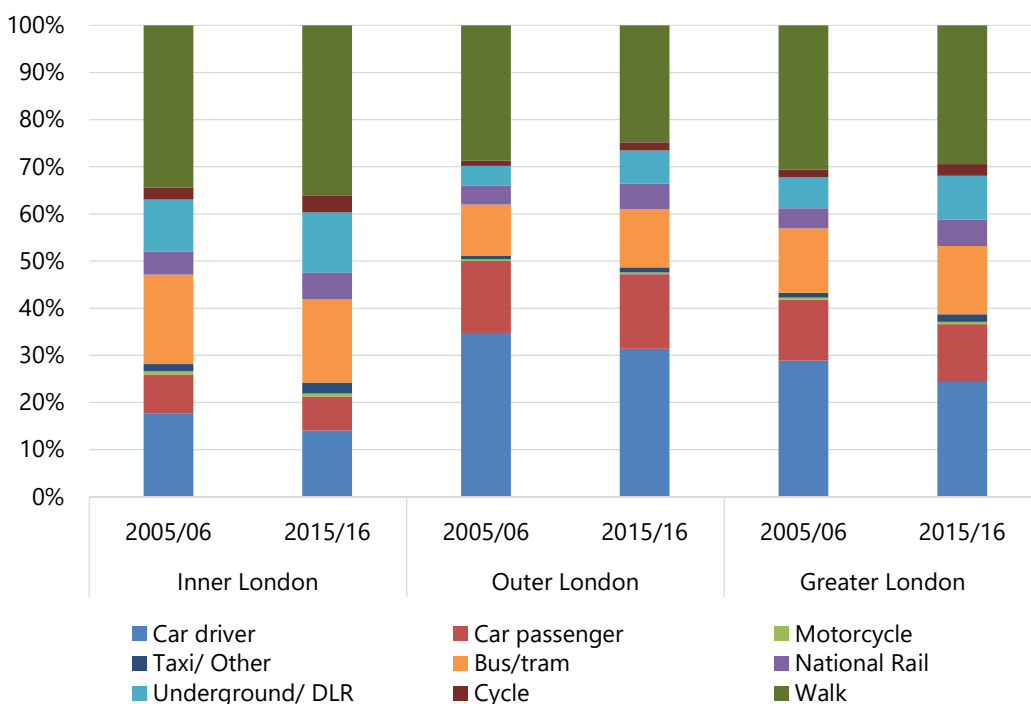
3.2 Our concept of congestion needs to remain however within the understanding that it is experienced very differently by different road users, and that focusing exclusively on one factor or another naturally leads to inequalities and trade-offs between users. Furthermore, the presence of congestion should not necessarily be viewed as ‘bad’ in itself – it is a marker that the network is being well used, and indeed acts as a deterrent to worsening conditions in itself. Decisions about ‘which’ congestion to prioritise will have knock-on effects for other road users.

‘Demand-side’ factors

Population growth and demographics

- 3.3 It is generally understood that travel growth goes hand-in-hand with population growth. Indeed, the observed population growth in London over the past decade has translated almost directly proportionately into a growth in personal travel demand, with trip rates per person remaining broadly constant over the long term, and distance travelled falling slightly²⁰.
- 3.4 However, the relationship between population growth and motorised travel has not been so direct. The downward trend in private car use shows a breaking of the link between population and motorisation rates in London. The latest London Travel Demand Survey data highlights the falling proportion of person based trips made by road across all parts of London, with particular falls observed in Inner London over the last decade (Figure 3-1).

Figure 3-1: Trips by Mode: Inner, Outer and Greater London



Source: ITP adapted from LTDS 2015/16

- 3.5 The location of population growth is also vitally important in understanding the way that travel patterns have evolved. TfL analysis has shown that increased population density tends to support higher public transport modal share, and lower levels of car ownership. The densification of population in Inner London for example, has served to support low car dependency in Central and Inner London, as has the decreasing average age of the population in London, reducing the potential impact of the growth in trips on London's highway network.
- 3.6 The trend in travel growth in relation to employment is less clear-cut than that of population. Growth in employment will however certainly have played its part in driving growth in trip making, with new jobs generating a derived demand for travel. In addition, economic activity is a key driver of freight movements which are typically road-based.
- 3.7 The implication of these trends for congestion are that pressure upon transport in London will continue to increase. This includes the existing Underground and bus networks, but also new and existing rail links and cycling and pedestrian infrastructure.

Motorised traffic

- 3.8 As we have already discussed in Chapter 2, motorised traffic levels across London have been broadly downward in trend until an inflection in the pattern in 2012, but considering volumes in isolation masks more complex underlying issues. The composition of motorised vehicle traffic has been changing, which may be contributing to congestion in ways which may not have traditionally been considered. The key points on motorised traffic that have a bearing on demand are:
 - The majority of trips made on London's roads are by private car, and also represent the greatest vehicle activity (vehicle kilometres). While this is less true in Central London, in Inner and Outer London the car still dominates modal choice for most journey purposes.
 - The number of bus kilometres operated has hit an all-time high. Although this means that there is more bus vehicle activity on the London highway network, they carry much higher loadings than other vehicles and therefore can have an overall positive impact on congestion despite their frequent stopping patterns (which at times may impact on general traffic speeds notwithstanding the extent of bus lane provision).
 - There has been a clear increase in the number of LGV kilometres in London driven by a rise in e-commerce, office deliveries, same-day delivery options and ever-increasing numbers of self-employed traders and small businesses using vans as work vehicles. Differences in road usage patterns of LGVs, for example the regular stopping behaviour of delivery vehicles, roadside parking and loading, and circulating to find delivery addresses, may potentially increase the impact that these vehicles have on actual traffic conditions although there is little in the way of robust quantitative evidence on the true scale of this impact.
 - Licensing data has identified a significant increase in the number of both licensed PHV drivers and licensed PHV vehicles in recent years. However, beyond cordon crossings in the CCZ, robust information relating to PHV usage and vehicle activity is very limited. This is reflective of the fact that traffic data has not historically been disaggregated into private car and PHV. As such, the scale of the impact of PHVs on travel activity is not well understood, beyond asserting that PHVs have represented a growing proportion of traffic composition.
 - The impact of app-based PHVs on traffic levels in cities also remains uncertain and is an issue of contention. The findings of a study of the impacts of app-based PHVs in New York City are that the presence of app-based PHVs tends to increase total vehicle miles travelled, and that passengers are most often moved from sustainable travel modes into PHVs, or generate trips which otherwise wouldn't have been made²¹.

Non-motorised traffic

- 3.9 It is not only motorised traffic that can have an impact on highway network conditions. People walking and cycling both have interaction with motorised traffic, and growth in the numbers of

both as a result of population increases and changing modal share must be considered in the evaluation of recent changes in network performance. The key points here are:

- Walking and cycling are amongst the more efficient means of transport in terms of the amount of road capacity they require per person moved. Encouraging use of these modes by allocating dedicated space may therefore increase the overall capacity of a corridor, with benefits to car users and bus passengers.
 - Even in cases where allocation of space to walking and cycling reduces the capacity of an individual corridor, this may still be desirable if it supports city-wide modal shift to walking and cycling.
 - A review of the research literature on cycling interactions and potential contribution to traffic conditions and congestion highlights a general lack of understanding in this area, and one which in the absence of strong numeric evidence will also be poorly represented in traffic models.
 - There is little evidence available on the effect that the increasing number of pedestrian movements has on motorised traffic, so again it is difficult to determine the scale of the issue. Fortunately, the technology for this area of data collection is improving rapidly and new opportunities to collect data through phone signal triangulation or Bluetooth capture are becoming more feasible.
 - Although a rapid growth in the number of people cycling and walking on London's roads is likely to have had some bearing on traffic conditions, to extend this assertion to suggesting that increased cycling and walking represents a dis-benefit to the network would however be to overlook the wider context of the objectives of supporting sustainable, efficient and healthy travel in London.
- 3.10 Whilst the remit of this report does not extend to exploration of congestion beyond motorised modes, it is recognised that travellers using non-motorised means can also experience congestion and crowding and we recommend developing a better understanding of the impact of congestion amongst those making trips by active modes of travel.

'Supply-side factors'

- 3.11 Congestion can be viewed as a manifestation of the balance between demand and supply on the road network. As with demand, the 'supply' of road space is not static, and changes to either physical space available for vehicles, or the management of that space will influence supply. What is more, these changes cannot be viewed in isolation as they will have an impact on the network equilibrium, thereby influencing demand.

Impact of changing road capacity on congestion

Reallocation of road space

- 3.12 A key impact of transport policy in London over recent years has been changes in road capacity allocation. This is a consequence of several factors; policy which is in favour of active and public transport modes, land being taken for redevelopment and urban realm programmes. This has led to increased provision of bus lanes, cycle infrastructure, including Cycle Superhighways, pedestrian and public realm space. Also, the large scale of general construction activity in London over recent years has significantly impacted on effective capacity in some areas, particularly Central London.
- 3.13 Between 2000 and 2014, bus lane kilometres²² in the London network grew from 162 kilometres to 281 kilometres. Re-allocating road space to buses through bus lanes may impact on journey times for other road users due to a reduced level of road space availability. This must be caveated by noting that taxis, motorcycles and people cycling can use bus lanes, and that whilst the adverse impact therefore falls primarily on private and goods vehicles, the road space reallocation will also change the dynamic of interaction between the different modes.

- 3.14 Similarly, although strongly supported through TfL consultations, it has been suggested that the road capacity which has been reallocated to people cycling through the provision of the Cycle Superhighways has contributed to the recent increase in traffic congestion²³. This does not necessarily imply a reduction in the overall carrying capacity of the road network however, given the potentially more efficient use of road space in terms of movement by cyclists.

Planned and unplanned incidents

- 3.15 There has been research conducted by TfL to assess the impacts of planned and unplanned, short-term and long-term disruptions on the network, but because of the complex relationship between many different aspects of the network, it is difficult to accurately assess their contribution. The impacts tend to be local and short term, and are best dealt with through active traffic management on that basis.

Roadworks

- 3.16 A city on the scale of London requires a large number of roadworks every day for a range of purposes from providing short term access to utilities to facilitating longer-term building projects. Each disruption or closure can have a knock-on effect on other parts of the network.
- 3.17 The impact of roadworks on traffic congestion has been carefully studied but can still be difficult to estimate. Various TfL schemes are in place to limit these impacts, including permit schemes adopted by the boroughs and the Lane Rental Scheme, which aim to encourage roadworks to take place during less traffic-heavy periods, although it should be noted that the Lane Rental Scheme applies to just over half of the TLRN, itself comprising only around 5% of London's roads. TfL and the boroughs also continually strive to improve the co-ordination of works by partnering together and with developers. In addition, considerable efforts are made on a daily basis to manage the impacts of roadworks (and other planned and unplanned incidents on the network) through real time traffic management operations.
- 3.18 The construction of schemes such as the Cycle Superhighways as part of the Roads Modernisation Plan (2014-2022) and now the Healthy Streets programme has also induced a certain amount of necessary roadworks, which has in turn temporarily removed additional capacity from the network.
- 3.19 There is clearly a trade-off between redevelopment and the impact which this work may cause. A clear relationship has been identified between the extent of bus journey time increases and the number of nearby roadworks, estimated to contribute to around half of the bus speed decrease which has in turn led to increased journey times resulting in the kind of losses in patronage reported in Chapter 2. It has been estimated that there is a relationship of a 10% fall in bus patronage for every 10% increase in journey times²².

Planned events

- 3.20 Major events can also have an impact on the performance of the network. In preparation for the Olympic Games in London in 2012, a comprehensive set of traffic management measures were implemented to ensure that the impact of any extra traffic on the network was minimised. As with other temporary disruptions, a loss of spare capacity on the dense Central London network contributes to a lack of options in terms of diversions. The impact of major events on the road network can generally be predicted in advance, and so tends to be dealt with on a tactical basis outside of efforts to address the prevailing trend of increasing motorised traffic congestion.

