Strategic Transport Modelling

Part of the London Plan evidence base

December 2017

London Plan: Strategic Modelling Supporting Evidence

Executive Summary

Introduction

The London Plan is the overall strategic plan for London, which sets out an integrated economic, environmental, transport and social framework for the development of London over the next 20-25 years. The London Plan, along with the Mayor's Transport Strategy and the Mayor's other strategies provides the blueprint for making London a city that is not only home to more people, but is a better place for all of those people to live in.

This document sets out the strategic modelling that has been carried out to assess the effectiveness of the draft MTS scenario in accommodating new London Plan growth projections, with an increase in sustainable, active and efficient travel.

Approach to strategic modelling

TfL's strategic models have been used widely for forecasting the impacts of transport and land use decisions in London and have been comprehensively enhanced and updated for this purpose. The strategic modelling establishes a core reference case as a baseline for transport outcomes with London Plan growth and funded investment, and then assesses the expected outcomes under the MTS Scenario.

Forecasting assumptions

The core reference case includes population and employment projections from the GLA, along with funded changes to the transport network identified in the 2017 TfL Business Plan and National Rail funded plans. It also includes wider assumptions about policies relating to aspects such as fares, fuel costs and car parking.

The GLA has published a new 2016-based population projection with a spatial distribution that reflects the new 2017 Strategic Housing Land Availability Assessment (SHLAA) and a new 2017 long term labour market projection. These GLA projections form the basis of the new draft London Plan, and the core reference case used in the draft MTS has been updated to include these new projections.

In 2041, total GLA population growth is now projected to be 10.8 million and total London employment is projected to reach 6.9 million.

The MTS scenario and London Plan growth

The MTS scenario builds on the core reference case and includes policies and proposals outlined within the draft MTS. Beyond the current funded programme, the scenario includes Crossrail 2, a London Suburban Metro and other upgrades to the national rail network. It includes delivery of the Deep Tube programme, Bakerloo line extension, station capacity work as well as upgrades and extensions to the DLR, Tramlink and London Overground. It includes developing the bus network to meet future demand, applying the Healthy Streets Approach to London's roads and delivering the full Ultra Low Emission Zone and further policies on vehicle emissions.

It also includes indicative traffic reduction measures as required to deliver the Mayor's vision for travel in London.

Travel demand and mode share

Travel demand is expected to increase in proportion to the growth in population and employment from around 27 million trips per day in 2015 to around 33 million trips per day in 2041.

In the London Plan core reference case, car percentage mode share is expected to fall from 36 per cent of all trips in 2015 to 30 per cent in 2041.The delivery of the MTS would enable demand for travel in London to increase in a more sustainable, active and efficient way, with car percentage mode share forecast to fall to 20 per cent in 2041.

Traffic congestion and bus speeds

Overall traffic congestion is expected to increase by 2041 without delivery of the MTS, with average vehicle speeds decreasing across London. In the MTS scenario, fewer cars and shorter journeys mean that speeds are likely to increase across most of London in 2041 compared to 2015. Reallocating road space to meet MTS Healthy Streets objectives could be achieved while reducing delay at a London wide level.

In the MTS scenario, buses benefit from stable or improved speeds for general traffic as well as the reallocation of road space to buses so that bus speeds improve London-wide to 2041.

Public transport and crowding

Strong growth in demand for public transport, particularly for rail based modes, is expected between 2015 and 2041. Crowding will worsen without further investment. With the draft MTS scenario there is an even greater growth of passenger kilometres from 2015 to 2041, however the MTS Scenario schemes would enable crowding on rail services to fall scenario despite rising passenger numbers.

Emissions

With the planned Ultra Low Emission Zone in place in 2019 in Central London, together with improvements to vehicular technology, levels of the four key emissions (CO_2, $PM_{2.5}$, PM_{10} and NO_x) are expected to fall from 2013 to 2041. The MTS scenario, could deliver further significant reductions in the four key emissions.

Connectivity

With the draft MTS scenario, new and enhanced public transport connections and improvements to bus speeds will mean that London residents will be better connected to jobs, services and to one another.

Conclusion

The key conclusion is that if the MTS is delivered, the revised London Plan population and economic growth can be achieved with sustainable transport outcomes. The London Plan and MTS make a sustainable, active and efficient mode share of 80 per cent achievable.

Contents

1. Introduction

1.1. The London Plan is the overall strategic plan for London, which sets out an integrated economic, environmental, transport and social framework for the development of London over the next 20-25 years. The London Plan, along with the Mayor's Transport Strategy and the Mayor's other strategies for economic development, the environment, housing, health inequalities and culture provides the blueprint for making London a city that is not only home to more people, but is a better place for all of those people to live in.

1.2. The Mayor's Transport Strategy is the statutory document that sets out the Mayor of London, Sadiq Khan's, policies and proposals to reshape transport in London over the next 25 years. The new draft MTS is an ambitious strategy that puts people's health and quality of life at the very heart of planning the city's transport.

1.3. This document sets out the strategic modelling that has been carried out to assess the effectiveness of the MTS scenario in accommodating new London Plan growth projections, with an increase in sustainable, active and efficient travel. It follows on from the draft MTS Outcomes Summary Report which sets out the options analysis and strategic modelling that has been carried out to inform MTS development and assess the effectiveness of the strategy. The draft MTS Summary Outcomes report was based on the Greater London Authority (GLA) projections of population and employment published in 2016. Since this work, the GLA published new long term projections of employment in July 2017 and population in November 2017 which form the basis of the new draft London Plan. This report describes potential outcomes of the policies and proposals contained in the draft MTS against a background of the new London Plan growth projections, and is primarily informed by a programme of modelling using TfL's suite of strategic models and supporting analytical tools

1.4. The remainder of this report is set out as follows:

- **Chapter 2** outlines TfL's strategic modelling suite and the role of strategic modelling in assessing the impact of London Plan growth and the new Mayor's Transport Strategy on London's transport system.

- **Chapter 3** summarises the forecasting assumptions used within TfL's strategic models and the new London Plan growth projections.

- **Chapter 4** outlines the scenario which underpins the new Mayor's Transport Strategy, and presents the results of testing the full strategy against a background of new London Plan growth. This scenario demonstrates the action required to achieve the Mayor's vision.

2. Approach to strategic modelling

2.1. Introduction

2.1.1. This Chapter outlines TfL's strategic modelling suite and an overview of the role of strategic modelling as part of the new draft London Plan evidence base.

2.2. TfL's strategic modelling suite

2.2.1. TfL's strategic models have been used widely for forecasting the impacts of transport and land use decisions in London. This has included assessment of previous Mayor's Transport Strategies and London Plans. The models have been comprehensively enhanced and updated to inform such assessments.

2.2.2. Figure 2.1 below shows the TfL strategic models that have been used to assess the impacts of proposals contained in the draft London Plan