Unplanned works and incidents

- 3.21 Unplanned incidents are difficult to control, although existing plans to improve safety at junctions (as part of the Safer Junctions Programme) will reduce the likelihood of collisions and measures can be improved to remove obstructions such as broken-down cars more quickly²⁴. There are also unplanned disruptions on the network to contend with, such as accidents, collisions, and unexpected or emergency works. Although the likelihood of these can be minimised to an extent, they are largely inevitable in a city as busy and large as London.
- 3.22 TfL already carefully manages the road network in real time with control of around 5,000 CCTV

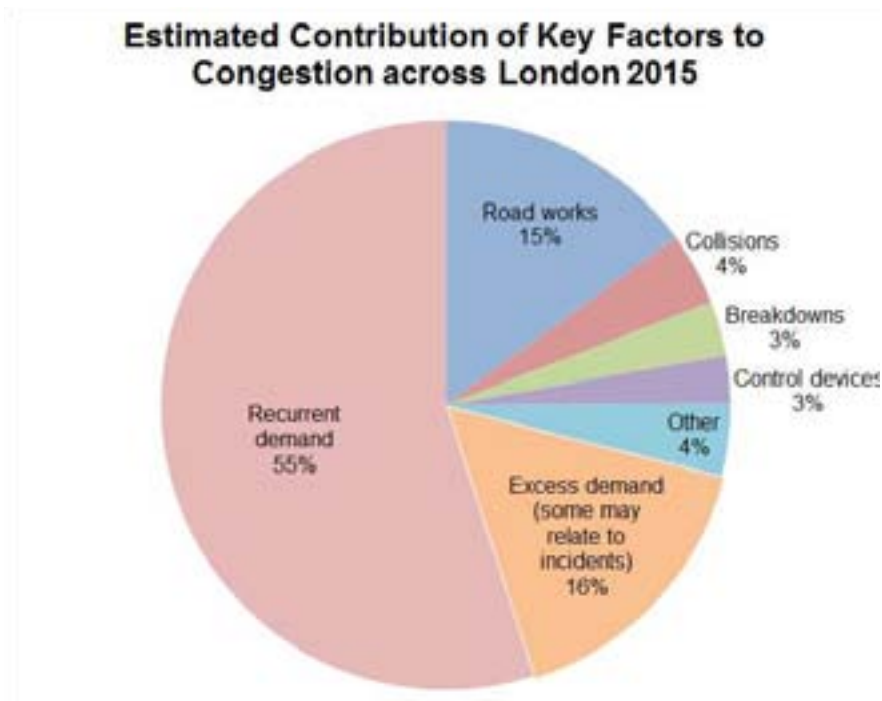
cameras, and by employing their Real-Time Origin Destination Analysis Tool (RODAT). They also control all 6,300 traffic lights, with SCOOT (Split Cycle Offset Optimisation Technique) technology doing this automatically at 75% of traffic lights which reduces delays at junctions by about 13% on average overall. Smart technology at 31% of traffic lights can identify and prioritise buses if necessary. Traffic controllers are also able to change the length of time a light is green or red to clear an unexpected queue and control vehicles moving into an already congested area²⁵.

- 3.23 RODAT combines ANPR, ATC and SCOOT data to create a 24/7 real-time monitoring tool which allows incidents to be identified and helps mitigation to be put in place. RODAT is currently in place for journeys to and from Central London, but extension into Greater London may be able to have a more widely felt effect. The average duration of a serious or severe unplanned event shows a decreasing trend in line with the implementation of these measures. The impact of each measure is marginal, but when combined can have an important effect.
- 3.24 Crucially, due to a loss of capacity to motorised traffic across the network (as demonstrated earlier in this chapter), there has been a loss of 'spare' or empty capacity in the network, increasing the importance of quick resolution of incidents. Spare capacity builds in resilience against short-term incidents, allowing re-routing of buses and other vehicles during the resolution of an unplanned disruption. This allows the impact of the disruption to be minimised.

Unpicking the causes of congestion

- 3.25 Disentangling the many factors at play which have had an impact on traffic conditions presents a real challenge. There is a lack of robust evidence on the impact of specific changes and the interrelationship between many aspects of network conditions. TfL has attempted to shed light on the relative importance of different factors through regression and level shift analysis, taking into account the impact of long-term events, short-term incidents, and 'demand' on vehicle delay in London. Figure 3-2 summarises the estimated contributing factors to congestion on the TLRN.

Figure 3-2: The Congestion Pie (TLRN only)

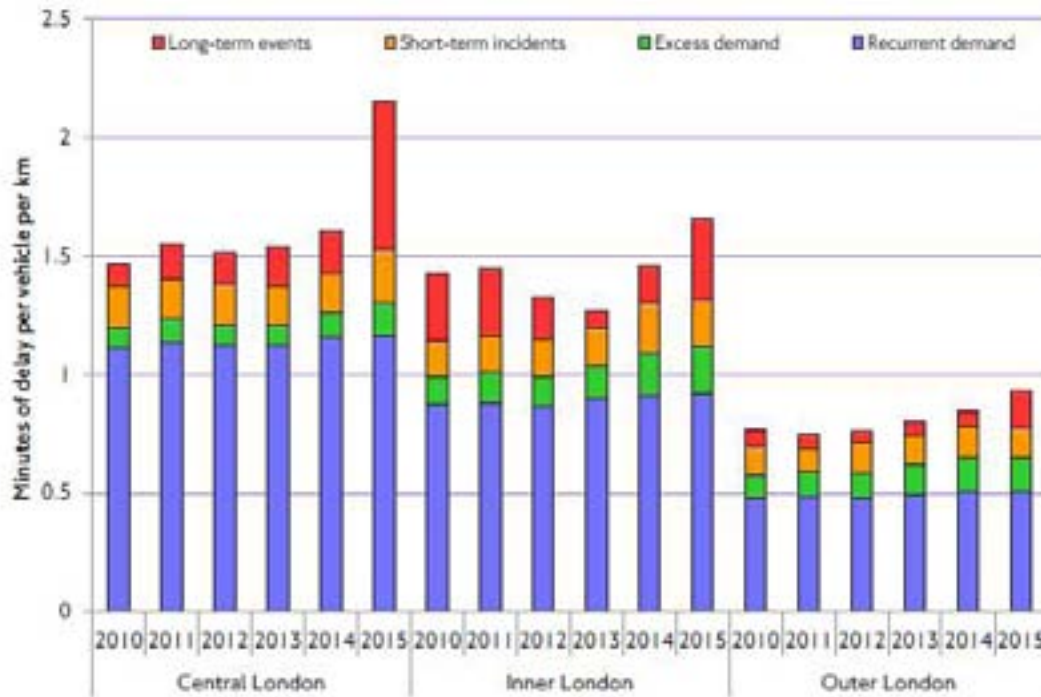


Source: Level Shift Analysis presentation, March 2017, TfL

- 3.26 Recurrent demand, that is the general volumes of traffic carried on a typical day, is considered to represent the greatest contributor to congestion. This is followed by excess demand, which represents instances of higher than typical demand occurring. On the supply side, roadworks are found to be the largest factor in causing congestion.
- 3.27 The analysis was taken further, in attempting to disaggregate causes of delay by different areas

of London and how the contributory factors have evolved in recent years. Figure 3-3 shows that whilst recurrent demand has remained relatively stable in all three zones (most so in Outer London), the most variable cause of congestion (measured in delay in minutes) is long-term events (over 3 days in duration, typically planned roadworks), which reached its highest level in 2015 for all three zones. Excess demand has also increased (although less dramatically), and the contribution of short-term incidents has remained fairly stable in all three zones.

Figure 3-3: Causes of delay in Central, Inner and Outer London



Source: Re-evaluating the congestion pie, TfL (2017)

Summary: Main contributors to congestion

The contributory factors to traffic conditions and congestion are multiple and varied, and unpicking the impact of individual elements in a system with complex interactions and interrelationships is very challenging.

The most comprehensive attempts to allocate causation suggest that whilst non-recurrent events such as roadworks, accidents and breakdowns play a part in contributing to congestion, the principal cause of congestion is the scale of traffic demand on the network. Hence, attempts to improve network conditions through better management of non-recurrent factors can only go a limited way to improving congestion unless measures to manage the overall demand levels on the network are also considered.

The changing vehicle composition and travel patterns may also be having a dynamic influence on the use of road space. Limited understanding of the emerging trends in LGV and PHV activity, and on the interaction between growing numbers of people cycling and walking and motorised traffic, prevents strong conclusions being drawn on the relative impact of these factors on observed congestion levels.

Changes which have occurred in London over recent decades include the reallocation of road space to bus lanes, Cycle Superhighways and pedestrian schemes and junction redesign to improve safety and make London more welcoming for people. Limited evidence suggests that while these schemes may have short-term negative impacts on traffic speeds during the construction phase, longer term impacts may be negligible.

4. Policy considerations

4.1 Before we move towards defining appropriate measures and the means of managing and tackling the congestion issues identified, this chapter outlines:

- Some of the key lessons learned from previous transport policy interventions; and
- The wider policy considerations within which our recommendations need to be framed.

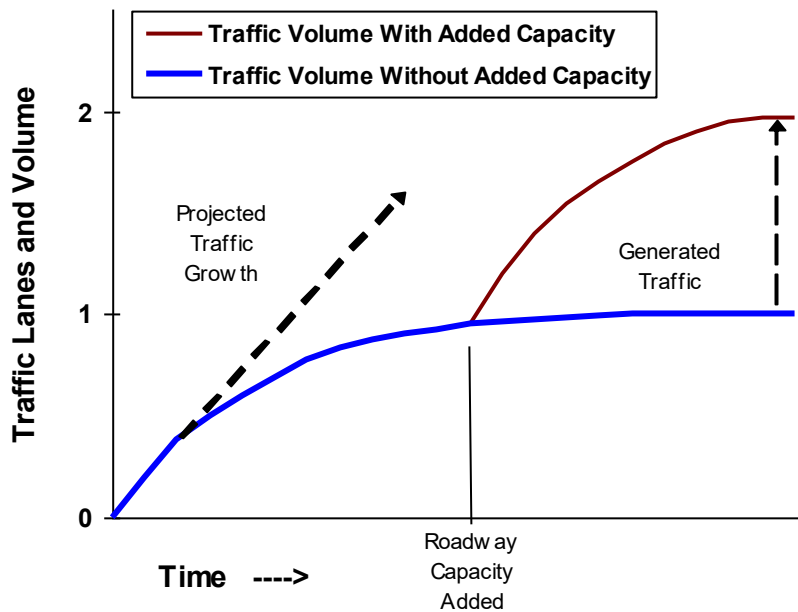
Learning from past experience

4.2 Whilst developing better ways of managing scarce road space offers some opportunity to improve conditions for motorists in the near term, experience tells us that over time traffic reaches a new self-regulating equilibrium through the occurrence of generated traffic. This means that better management on its own is unlikely to deliver notable congestion benefits and may serve to increase congestion over time. It is also unlikely to lead to the most efficient use of road space.

Concept of induced demand

4.3 Figure 4-1 shows how traffic volume typically responds to an increase in road space (in this case adding an extra lane). The concept applies also to an increase in effective road capacity, for example through improved junction layout, signalling or stopping restrictions.

Figure 4-1: Concept of traffic volume responding to increased capacity



Source: Victoria Transport Policy Institute (2017)

- 4.4 New trips generate some societal value in the short term, as travellers enjoy the benefits of quicker journey times. However, as traffic levels increase and journey speeds fall, these benefits are lost. What remains are the externalities caused by the new trips in the form of pollution, parking space requirements and incidence of collisions.
- 4.5 Recognition of the feedback cycle of induced demand is important in determining the most appropriate policy response. We can distinguish between strategies which generate congestion from those which do not (see Table 4-1). In basic terms, interventions which reduce the 'cost' of travel to the motorist (including time cost) are likely to generate demand, unless offset by a more sizable fall in cost of travel by alternative modes.

Table 4-1: Summary of policy response impacts on traffic generation

Generates Traffic	No Traffic Generation Impact
Increased road capacity	Road pricing / congestion charging
Intelligent traffic management (SCOOT etc.)	Transit Oriented Development / better land use planning
Roadwork impact reduction	Public transport improvement measures
Travel demand management measures causing small scale modal shift	Travel demand management measures achieving large modal shift

Source: Derived from Victoria Transport Policy Institute (2017)

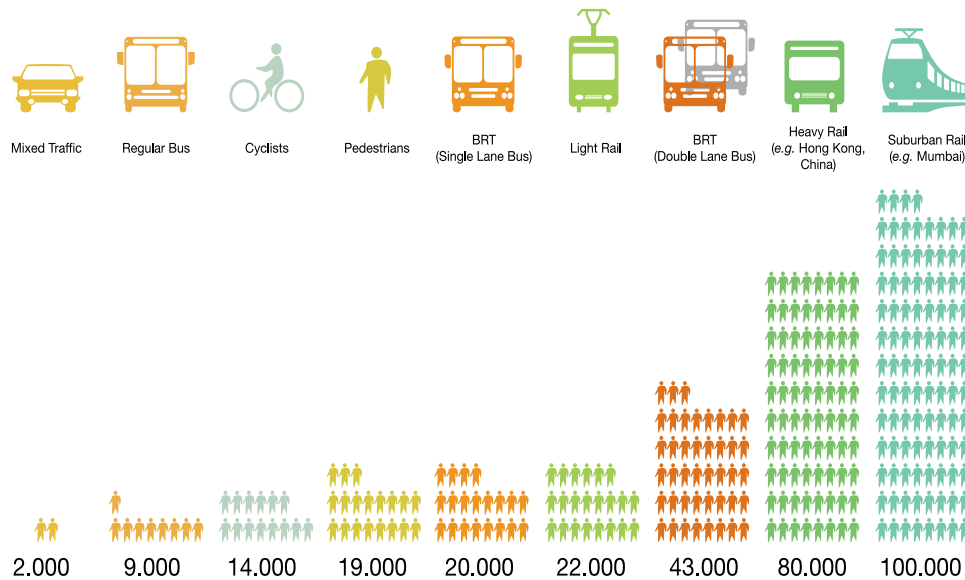
- 4.6 This means that in considering interventions, we must be careful to consider the various and long-term consequences for traffic generation. If an intervention leads to more traffic because drivers experience improved journeys then its effect is cancelled out – and then it will require further interventions, each likely to be of reduced impact.

Efficiently utilising the available road space

- 4.7 Given the limitation of measures to improve network efficiency, we need to consider other approaches: such as the kind of traffic that would best utilise the road space and improvements in network efficiency that can be delivered by prioritising vehicle activity, making most efficient use of the space available.
- 4.8 The private car, particularly when only occupied by the driver, represents one of the least efficient forms of travel from a space utilisation perspective. Buses are able to carry greater numbers of people whilst taking up little extra space. Non-motorised modes can also be accommodated with great efficiency. Figure 4-2 shows the person based throughput feasible in a standard lane for different types of transport mode.

Figure 4-2: Utilising the available roadspace most efficiently

Corridor Capacity people per hour on 3.5m wide lane in the city



Source: LADB, GIZ (2011). Changing Course in Urban Transport: An Illustrated Guide. Asian Development Bank: Manila

- 4.9 Making best use of network capacity would therefore imply the prioritisation of more efficient modes above that of the private car. Indeed, the implementation of bus and cycle lanes, and pedestrian zones partly reflects this principle. However, efficient utilisation of space is one of a number of factors requiring consideration.

Valuation of different trip types

- 4.10 Another consideration in the allocation of road space and the prioritisation of different modes of travel is the value placed on different types of trip. The network presently serves travellers making trips for a wide range of different purposes, whether for commuting, leisure or business travel, for the delivery of goods or in provision of services. Travellers themselves place different valuations on the trips being made, whilst the societal value of the trip will also differ by purpose.
- 4.11 As demand pressures on the network increase, competing trip purposes and priorities will make trade-offs less avoidable. At present, congestion levels act as an important component of rationing of the road space. As traffic conditions deteriorate, and the 'cost' of travelling by road increases, only those travellers for whom the value of the trip exceeds that cost will travel. Others will either switch to alternative modes or not travel.
- 4.12 Allowing congestion levels to serve as a means of rationing of road space might be effective, but may not be the most efficient means of achieving this goal. Ensuring that the road network is delivering maximum value may increasingly require the prioritisation of trip making. The important factors to consider in making such prioritisation decisions are:
- Trip value – both to the trip maker and societal value; and
 - Trip impact/externalities on the network and for wider society.
- 4.13 The present mechanism of implicit rationing of road space through congestion takes some account of the former, but does not adequately capture the latter consideration. Economists have long argued that to effectively reflect the wider external costs that road users inflict on others and on society at large, the adoption of some form of road user pricing is required.

Achieving the transport strategy objectives

- 4.14 The Draft Mayor's Transport Strategy sets out the following overarching objectives:
- Healthy Streets and healthy people;
 - A good public transport experience; and
 - New homes and jobs.
- 4.15 In moving towards this vision for London, we can identify the following steps which form key components in achieving these objectives:
- Increased modal share of public transport trips, which in turn requires:
 - A reliable, accessible and affordable public transport system with sufficient capacity to meet future demand;
 - Provision of facilities and infrastructure to support active travel; and
 - Reduced traffic levels to improve air quality and ensure an environment conducive to active travel and in support of the Healthy Streets approach.
- 4.16 The policy decisions and measures related to the allocation and operation of the highway network in the near term will have an important influence over the achievement of these objectives in the coming years.

Summary: Congestion management within the wider policy context

Improved management of the highway network, whilst worthy and desirable, cannot be expected to 'solve' the congestion challenge. Increasingly, the avoidance of unacceptable levels of traffic congestion must focus on measures which influence the overall demand for travel, and promote modal shift towards more space efficient means of transport.

5. Tackling congestion: intervention options

5.1 This chapter considers measures, policies and interventions which may be pursued to ‘tackle’ congestion and its adverse impacts. Reflecting the approach taken in previous chapters, these have been distinguished as:

- Demand-side interventions focussing on influencing who, how and when travellers make journeys; and
- Supply-side interventions which relate to making changes to the layout of the road space, the available capacity, or the way in which the road space is managed.

5.2 In selecting these interventions, we have been mindful of the London context and the policies set out in the draft MTS. Table 5-1 identifies the well-recognised policy areas which form part of the transport authority’s toolkit in the management of the network, with a (non-exhaustive) list of example measures falling under these main headings.

Table 5-1: Congestion management measures

Measures / Interventions	
Supply Side	Demand Side
<p>Highway Capacity</p> <ul style="list-style-type: none"> • Junction improvement/redesign • Grade separation • Highway widening • Pinch-point/new links • Road space allocation (e.g. PT/HOV lanes) <p>Road Network Management</p> <ul style="list-style-type: none"> • Traffic control systems/ITS • Rapid response units • Traffic enforcement • Roadwork co-ordination/management • Network maintenance/repair • Traffic calming <p>Public Transport/NMT Network</p> <ul style="list-style-type: none"> • Investment in public transport • NMT provision (pedestrian facilities, cycle lanes, parking) 	<p>Travel Demand Management (TDM)</p> <ul style="list-style-type: none"> • Fiscal measures (fuel tax etc) • Road pricing/congestion charging • Parking policy • Smarter choices programmes • Car sharing • Fare strategy and pricing <p>Travel Planning</p> <ul style="list-style-type: none"> • Journey planning/travel information • Incident/roadworks/event communication <p>Land Use / Transit Oriented Development</p> <ul style="list-style-type: none"> • High density development • Mixed use activity centres <p>Freight Policy</p> <ul style="list-style-type: none"> • Delivery regulations • Freight consolidation

5.3 TfL is actively applying a series of strategies and measures to maximise efficient operation of the road network, minimise impact of planned interventions or unplanned disruptions, manage demand and keep the network in a good state of repair.

5.4 On the supply side, these include:

- A £4 billion programme under Healthy Streets, featuring road schemes, junction improvements, traffic signal modernisation and maintenance works on roads, bridges and tunnels;
- Non-motorised transit provision including cycle lanes, enhanced pedestrian facilities and crossings and place making;
- Investment in public transport service provision including new rolling stock on underground and overground lines, extended operating hours, network extensions to tube and DLR and the forthcoming delivery of Crossrail as a major new transit line;
- Roadwork Lane Rental and Permit Schemes; and

- Traffic control centre and rapid response units focused on optimising the management of traffic and dealing quickly with incidents.

5.5 Demand side measures presently pursued include:

- Road user charging in Central London in the form of the Congestion Charge;
- Investment and prioritisation of public transport to support modal shift;
- Smarter choices initiatives to encourage shift to sustainable travel options, including school and workplace travel planning, facilitation of car clubs etc.;
- A Travel Demand Management programme focused on changing travel behaviour through information dissemination, enhancing journey planning tools and effective communication;
- A freight plan focused on increasing operational efficiency, enhancing freight journey planning and promoting partnering opportunities; and
- Parking and loading regulations.

5.6 Leading cities around the world pursue similar policies, sometimes with slightly different emphasis in particular areas reflecting local priorities and culture. Amongst the usual investment in high quality public transport, walking and cycling facilities and intelligent traffic management, city specific schemes can be observed. Car free days have been trialled in Paris, Barcelona is repurposing road space into citizen's spaces with its 'superilles' (superblocks), and Stockholm has followed London in introducing a congestion charge.

Demand-side interventions

5.7 The influencing of travel behaviour is commonly achieved through a combination of 'carrot and stick' elements to encourage efficient choices. Changing the 'cost' of travel, whether in terms of money, time or 'hassle' can be an important mechanism for changing travel behaviour, whilst ensuring the availability and standards of alternative options, and providing information which raises awareness as to the alternatives, also has an important role to play.

Road user charging

5.8 The principle of charging road users not only for the privilege of using the highway infrastructure but also the dis-benefits which they inflict on other road users, has long been advocated by economists as a societally efficient way of rationing road space. The principle of 'internalising the externality' provides a sound framework on which to develop the optimal charging structure, and can be proven to be more efficient than the current combination of road and fuel taxation.

5.9 However, whilst the theory is clear, the practical and political dimensions of introducing road user charging have presented challenges. London's Congestion Charge, introduced in 2003, was one of the first of such schemes, following Singapore and Rome, and more recently joined by Stockholm, Milan and some smaller cities including Durham.

5.10 The scheme has been effective in managing demand levels within the central area, but as it approaches 15 years in operation, new challenges and technological advances present an opportunity to review whether changes to the scheme may be merited. Also, given the very limited area of coverage of the scheme, and recognising that congestion is growing across London, there is a more fundamental question on the role which road pricing may play in managing congestion in all parts of London.

Options for updating the Congestion Charge

5.11 There are a variety of options for updating the existing Congestion Charge which are drawn from criticism of the present arrangements, technological advances and practices observed in other cities.

Removing exemptions

- 5.12 A large proportion of entries to the charging zone are made by vehicles which are exempt from the charge. These include taxis, PHVs, resident permit holders and vehicles which meet strict low emissions standards. Given the policy objectives and principles behind the implementation of congestion charging, and in recognition that all vehicles contribute to congestion, best practice in scheme design would point to there being as few exemptions as possible, ensuring that vehicles entering the Zone, and contributing to congestion within the central area are treated equally with respect to the financial implications of travelling into the Zone.

Charge for re-entry, not per day

- 5.13 An important and restrictive feature of the present Congestion Charge is that motorists pay a single-entry fee to allow all day access to the charging zone. Stockholm and Gothenburg have both found success in applying a charge each time the cordon is crossed. In Stockholm, this scheme resulted in a total reduction in traffic (including exempt vehicles) of 8-9% within the cordon, and reductions in both journey times and journey variability²⁸. In Gothenburg similar results were observed. A reduction of 12% in traffic crossing the cordon, 9% within the cordon (3-5% after accounting for reductions likely attributable to the introduction of bus lanes), and reductions in journey times and variability²⁹.

Variable pricing within the CCZ

- 5.14 The present flat rate charge for entry to the CCZ bears little relation to the individual vehicle contribution to congestion levels within the Zone, which may vary considerably according to time, trip pattern and level of activity (vehicle kilometres) undertaken within the Zone.
- 5.15 Charging could be varied by time of day, distance travelled within the Zone and by vehicle type or emissions level (as now being done under the new T-charge for the most polluting vehicles). A policy of variable charging could, for example, help to incentivise freight re-timing. It could also be used to greater effect in moving certain journeys to more sustainable modes of travel.
- 5.16 For example, Singapore uses an Electronic Road Pricing system which updates its charges every 30 minutes. The result is a real-time variable pricing system which charges road users for their own impact on congestion, meaning the charge is higher when congestion is higher.
- 5.17 The Land Transit Authority in Singapore has recently announced that it will be moving to a next-generation, satellite-based system, removing the need for physical gantries and allowing for a more sophisticated, distance-based charging system. Future road pricing schemes – in London or elsewhere – could also take advantage of this type of technology, which was not available when the Congestion Charge was introduced in 2003.

Case Study: Electronic Road Pricing (ERP) in Singapore

The ERP system in Singapore is an automatic toll system for charging cars which enter the city centre. It uses open road tolling – vehicles do not stop or slow down to pay tolls. The system has been updated with a traffic estimation and prediction tool (TrEPS), which uses historical traffic data and real-time feeds with flow conditions from several sources, to predict the levels of congestion up to an hour in advance. This technology can therefore implement variable pricing, as well as improved overall traffic management (similar to smart motorways in the UK).

Within the restricted zone itself, traffic has reduced by about 13%, while the hours of peak traffic seem to have spread into off peak hours, suggesting a more efficient use of road space. Speeds have remained fairly constant despite growing traffic volumes.

A device known as an In-vehicle Unit (IU) is attached to the car windscreen, and the payment card is inserted for payment of the road usage charges. The cost of an IU is \$150, and it is mandatory for all Singapore-registered vehicles to be fitted with one if they wish to use the priced roads.

Non-payment of the charges come with hefty fines and penalties (up to a month in prison if the fine is unpaid for a month).



Sources: Singapore Land Transport Authority

Wider road-user charging, with better technology and variable pricing

- 5.18 As we have seen, the majority of traffic volume and delay occurs in the outer areas of London which are unaffected by the scheme. The present congestion charging scheme covers only a small area of Central London and so can play only a minor role in managing congestion levels in London overall.
- 5.19 There have long been calls for a more dynamically variable congestion charging system in London than the current cordon system, originating with the 1964 Smeed report³⁰ and this year alone there have been several high-profile studies that have advocated a distance-based approach to road pricing, including by the Institute for Public Policy Research, the Wolfson Prize winning entry³¹, the London Assembly Transport Committee and most recently the Centre for London³².
- 5.20 Increasing levels of congestion and recognition of the wider costs associated with it (both economic and environmental), alongside new opportunities offered by evolving technology, make consideration of the merits of extending road or congestion pricing beyond the existing zone ever more pertinent. This new technology offers the ability to considerably nuance charges: by area, time of day and emissions level. At the same time, for the user, this could be expressed as an easy-to-understand weekly or monthly charge similar to bills for other services.

Table 5-2: Road user charging - intervention summary

Intervention	Commentary	Area of application	Co-benefits/ dis-benefits
Road user charging	<p>Review of existing charging scheme and consideration of exemption, removal, pricing policy, extension of charging zone</p> <p>Implementation of variable (distance-based) charging covering a greater area</p>	Central London, with development of proposals for widening beyond existing boundary to a London wide road pricing model	<p><i>Co-benefits</i></p> <p>Improved air quality, increased safety and journey quality for non-motorised modes</p> <p><i>Dis-benefits</i></p> <p>Equity impacts, business impacts</p>

Workplace parking levy

- 5.21 A workplace parking levy (WPL) is a charge on private off-street parking used by employees (levied on employers). Such a scheme is designed to reduce car based commuting through increasing the cost of commuting to work by car (indirectly through employer pass-through of costs) and reducing the supply of workplace parking as employers seek to reduce their liability from the levy.
- 5.22 London has had the legislative power to introduce a workplace parking levy since 1999 under the Greater London Authority Act³³. However, to date Nottingham has been the only city in the UK to introduce a workplace parking levy.
- 5.23 Evaluation of the Nottingham scheme has shown a reduction in available workplace parking places by 25%, with the levy costs on around 40% of the remaining places passed on to employees³⁴. Statistical analysis of the scheme impact has demonstrated a positive impact on congestion levels, despite background factors such as the construction of the tram extension and other roadworks seeing general congestion levels rising.
- 5.24 Recent research for the DfT found that Nottingham achieved the biggest reduction in per capita car traffic of any non-London English local authority, whilst the feared negative impacts on the local economy and inward investment have not transpired³⁴.

Case study: Nottingham’s Workplace Parking Levy

The workplace parking levy (WPL) was introduced in 2012 covering employers who provide 11 or more liable parking places. The charge commenced at £288 per space and now stands at £387 per space for 2017/18. With over 25,000 parking places liable for the levy, the scheme has generated over £44m in revenues since scheme commencement.

Levies are not applied to spaces available for customers, occasional business visitors, business fleet vehicles (not used for commuting) and discounts of 100% are applicable to Blue Badge holders, emergency service vehicles and qualifying NHS premises.

Revenues are ring-fenced by law to spend on transport initiatives, and proceeds have contributed to the financing of the city’s tram network, electric link bus network and redevelopment of the city’s railway station. Grants are available to businesses to encourage reduction in workplace parking through initiatives such as a cycling grant for showers and cycle facilities.



Source: Dale, S., Frost, M., Ison, S., Quddus, M., Warren, P., (2017). Evaluating the impact of a workplace parking levy on local traffic congestion: The case of Nottingham UK. Transport Policy, 59, 153-164. (Image source ITP)

- 5.25 Consideration of a workplace parking levy for London is not new. It is referenced in the draft Mayors Transport Strategy, and is being proposed by a range of bodies including the London Assembly Transport Committee and Sustrans.

Table 5-3: Workplace parking levy - intervention summary

Intervention	Commentary	Area of application	Co-benefits/ dis-benefits
Workplace parking levy	Implementation of WPL covering liable off-street employer provided parking spaces in London	Target trips are low occupancy car based commuting trips which are most prevalent in Outer London. Scheme feasibility is greatest in areas where on-street parking is regulated and charged for. Outer London Metropolitan Centres present the greatest opportunity	<p><i>Co-benefits</i></p> <p>Improved air quality, promotion of modal shift to sustainable modes, revenues generated to support further improvement to public and non-motorised transport.</p> <p><i>Dis-benefits</i></p> <p>Potential business impacts, equity impacts</p>

Freight strategy

- 5.26 In Chapter 3 we highlighted the growth of light goods vehicle movements on London’s roads. The numbers of deliveries have been increasing, reflecting the growing trend in online shopping, and the rise in self-employment and small business activity has seen growth in use of LGVs as commercial service vehicles. The growth in LGV and freight activity has been particularly significant in the outer areas of London.
- 5.27 Freight operators are typically strongly incentivised to increase efficiency as this leads to lower cost of operation. However wider market trends such as the increasing demand for same day or just-in-time delivery can run contrary to delivering efficient logistics. Also, whilst some of the larger delivery companies may easily implement efficiency measures, many smaller firms do not have the scale to pursue these measures.
- 5.28 TfL has pursued a range of strategies to reduce the impact of freight movements in its role as strategic transport authority for London, but there is scope to take a more pro-active role in developing a vision for the future of freight and logistics within London. The successful delivery of the Healthy Streets objectives will require further action in promoting physical, operational and behavioural changes.
- 5.29 **Physical measures** may include the construction of freight consolidation centres and distribution hubs and the introduction of flexible delivery spaces (for example pop-up delivery bays reserved through smart pre-booking). The potential for dedicated freight lanes or advance vehicle detection at junctions (in a similar way to that provided for public transport vehicles) could also be explored, prioritising freight movements on certain strategic corridors.
- 5.30 **Operational measures** pertain to the means and the timing of distributing goods, the vehicles used and the management of these movements. Increasing adoption of electric or hybrid electric vehicles reduces the noise levels of delivery vehicles (making night time deliveries more acceptable), further promotion and facilitation of human powered (and electric assisted) freight delivery and autonomous delivery vehicle technology (once the legal framework is in place) presents opportunities for last mile delivery.
- 5.31 Ultimately, better operational management of freight movements needs to be driven by smarter planning, which in turn needs to be underpinned by smarter data. Presently, there are gaps in the understanding of the emerging patterns which constrain TfL’s ability to provide strategic steer to

facilitate improved efficiency within the industry. There is a need for increased partnership with the freight sector and with the major commercial clients, and exploration of the ways in which data gathering and sharing could be of collective benefit.

- 5.32 Improvements in freight efficiency and changes to the way goods are delivered will not alleviate the growing demand. **Behavioural change**, both at a commercial and consumer level must form an important part of a future freight strategy for London. A change of mindset to include consideration of freight within mainstream travel planning rather than as a separate entity is also required. More widespread use and application of construction management and construction logistics plans will help to minimise the impact of the continuing construction and redevelopment work occurring in the city. Better freight practices can also be delivered through training, and further promotion of programmes such as the Construction Logistics and Community Safety (CLOCS) and Fleet Operator Recognition Schemes (FORS).

Table 5-4: Freight strategy - intervention summary

Intervention	Commentary	Area of application	Co-benefits/ dis-benefits
Freight strategy	<p>Physical measures</p> <p>Freight consolidation/ neighbourhood centres at different scales</p> <p>Freight lanes</p> <p>Pop-up delivery bays</p> <p>Operational Measures</p> <p>HGV detection trials to keep freight vehicles moving on key corridors</p> <p>Promotion of human powered freight deliveries</p> <p>Smart planning techniques to avoid unnecessary traffic</p> <p>Use of autonomous vehicles and robotics for last mile delivery</p> <p>Behavioural measures</p> <p>Forward planning tools for routing and vehicle assignment</p> <p>Smarter use and application of construction management and construction logistics plans</p> <p>Development of CLOCS and FORS training</p> <p>Embedding 'freight' in the wider sense into mainstream travel planning</p> <p>Targeted work with SME sector</p>	<p>Applicable to all areas of London. Focus on regulation of deliveries in Central London, development of consolidation for different types of location (Central, Inner and Outer London) and highly pressured suburban centres</p> <p>Freight consolidation is particularly applicable to Outer London areas which have seen the greatest growth in freight activity</p>	<p><i>Co-benefits</i></p> <p>Reduced emissions, improved safety</p> <p><i>Dis-benefits</i></p> <p>Business impacts, employment impacts</p> <p>Impacts on residential amenity</p>

Smarter choices / Mobility management

- 5.33 Mobility management relates to the influencing of travellers to make efficient decisions regarding the way that they travel. This includes increasing awareness about alternative travel options, providing information on travel conditions to allow effective routing and journey timing decisions through to providing actual incentives to encourage those who are able to change their travel patterns to do so.
- 5.34 Smarter choices programmes fall within this category and these programmes have been pursued in areas within the UK under the DfT funded Sustainable Travel Towns Programme for example. National research suggests that such approaches can reduce car based travel demand by 14%-18%³⁵, provided it is well targeted, over a sufficient time period, with significant investment, and allied to a package of measures which manage the demand for car use through progressive provision and pricing of car parking. These packages may include a broad range of interventions covering:
- Car sharing - can have a big impact if delivered systematically, and alongside infrastructure that supports multi-occupancy car use (dedicated workplace parking for car-sharers, for example). There is significant potential associated with large employment sites.
 - Workplace travel planning - learning from the most recent lessons of LSTF programmes and targeting investment in long term changes in behaviour at key employment sites, using a combination of 'push' measures, such as parking restraint, and 'pull' measures, such as improved workplace cycle parking. Significant investment would be required to deliver an effective behaviour change campaign working with major local employers.
 - Education travel planning - can sit at the heart of local network improvements, through reducing car use associated with the school run. Successful programmes seek to genuinely learn and adapt to ensure sustainable outcomes are 'locked in'.
 - Station travel planning - all stations should be audited and assessed to ensure proper provision is provided for sustainable access, and once networks are in place, intensive behaviour change programmes using Personalised Travel Planning (PTP) (see below) for example, and other techniques, can be deployed in local communities.
 - PTP – is a technique used to influence change at the community level using targeted sustainable travel information to enable people to think about the way they currently travel and to consider walking, cycling and using public transport more often. Ideally scheduled alongside infrastructure changes (such as new bus services), PTP has the ability to influence all trip types.
- 5.35 Additionally, where traffic disruption is caused by private sector works, there is the possibility to fund incentives through the requirement for the developer to allocate funds to be used to negate some of the impact caused by the works being undertaken.

Case study: Dutch Mobility Management – Minder Hinder

The Dutch ‘Minder Hinder’ (reduce nuisance) programme adopts mobility management measures as one of 7 pillars of intervention, in the pursuit of reducing the impact of roadworks on travellers.

7 Pillars	
1. Smart planning (No roadworks on alternative/parallel routes, combine roadworks where possible, use low traffic periods)	7. Regional co-operation
2. Smart construction (Contractors required to demonstrate how they will prevent or mitigate traffic jams, phasing/temporary roads, flexible systems)	
3. Mobility Management (Influencing travel behavior of motorist)	
4. Efficient traffic management (Active network management, incident management)	
5. Communication (Planning details – help decisions, story-telling – what’s happening and why, multiple channels)	
6. Public-oriented execution (Logical road signing, clear visibility, user satisfaction questionnaires)	

Within the mobility management category, the objectives are to facilitate behavioural change and encourage motorists to:

- Re-time journeys (change the time of travel);
- Re-mode (consider switching from car based trips to other modes);
- Re-route (choose different travel routes to avoid congested areas); and
- Remove (consider not travelling at all – for example working from home).

Measures to encourage the above changes in travel patterns include investment in additional public transport at times when roadworks are expected to impact on journeys and the offering of incentives to motorists for making changes to their journeys. These incentives have included, for example, shopping vouchers or discounts on showing of public transport tickets through to direct financial incentives gained by not travelling on a usual route, with eligibility established through ANPR camera monitoring.

Source: <http://www.minderhinderplatform.be>;
<http://www.highways-uk.com/content/huk/docs/ib1-improving-customer-experience-during-roadworks.pdf>

Table 5-5: Mobility management - intervention summary

Intervention	Commentary	Area of application	Co-benefits/ dis-benefits
Smarter choices / mobility management	Encourage travellers to ‘re-time, re-mode, re-route, remove’ journeys through smarter choices programmes and provision of tangible incentives to change travel behaviour	Particularly applicable to areas with higher car usage, and as a targeted measure to minimise the impact of planned disruption	<p><i>Co-benefits</i></p> <p>Reduced emissions, positive economic benefits</p> <p><i>Dis-benefits</i></p> <p>Potential business impacts of financing incentives programme</p>

Understanding and regulation of the PHV sector

5.36 The rise in PHV activity and use within London has been one of the important trends observed within the pattern of traffic composition in recent years. Analysis of the traffic data highlights

gaps in knowledge regarding the nature and scale of PHV activity, particularly within the Inner and Outer London areas.

- 5.37 Increasing accessibility to, and the falling cost of, MaaS (Mobility as a Service) represents an important new market trend and brings new opportunities in terms of reduced reliance on private vehicle ownership, and with it a reduced need for parking provision. This change also potentially brings new challenges in the form of increased vehicle activity and potential abstraction of public transport trips. Looking to the future, the rise in autonomous vehicle use has the potential to significantly reduce the cost of personal mobility and thus increase demand on the congested road network.
- 5.38 In London, PHV operators are required to apply for a licence and meet certain licensing standards. The number of licensed PHV drivers and vehicles has grown rapidly, unlike taxis which face higher barriers to market entry due to the requirement to pass ‘The Knowledge’ and the cost of investment in taxi vehicles. There have been calls for tighter regulation of PHV operations, and a limit on the number of operators as in many other cities, to avoid the market being flooded with capacity, on the assumption that oversupply would have adverse impacts on congestion.
- 5.39 Whilst the merits of limiting PHV numbers or tighter regulation of operations may be debated, there is a need to ensure that the appropriate regulatory framework is in place to be able to effectively manage quality standards within the sector and monitor PHV activity within this rapidly evolving market, both now and in the future. This will provide the flexibility going forwards to ensure that private hire services operate in a way which does not undermine or cause undue impact to the efficiency of the London network.
- 5.40 Being able to access or to collect the necessary data to effectively regulate service provision should form part of the regulatory powers.

Table 5-6: PHV regulation - intervention summary

Intervention	Commentary	Area of application	Co-benefits/ dis-benefits
PHV regulation	Review regulatory framework to ensure appropriate mechanisms are in place to regulate standards and monitor PHV activity within the city	Applicable to all areas of London, with flexibility in the framework to tailor regulation to the demonstrated needs and issues within different parts of London	<p><i>Co-benefits</i></p> <p>Support of public transport service sustainability, reduction in air pollution</p> <p><i>Dis-benefits</i></p> <p>Business impacts, employment impacts, accessibility for disabled people, alternative to car ownership for lower income groups</p>

Supply side interventions

- 5.41 The creation, allocation, management and maintenance of highway space which is made available to road users all form part of the supply side element of the congestion equation.
- 5.42 TfL invests significant sums in tools to ensure the active management and optimisation of traffic flows on the network. In recent years, changing patterns of road space allocation and prioritisation of public transport, walking and cycling have had significant journey quality, reliability and overall journey experience impacts for these modes, making sustainable travel more attractive and contributing to the modal shift targets set out within the strategic vision for travel in London.

- 5.43 Notwithstanding the above, it is recognised that the management of the limited available road space and prioritisation of use between different users entails trade-offs. The historic policy of constructing new infrastructure to keep pace with growing demand has now been recognised to lead to inevitable failure as induced demand quickly fills the newly available capacity, with adverse impacts on the city in terms of journey time reliability and quality of life.
- 5.44 Our consideration of supply side interventions therefore focuses on the more efficient management and prioritisation of the use of the available road space.

Network management

- 5.45 TfL operates a range of network management tools including a system of adaptive traffic signals (with over 5,000 of the 6,000 on the strategic network equipped with SCOOT technology) and the London Streets Traffic Control Centre (LSTCC) from which traffic conditions can be monitored and responded to in real time by means of a network of cameras.
- 5.46 Technology sits at the centre of maximising the effective use of limited road space and significant investment has been made in recent years, with further programmes planned. The Surface Intelligent Transport System (SITS) Programme sees the replacement and upgrading of TfL’s current systems and data capabilities for traffic signal control and incident management, and development of methods of managing traffic through better analytical tools, predictive planning and better information sharing between agencies.
- 5.47 In addition to investment in new technology, effective maintenance of existing systems also plays an important role in maintaining standards of performance. As traffic profiles change, signal timings can become outdated and operate sub-optimally. Pressure on budgets can mean routine maintenance is overlooked amidst other spending priorities.

Table 5-7: Network management - intervention summary

Intervention	Commentary	Area of application	Co-benefits/ dis-benefits
Network management	Continued investment in technology to enhance efficient management of highway network Prioritisation of regular maintenance of existing systems to ensure optimal operation	Central, Inner and Outer London	<i>Co-benefits</i> Improved road safety Emissions savings <i>Dis-benefits</i> None

Roadwork co-ordination and management

- 5.48 Roadworks have been identified as a significant contributory factor to traffic congestion. In the recent period, a programme of major public infrastructure works, paired with the upturn in construction, both commercial and residential, in the post-recession (and post-Olympic games) period has seen higher numbers of roadworks, and greater impacts of these large-scale works. In relation to increased construction activity, travellers may experience disruption both from the physical works, where these extend onto the pavement or highway, and also from construction traffic which has distinctive and atypical patterns with regard to stopping and loading.
- 5.49 TfL already implements a Lane Rental Scheme designed to ensure roadwork scheme promoters are faced with the wider impacts of their activities to society. This scheme encourages the conducting of roadworks at off-peak times or overnight (or to discourage them altogether) by charging those carrying out works up to £2,500 per day for working in the most congested areas or at peak hours.

- 5.50 The number of planned utility works taking place overnight on the highway sections covered by the Rental Scheme has increased from 11% to 42% since scheme inception³⁶. Annual monitoring of the scheme has highlighted benefits including increased collaborative working, increased night time working and falling levels of frustration reported due to repeated roadworks on the same stretch of road. This scheme only applies however to a relatively small proportion of London’s roads.
- 5.51 Works are also subject to permitting under roadwork permit schemes operated by TfL and the boroughs, to ensure that they can be co-ordinated to reduce disruption as much as possible. TfL’s Permit Scheme has been in place since 2010 and TfL estimates that over 500,000 permit applications are made each year, with the authorities having the power to pro-actively manage when roadworks will take place and under what form of traffic management arrangements.
- 5.52 It is recognised that there is potential for further enhancement in the co-ordination of roadworks, and whilst construction activity and roadworks form an important component in supporting London’s growth, better understanding of the impact caused by these works, and the potential for mitigation through better co-ordination and retiming of works, would allow permit issuing authorities to make the most informed decisions in the issuing of permits, balancing the needs of utilities and the construction industry with that of travellers.

Table 5-8: Roadwork co-ordination and management - intervention summary

Intervention	Commentary	Area of application	Co-benefits/ dis-benefits
Roadwork co-ordination and management	<p>Evaluation of Lane Rental and Permit Scheme effectiveness and equipping of permitting authorities with the analytical tools required to make optimal decisions on roadwork scheduling and traffic management</p> <p>Consideration of extension of Permit Scheme to cover Highways Act licensed activities including skips, cranes and scaffolding, subject to necessary legislation being enacted</p>	All areas, with quantification of impacts on an area by area basis to allow tailored decision making	<p><i>Co-benefits</i></p> <p>Improved road safety Emissions savings</p> <p><i>Dis-benefits</i></p> <p>None</p>

Parking policy and regulation

- 5.53 Parking regulations and parking pricing play an important role in ensuring that the highway network is able to operate efficiently and also as a demand management tool. Regulation and enforcement of existing parking provision falls to the London Boroughs, other than provision on the TLRN. Guidance related to the provision of parking in new developments also represents an effective means of influencing travel behaviour and car ownership patterns.
- 5.54 In Central London, parking is both tightly regulated and highly priced. However, free on-street parking becomes more commonplace in the outer areas of London and, with the exception of the larger urban centres, regulation on parking is less restrictive. Parked vehicles take space which has a value and the potential to be used for other purposes. Therefore, other than parking

on private property, the availability of free car parking for car users may be viewed as an implicit subsidy to car travel.

- 5.55 London authorities have in place a range of parking policies, including Controlled Parking Zones (CPZs) which limit parking at certain times and in sensitive areas³⁷. These can assist in reducing car use as a main mode for work or to access public transport services (e.g. train station parking).

Case study: School Parking Enforcement

Recent trials in various London Boroughs have made it a fine-able offence for parents to park in the controlled parking zone around certain schools at peak times. The London Borough of Havering was the first to launch this type of scheme, in November 2016, administered through a PSPO (Public Space Protection Order). The Order prohibits parking in the zone around certain schools between 8-9.30am and 2.30-4pm. This is enforced by Council Enforcement Officers, but also through CCTV and ANPR. Offenders may be fined £100, but anyone who commits three or more offences could receive a £1000 fine and a criminal record.

The aim of these schemes is to improve child safety around the school, both from risk of being hit by cars and from air pollution, and to encourage active travel to school, either by walking or cycling, or parking slightly further from the school and walking the remainder of the journey.

Exemptions are available for disabled children or children with other needs which might necessitate parking near the school. Residents' parking is also not affected. Although the schemes have largely been successful and supported by parents, teachers and local residents, there have been some more negative views. The scheme has brought some issues for working parents in changing their schedules and therefore making access to their workplace slower or more difficult.



Sources: <http://www.express.co.uk/news/uk/772312/London-school-parking-punishment-fine-criminal-record-parents-school-run>
https://www.haverling.gov.uk/info/20004/parking/121/parking_tickets_and_traffic_fines/5

- 5.56 Looking forward, patterns of falling car ownership supported by an increasing reliance on MaaS offers great opportunity for a reduction in the scale of parking required. Evolving technology, including the growth in electric vehicle numbers and the rise in autonomous vehicles may however change the nature of parking provision requirements.
- 5.57 In response to changing technologies, new technology must equally play a major role in effective management of parking supply. Vehicle detection is already being adopted to more effectively manage available parking supply, and better information dissemination on the extent and location of available spaces will reduce circulating time.
- 5.58 A strong case can also be made for using newly introduced technology not only to dynamically manage the supply of parking, but also to manage demand through variable charging at different times of the day.

Table 5-9: Parking policy - intervention summary

Intervention	Commentary	Area of application	Co-benefits/ dis-benefits
Parking restrictions, pricing, and enforcement	<p>Review of parking strategy and enforcement</p> <p>Reduce car parking provision over time</p> <p>Introduction of dynamic parking management.</p> <p>Consideration of variable pricing of parking</p>	Principally relevant to Inner and Outer London Areas	<p><i>Co-benefits</i></p> <p>Reduced emissions if modal shift achieved</p> <p><i>Dis-benefits</i></p> <p>Potential business impacts, accessibility for disabled people</p>

Prioritisation of bus

- 5.59 In London, buses, carry almost as many trips as underground and overground rail combined. In terms of road based transport, bus ranks highly in efficiency terms, providing flexible and space efficient mass transit to all parts of the city. With the tube network increasingly congested at peak times, and extensions to the underground and rail networks expensive and with long lead times, the bus is an important mode in alleviating congestion.
- 5.60 In recent years there has been significant commitment to improving bus infrastructure (including bus lanes and bus priority), but increasing congestion represents a risk to the efficiency and effectiveness of the bus network. Continued investment is needed to ensure the bus represents an attractive alternative to private car use. This is important not only for passengers, but also in operational terms to ensure that subsidy requirements remain manageable going forward. Bus journey times have been increasing in recent years, reflecting in part the increase in roadworks as a result of the Roads Modernisation Plan. This has a double-whammy impact, reducing operational efficiency resulting in increasing costs, and loss of patronage, and hence revenues, as journeys become less attractive.

Improving the adaptability of the bus network

- 5.61 Investment and innovation in the bus sector is vital in improving congestion in London, as it is the only public transport mode which is easy (and relatively cheap) to build capacity with. It is even more vital in Outer London as it is able to compensate for the lack of orbital train links, replacing what might otherwise be car trips.
- 5.62 However, buses face increasing competition from other transport modes (including app based PHVs). To respond to this, the bus network planners and operators must continue to innovate, not only in terms of bus technology (as observed through the introduction of hybrid and electric buses) but also through the level of service provided.
- 5.63 Recently, an app company has started to run bus services which aim to fill gaps in TfL’s current network. Whilst there is a danger that this will begin to remove passengers from the existing TfL network if it is able to grow, there may also be lessons to be learned from how these gaps are identified, and how quickly they can be filled in order to ‘capture’ users who might otherwise shift to PHV services. The current TfL bus route tendering process may not be responsive enough to cope with the rapidity of growth and change of passenger flows in today’s London, and into the future.
- 5.64 Re-evaluating the way new bus routes are planned must also look at how people are using cars. In Outer London there may be potential for express bus services which run between metropolitan hubs with few stops between, effectively creating an orbital public transit system.
- 5.65 This increasing adaptability may also encompass using a broader range of bus types and sizes, from minibuses to bendy buses, to ensure that the space that is required is being utilised

efficiently. Running frequent but shorter routes with smaller buses might better fulfil passenger requirements during peak times. Furthermore, the re-introduction of bi- or tri-articulated buses (particularly outside of Central London) might represent a positive addition to bus capacity on high-patronage routes.

Table 5-10: Prioritisation of bus - intervention summary

Intervention	Commentary	Area of application	Co-benefits/ dis-benefits
Prioritisation of bus	Maintain investment in bus priority measures, with consideration of innovative bus pilot schemes and high-quality bus routes where feasible, including areas of new development.	Applicable to all areas, but improvements in bus service quality of particular importance in areas with higher car usage, and opportunity for new transit corridors greater in areas with significant new development	<i>Co-benefits</i> Reduced emissions if modal shift achieved <i>Dis-benefits</i> Safety for non-motorised modes, particularly people cycling, trade-off in road space allocation between bus and NMT

Land use and Transit Oriented Development

- 5.66 Land use planning can play a key role in the generation of travel demand and in influencing travel patterns. As London grows and areas are developed and redeveloped to meet new housing and commercial needs, there is significant opportunity to 'design in' the foundations of sustainable travel.
- 5.67 The above measures have principally focused on improving *mobility* through improving journey conditions, allowing people to travel faster and hence further within a given time. Land use planning offers the potential to improve *accessibility* by ensuring that the facilities, services, activities and opportunities which people desire are located within close proximity.
- 5.68 London's new development sites should be designed to minimise the need to travel to access key facilities. Where trips are necessary, the developments should be well served by public transport and also have good walking and cycling facilities to promote active travel opportunities.

Table 5-11: Transit Oriented Development - intervention summary

Intervention	Commentary	Area of application	Co-benefits/ dis-benefits
Transit Oriented Development	Ensure that new developments are planned to minimise the need to travel and that they are served by sustainable and active travel options with limited car parking spaces	All areas with new development	<i>Co-benefits</i> Reduced emissions if modal shift achieved <i>Dis-benefits</i> None

Summary: Intervention options

In this chapter we have explored areas of intervention which are most relevant in responding to trends observed in recent years, mitigating their impact on levels of congestion within the city, and being prepared for the anticipated patterns of the future, and the demands that they may place on the network.

The next chapter translates this discussion into a series of specific and targeted recommendations, with allocated responsibilities and proposed timelines for implementation.

6. Conclusions and recommendations

- 6.1 London has recently experienced a pattern of increasing congestion, a trend mirrored in other major cities within the UK and further afield. The driving factors behind this trend are multi-faceted, comprising both a change in traffic composition and in the way in which vehicles are used and are managed within the road space.
- 6.2 In different areas of London, the challenges differ. Whilst Central London has the lowest absolute vehicle speeds (and thus arguably the worst congestion), this is experienced by very few vehicles, with the vast majority of trips being undertaken by public transport. Private car use is much greater in the outer parts of London, with the greatest overall delays experienced in these parts, reflecting the higher number of trips impacted.
- 6.3 As London grows, the need for the transport network to serve an ever-increasing number of travellers and trips necessitate continual progress towards more effective use of the available road space, to meet mobility needs most efficiently, and where possible to reduce the need for travel by ensuring accessibility to services and opportunities through effective land use planning.
- 6.4 Transport policy has evolved in recognition that attempting to 'solve' vehicle based congestion through increasing network capacity (whether physically or through enhanced management) is ultimately self-defeating. Generated traffic will fill the available capacity until the self-limiting equilibrium is reached, with overall congestion increased as a result of more vehicles experiencing the delay. In turn, some level of traffic congestion is recognised as an inevitable and necessary corollary of a successful city.
- 6.5 With this insight, policy has shifted to focus on the individual, with the transport network playing its role in contributing to people's welfare, in ensuring accessibility to services and activities of value to the traveller, but also in contributing to the health and wellbeing of the population by ensuring a safe, clean and calm environment in which to live, work and play.
- 6.6 The draft Mayor's Transport Strategy is the embodiment of the new policy approach to transport provision and the strategy places emphasis on delivering health and wellbeing to the population. To achieve these objectives, emphasis is placed on:
- Further investment and prioritisation of public transport to facilitate increased modal shift to public transport;
 - Provision for and promotion of active travel modes; and
 - Reduced traffic on London's streets to support the Healthy Streets approach.
- 6.7 The recognition that often congestion alleviation measures, whilst effective in the short term, will lead to further traffic generation and a loss of impact over the longer term, provides strong reason to pursue policies which will have lasting impact and which will serve to achieve the wider policy objectives.

Recommendations

- 6.8 Below we set out the recommendations of this study, reflecting the analysis conducted, the identified causes of congestion and examination of the intervention options.

Efficient use of road space

- 6.9 Under the pressures of increasing demand for limited road space, the strategic focus for managing congestion should be on ensuring the allocation of this space to the most space-efficient means of mobility. Walking and cycling represent highly space-efficient forms of travel over shorter distances whilst the bus outperforms other road based modes of passenger transport in terms of space utilised. Accordingly, allocation of road-space for active travel and public transport modes provides a strategic long-term solution in an environment of limited road

space, with little prospect of highway expansion, representing a more space efficient means of moving people than low-occupancy vehicles.

Recommendation 1

Prioritise the efficient use of space in the allocation and re-allocation of road space. The most space-efficient means of moving people – walking, cycling and public transport – should be prioritised over low-occupancy private transport.

Road user charging

- 6.10 London's road space is valuable, and maintenance and investment in technology to effectively manage the road space is costly. Additionally, there are opportunity costs in devoting such a high proportion of this valuable land to transport. Beyond the Congestion Charging Zone, use of road space is rationed principally through congestion itself, incurring high social cost in terms of lost time, vehicle operating costs and emissions. Looking forward, the cost of congestion is expected to continue to rise as ever-increasing demands are placed on the network.
- 6.11 The ability to appropriately price road use to reflect these wider societal costs, with variable charging according to time and distance travelled, will promote more efficient decision making by those using the road. It is also wholly consistent with the wider transport strategy objectives of promotion of active travel and use of public transport, and is vital to ensuring the future London transport network can accommodate the projected growing demand.
- 6.12 Pricing of road use as a means of managing demand will also become increasingly important as we approach the age of driverless vehicles, with the internal cost of road use expected to fall further in the absence of a driver.
- 6.13 The implementation of the Congestion Charging Zone back in 2003 represented a paradigm-shift in the way in which traffic levels could be managed in Central London. Although ground-breaking in its time, the scale of exemptions and the restrictive nature of the cordon charging approach and the flat rate charge are identified limitations of the present scheme. Addressing these areas presents opportunity for more effective management of demand and congestion in the city centre, and we recommend that changes to the scheme are made. However, the spatial coverage of the charging zone is very small, and has little influence in relation to vehicle activity across the London road network.
- 6.14 To effectively manage demand and improve congestion levels in London, the majority of which is experienced in Outer London, a road user charge needs to cover the whole of London. The revenue streams generated will enable further investment in managing and maintaining the road network and improving active travel and public transport provision.
- 6.15 In the interim period before London-wide distance based pricing is implemented, short term measures can be taken to improve the effectiveness of the existing Congestion Charge. The proportion of charge exempt vehicles entering the Zone limits the effectiveness of the charge and has an adverse impact on conditions within the Zone for those paying the Charge.
- 6.16 In a similar vein, and in light of the increasing proportion of exempt vehicles entering the Zone within the taxi and private hire sector, the offering of this exemption must be reconsidered.

Recommendation 2

Adopt the policy of introducing variable, distance-based road user charging at a London-wide level. A scheme should be designed to optimise its air quality, carbon and congestion benefits, while giving due regard to equity impacts. Revenue from the scheme should be used to improve public transport, walking and cycling.

Recommendation 3

Review the present Congestion Charge exemptions and discounts, removing them unless their social value strongly outweighs the adverse impact that exempting vehicles has on congestion levels in the Zone.

Land use / Transit Oriented Development (TOD)

- 6.17 Reducing the need to travel will be essential for managing the demands of a growing London population. Bringing services, activities and opportunities closer to those living in London as an integrated part of the planning of new development will reduce the burden on the transport network. Ensuring good access by foot or cycle infrastructure to local services, and good connections to the public transport network for necessary longer trips will reduce reliance on private vehicles.

Recommendation 4

The London Plan should focus new residential development in areas with excellent public transport, and support high quality, high density developments with low or zero parking in these locations. In areas without excellent public transport, development should not take place until appropriate public transport and active-mode facilities have been committed. All new residential development should include high quality facilities for people walking and cycling to access local centres. Investment in public transport must continue so that as population and employment-levels grow, public transport becomes a more attractive option than private car use wherever possible.

PHV regulation

- 6.18 The rapid growth in the PHV market has brought new travel opportunities in London. While there is potential for this sector to further reduce the need for car ownership, there is also a danger that their relative affordability and ease of use will lead to increased car vehicle kilometres and ultimately congestion. The advent of autonomous vehicles in the future and the potential further growth in the PHV market this may generate is a further factor here
- 6.19 To respond to these changes effectively, it is important to understand more about how PHVs (and indeed taxis) are used. PHV operators (and CAV operators) must however be subject to appropriate regulation to ensure safety of travellers and to ensure that the nature of operations do not cause undue detrimental impact on other users of the network.

Recommendation 5

Review the present regulatory regime for PHVs, including a potential change to the law to allow TfL the power to limit the number of vehicles licensed.

Prioritisation of bus

- 6.20 Buses serve as the flexible backbone of public transport in London. As the principal form of road based passenger transport, and with a wider coverage than other forms of public transport, congestion presents a particular risk to the level of service offered by the bus network.
- 6.21 Within the wider context of movement of people within limited road space, buses are able to transport people with much greater efficiency than the private car, and with the relative modal share of trips carried by bus, declining service levels present a risk not only to bus users but to all travellers. Increasing modal shares for public transport forms a vital component of avoiding a deterioration in traffic levels for all road users as underlying demand for the road space increases. Past programmes of bus priority have provided some protection to services from general congestion levels. In the context of traffic reduction under the Healthy Streets

approach, it is important to ensure that buses are protected from variable traffic delays wherever feasible to do so, by such measures as bus lanes, signal priority and the creation of low-traffic environments.

- 6.22 London's bus network patronage growth has been a success story of recent years, driven by investment. Bus provides the flexibility to respond to the rapidly changing face of the city in a way which rail based modes cannot. This flexibility extends to the ability to tailor services to the needs of different markets, for example the operation of express services or on demand services. New entrants are demonstrating innovation in service provision, which if popular, could serve as a model for other routes.
- 6.23 High quality bus based transit routes such as Fastrack in the Thames Gateway also provide a model for maximising the attractiveness of bus. The implementation of further pilots providing high quality public transport coverage and demonstrating innovative approaches to bus based travel could therefore be warranted.

Recommendation 6

Continue with the delivery of bus priority schemes to support reliability of bus journey times and implement pilot schemes to explore the impact and attractiveness of express service operation, bus rapid transit and demand-responsive services on appropriate corridors.

Parking policy and regulation

- 6.24 Parking represents an integral component of road use, and an important tool in the effective management of road usage and network management. The provision of parking has important implications for the wider use of the network, influencing demand patterns and also potentially contributing to vehicle activity through circulation for spaces.
- 6.25 Within a space-constrained environment, the provision of free or under-priced parking represents an implicit subsidy to private vehicle use. Restriction of parking availability and appropriate charging for the space occupied can be effective tools in the management of demand (and hence traffic conditions) and in the promotion of wider strategic objectives. Better management of existing spaces also offers the opportunity to identify underutilised resources and to reallocate space to more efficient and desirable uses.
- 6.26 The success of the workplace parking levy in Nottingham, in reducing peak period congestion and also in generating revenue streams which can support further transport investment, provides a roadmap for development of London based schemes.
- 6.27 In order to achieve greatest impact, the scheme should be introduced initially in areas with regulated on street parking (or alongside such regulation being introduced), in urban centres which exhibit a high proportion of car based commuting and which are well served by public transport. Metropolitan Centres outside Central London such as Bromley, Croydon, Hillingdon, Ilford and Sutton are likely to offer strong potential for successful WPL schemes, reflecting the combination of peak period congestion observed and car based commuting patterns, but also a supporting framework of regulated on-street parking and good public transport links.

Recommendation 7

Implement workplace parking levies in Metropolitan Centres or borough-wide.

- 6.28 The management and regulation of parking provision, and appropriate pricing of parking must complement other measures related to the effective use of road space. Policies also need to be appropriate for the evolving nature of usage brought about by changing vehicle technologies and car usage patterns. Over time, and to support declining private vehicle usage, more emphasis should be placed on the quantum of parking supply, and steps taken to actively reduce supply over time.

Recommendation 8

Consider how parking is charged for on the TLRN. Boroughs should adopt a policy of reducing on- and off-street car parking supply over time, in line with their traffic reduction strategies.

Recommendation 9

Adopt variable pricing of parking supply and use of vehicle sensing technology in order to better manage existing parking space.

Freight strategy

- 6.29 The changing nature of trade and the rise of e-commerce has driven a marked increase in freight activity. Light goods vehicle kilometres have been increasing annually, a trend which has been particularly prevalent in Outer London. Further growth is to be expected, driven by the needs of an increasing population and as a by-product of London's continued economic growth and consumer needs.
- 6.30 It is in the interest of logistics companies to optimise efficiency. However, increasing congestion frustrates this objective, requiring greater numbers of vehicles to offset falling productivity. Co-operation and partnership between the freight sector, commercial clients, the boroughs and TfL is therefore in the common interest. As the transport authority and regulator, TfL is able to take a strategic approach and to facilitate sector reforms which would not be achievable by industry alone.
- 6.31 There is scope to further embrace, promote and advance evolution in the sector with freight consolidation centres paired with last mile possibilities brought by cycle delivery and use of technology.
- 6.32 Goods vehicles are classified and disaggregated within most traffic datasets. However, the more detailed nature of trip patterns or chains and nature of the travel activity which takes place within London is not well understood, limiting the ability to plan strategically. Partnering and closer co-operation with the freight sector and industry offers opportunity for co-ordination to realise operational savings for businesses, improvements in service for customers and a reduction in emissions and wasted van kilometres for London's road users overall. Robust data and understanding of activity is key to achieving these strategic goals.

Recommendation 10

Develop a London-wide integrated system of consolidation centres to meet both strategic and localised freight needs, developed in partnership between the public and private sectors. Through the London Plan and specific Borough Local Plans, industrial land and other appropriate development sites in Central, Inner and Outer London should be safeguarded for consolidation activity.

Recommendation 11

Support last mile delivery with the use of innovative, sustainable transit techniques according to the location, type of goods being conveyed and land use activities. This will include cycle freight, electric vehicle, and (in future) autonomous vehicle solutions (once legal framework issues have been resolved and successful trials undertaken) according to the suitability of local circumstances.

Recommendation 12

Explore potential for freight-only lanes or prioritisation of freight through advance vehicle detection to reduce journey times on key freight corridors, aligned with distribution hub/consolidation centre locations.

Recommendation 13

Expand the use of localised or borough-based Quiet Deliveries schemes across London to optimise off-peak, evening and, where appropriate, night-time deliveries (with separate planning, environmental and highways approvals where these are required).

Smarter choices / Mobility management

- 6.33 Changing where, when and how people travel will be an important aspect of maximising the utility of the existing network. National and international trials have proven that communication, information provision and incentives to change travel behaviour have a positive impact and that changing the behaviour of even a small proportion of travellers can have tangible decongestion benefits. Smarter choices programmes have been pursued by TfL and by the boroughs, whilst case study evidence from abroad offers examples of taking mobility management further through the incentivisation of desirable travel choices.

Recommendation 14

Use Smarter choices-type programmes to promote sustainable travel choices and consider a pilot incentivisation programme which provides positive incentives to change travel behaviour in areas with high car dependence.

Network management

- 6.34 Continued investment in intelligent traffic management technology will facilitate further efficiency gains in effective use of existing road space. However, as well as new technology, existing systems must be maintained and their performance regularly reviewed. Traffic signal timings lose calibration over time, and when budgets come under pressure, routine maintenance can be an early casualty.

Recommendation 15

Make further investment in intelligent traffic management including the Surface Intelligent Transport System.

Recommendation 16

Ensure the programme of routine maintenance and retiming of existing traffic signals remains a priority.

Roadwork co-ordination and management

- 6.35 An inevitable cost of being a thriving world city, and a place in which people want to live and do business is the ongoing level of construction activity and utility works required to meet the needs of this continued growth. Roadworks and construction activity have been identified as a major contributor to the 'non-recurrent' disruption on the network.
- 6.36 The Lane Rental and Permit schemes are in place to exercise control over the timing and management of the roadworks, and to ensure that the wider impacts are in some way reflected in the decision-making by scheme promoters. Permit schemes offer the potential to influence the

co-ordination of works, the timing of works (for example avoiding peak times) and the nature of traffic management which should be adopted. To make optimal decisions, the permit authority needs a strong evidence base on the relative impacts of different timing and management options.

- 6.37 Further, there is a strong feeling amongst stakeholders that improved co-ordination of works and closer partnership between TfL, the London Boroughs and scheme promoters has the potential to further minimise the impact of works.

Recommendation 17

Continue to actively use permit schemes to manage roadworks and review whether the application of conditions could be used to further reduce the impact of works. Evaluate whether fixed penalty notices provide sufficient incentive against offences, with amendment to legislation to increase penalties if required.

Recommendation 18

Consider using the current provisions within the Highways Act 1980 to extend the use of permit schemes to skips and scaffolding placed in the highway.

Recommendation 19

TfL should retain its lane rental powers and consider extending the Lane Rental Scheme to the London Boroughs where appropriate.

Network monitoring

- 6.38 The range of commonly used measures of congestion has been outlined in this report and their shortcomings discussed. The narrow scope of network performance measures, which focus only on motorised vehicle speeds, cannot adequately capture how well the network is serving the full range of users, and should not form the basis for monitoring performance.
- 6.39 Our research has also identified shortcomings in data availability to allow a comprehensive understanding of the evolving travel trends, particularly with regard to PHV and freight movements. Understanding these travel patterns is essential to effective planning and management of the network.

Recommendation 20

Develop new congestion indicators covering cycling and walking, and to measure person-based delay.

Recommendation 21

Disaggregate between private cars and private hire vehicles in the reporting of traffic data from ANPR cameras, so that trends in PHV mileage, and their contribution to traffic growth, can be understood.

Recommendation 22

Collect information from taxi and PHV operators on the usage of these vehicles.

Summary of recommendations

6.40 The table below provides a summary of the recommendations, stating the proposed areas in which implementation is proposed (Central, Inner or Outer London), the timescale, and the party required to take the lead on delivering the recommendation.

Recommendation	Area of Application	Timescale	Responsibility	
<p>Efficient use of road space</p> <p>A long-term, strategic plan is required to resolve London’s congestion problems, and the evidence collated and analysed for this study shows that this must focus on the allocation of London’s limited road space to the most space-efficient means of moving people – walking, cycling and public transport. Pressure on public space is especially great in Central London, parts of Inner London and in town centres, but as the population continues to grow, this will increase across all parts of the city. To reduce congestion now and avoid new congestion problems arising in the future, the only strategic, long-term solution is for London’s public street space to be managed in the most space-efficient way possible.</p>				
1	<p>Prioritise the efficient use of space in the allocation and re-allocation of road space. The most space-efficient means of moving people – walking, cycling and public transport – should be prioritised over low-occupancy private transport</p>	<p>Central, Inner and Outer London</p>	<p>Short (1 to 3 years), medium (5 to 10 years) and long term (10 years +)</p>	<p>The Mayor, operating through TfL, and the London Boroughs</p>
<p>Road User Charging</p> <p>Much has already been done on the supply-side to manage congestion and London has led the way with the introduction of the Congestion Charge in 2003. Increasing pressures on the network, deteriorating air quality, evolving patterns of demand and future challenges presented by the introduction of autonomous vehicle technology mean that it is now time to focus more on managing demand. Using the new technologies available, a nuanced, London-wide scheme could have wider benefits for congestion and the environment.</p>				
2	<p>Adopt the policy of introducing variable, distance-based road user charging at a London-wide level. A scheme should be designed to optimise its air quality, carbon and congestion benefits, while giving due regard to equity impacts. Revenue from the scheme should be used to improve public transport, walking and cycling</p>	<p>Central, Inner and Outer London</p>	<p>Policy adoption -Short term Delivery – Medium term</p>	<p>TfL, subject to consultation and approval by the Mayor</p>
3	<p>Review the present Congestion Charge exemptions and discounts, removing them unless their social value strongly outweighs the adverse impact that exempting vehicles has on congestion levels in the Zone</p>	<p>Central London</p>	<p>Short term</p>	<p>TfL, subject to consultation and approval by the Mayor</p>

Recommendation	Area of Application	Timescale	Responsibility
<p>Land use / Transit Oriented Development (TOD) Transport and land-use must be considered together. Transport has a key role to play in unlocking development, and the way development is planned has a key role in ensuring sustainable mode share. The Mayor’s commitment to good growth (as per Policy 19 of the draft MTS) should be supported.</p>			
<p>4 The London Plan should focus new residential development in areas with excellent public transport, and support high quality, high density developments with low or zero parking in these locations. In areas without excellent public transport, development should not take place until appropriate public transport and active-mode facilities have been committed. All new residential development should include high quality facilities for people walking and cycling to access local centres. Investment in public transport must continue so that as population and employment levels grow, public transport becomes a more attractive option than private car use wherever possible.</p>	<p>All development sites in London</p>	<p>Short to Medium Term</p>	<p>GLA, TfL and Boroughs</p>
<p>PHV Regulation TfL regulates taxis and PHV licensing in London and it should use these powers to examine and manage their impact on congestion and on the overall operation of the network, supporting the achievement of MTS objectives. While the number of taxis has remained stable, the number of PHVs has significantly increased in recent years and the implications of the introduction of autonomous vehicles will pose new regulatory challenges in future.</p>			
<p>5 Review the present regulatory regime for PHVs, including a potential change to the law to allow TfL the power to limit the number of vehicles licensed</p>	<p>All areas of London</p>	<p>Short Term</p>	<p>TfL, Central Government (licensing laws)</p>
<p>Prioritisation of Bus Buses are an affordable, sustainable mode and London’s bus fleet is one of the cleanest in the world. Buses bring congestion benefits to the network by carrying large volumes of people in proportion to the road space they occupy. In Central London, there is already high bus use compared to car use, and it is important to maintain service standards by minimising the effects of disruption on journey times and services. In Outer London it is important to prioritise mode shift by making buses a viable and attractive alternative to travel by private car.</p>			

Recommendation		Area of Application	Timescale	Responsibility
6	Continue with the delivery of bus priority schemes to support reliability of bus journey times and implement pilot schemes to explore the impact and attractiveness of express service operation, bus rapid transit and demand-responsive services on appropriate corridors	Particular focus on areas of new development and Outer London areas exhibiting higher car dependency	Medium Term	TfL in partnership with the London Boroughs
Parking Policy The availability and cost of parking is a key factor in the decision to drive. An active approach to parking provision and pricing is therefore a critical part of any approach to congestion management.				
7	Implement workplace parking levies in Metropolitan Centres or borough-wide	Appropriate Metropolitan Centres	Short- Medium Term	TfL working with London Boroughs, with support from Central Government - secondary legislation is required
8	Consider how parking is charged for on the TLRN. Boroughs should adopt a policy of reducing on- and off-street car parking supply over time, in line with their traffic reduction strategies	All areas, but particularly in Outer London	Short Term	TfL, London Boroughs
9	Adopt variable pricing of parking supply and use of vehicle sensing technology in order to better manage existing parking space	All areas, in particular Inner and Outer London	Medium Term	London Boroughs
Freight Strategy London needs its freight and servicing trips in order to remain a successful city. Much can be done to manage these better and to rationalise the number of trips made and the vehicles used to make them. In this way we can make the best use of our roads, reduce congestion and emissions and support economic growth.				
10	Develop a London-wide integrated system of consolidation centres to meet both strategic and localised freight needs, developed in partnership between the public and private sectors. Through the London Plan and specific Borough Local Plans, industrial land and other appropriate development sites in Central, Inner and Outer London should be safeguarded for consolidation activity	Outer limit M25 ring, with further sifting points in strategically appropriate areas	Medium term	TfL to facilitate discussions with GLA, London Boroughs and industry

Recommendation		Area of Application	Timescale	Responsibility
11	Support last mile delivery with the use of innovative, sustainable transit techniques according to the location, type of goods being conveyed and land use activities. This will include cycle freight, electric vehicle, and autonomous vehicle solutions (once legal framework issues have been resolved and successful trials undertaken) according to the suitability of local circumstances	Central London	Medium term	TfL to facilitate discussions with London Boroughs and industry
12	Explore potential for freight only lanes or prioritisation of freight through advance vehicle detection to reduce journey times on key freight corridors, aligned with distribution hub/consolidation centre locations	Strategic freight corridor from Outer to Central London	Medium term	TfL on GLA roads, and London Boroughs on borough roads
13	Expand the use of localised or borough-based Quiet Deliveries schemes across London to optimise off-peak, evening and, where appropriate, night time deliveries (with separate planning, environmental and highways approvals where these are required)	All areas of London	Short Term	London Boroughs
<p>Smarter Choices / Mobility Management</p> <p>Changing travel behaviour can provide the foundation for sustainable travel into the future. TfL and the boroughs already operate many TDM schemes such as workplace travel plans and the school STARS programme. These should be continued and a pilot incentives scheme explored.</p>				
14	Use Smarter Choices-type programmes to promote sustainable travel choices and consider a pilot incentivisation programme which provides positive incentives to change travel behaviour in areas with high car dependence	All areas of London, with particular focus on those where private car based trips could be avoided or re-timed	Short Term	TfL in partnership with the London Boroughs
<p>Network Management</p> <p>Investment in state-of-the-art traffic management technology and intelligent data collection and analytics will ensure that the existing network can be utilised with greatest efficiency, minimising delays, increasing reliability and improving network resilience.</p>				
15	Make further investment in intelligent traffic management including the Surface Intelligent Transport System	Central, Inner and Outer London	Short to Medium Term	TfL
16	Ensure the programme of routine maintenance and retiming of existing traffic signals remains a priority	Central, Inner and Outer London	Short Term	TfL and London Boroughs

Recommendation	Area of Application	Timescale	Responsibility	
<p>Roadwork Co-ordination and Management</p> <p>Roadworks must be managed in a way that facilitates the essential maintenance of the city’s utilities and supports the development and regeneration necessary for continuing growth. This requires pro-active co-ordination and measures to ensure that impacts on the network are minimised.</p>				
17	Continue to actively use permit schemes to manage roadworks and review whether the application of conditions could be used to further reduce the impact of works. Evaluate whether fixed penalty notices provide sufficient incentive against offences, with amendment to legislation to increase penalties if required	London Boroughs with permit schemes in operation	Short Term	TfL Central Government to amend legislation
18	Consider using the current provisions within the Highways Act 1980 to extend the use of permit schemes to skips and scaffolding placed in the highway	London Boroughs with permit schemes in operation	Short Term	Central Government
19	TfL should retain its lane rental powers and consider extending the Lane Rental Scheme to the London Boroughs where appropriate	London Boroughs with permit schemes in operation	Short Term	Central Government to amend legislation
<p>Network Monitoring</p> <p>As we have seen in this report, there is a lack of data related to non-vehicular traffic and to congestion from the perspective of individuals experiencing it. In order to monitor and achieve the goals in the draft MTS, it is important to address this shortcoming.</p>				
20	Develop new congestion indicators covering cycling and walking, and to measure person-based delay	All areas of London	Short Term	TfL
21	Disaggregate between private cars and private hire vehicles in the reporting of traffic data from ANPR cameras, so that trends in PHV mileage, and their contribution to traffic growth, can be understood	All areas of London	Short Term	TfL
22	Collect information from taxi and PHV operators on the usage of these vehicles	All areas of London	Short Term	TfL

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APPENDIX A:

Stakeholders consulted by the Study Team

Organisation	Person	Job Title	Location	Date
GMB	Simon Rush	Branch President	230 Blackfriars Rd, London, SE1 8PJ (added to regular scheduled TfL/PH trade meetings)	8/8/2017
Private Hire Board	Eddie Townson	Chairman		
Addison Lee	Michael Galvin	Head of Regulatory Affairs		
LPCHA	Steve Wright	Chairman		
RAC Foundation	Steve Gooding	Director	89-91 Pall Mall, St. James's, London SW1Y 5HS	16/8/2017
London First	Richard Dilks	Programme Director - Transport	Middlesex House, 34-42 Cleveland Street, W1T 4JE	21/8/2017
Go Ahead PLC	John Trayner	Managing Director	4 Matthew Parker St, Westminster, London SW1H 9NP	25/8/2017
	David Brown	Chief Executive		
Freight Transport Association (FTA)	Natalie Chapman	Head of Policy	78 Cannon Street, London EC4N 6HN	25/8/2017
London Living Streets	Jeremy Leach	Chair	6 Hay's Lane, London Bridge, London SE1 2HB	29/8/2017
	Steve Chambers	Policy Coordinator		
LTDA	Steve McNamara	General Secretary	230 Blackfriars Rd London, SE1 8PJ (added to regular scheduled TfL/taxi trade meetings)	31/8/2017
LCDC	Grant Davis	Chairman		
UCG	Trevor Merralls	General Secretary		
Unite	Jim Kelly	Regional Chair		

Organisation	Person	Job Title	Location	Date
TfL	Glynn Barton	Director of RSM	Palestra 197 Blackfriars Rd, London SE1 8JZ	1/9/2017 & 4/10/2017
TfL	Andy Emmonds	Chief Traffic Analyst		28/07/2017, 1/9/2017 & 4/10/2017
TfL	John Barry	Head of Network Development - Buses		28/07/2017
TfL	Janet Brown	Network Performance Manager		1/9/2017
TfL	Ben Plowden	Director of Strategy and Planning		
London Borough of Hounslow	Mark Frost	Head of Traffic and Transport	Palestra 197 Blackfriars Rd, London SE1 8JZ	1/9/2017
London Borough of Camden	Sam Margolis	Transport Policy Team Manager		
City of London	Iain Simmons	Assistant Director		
London Borough of Westminster	Tim Long	Principal Policy Officer		
Uber	Benjamin Bell	Public Policy Team Representative	6 Hay's Lane, London Bridge, London SE1 2HB	5/9/2017



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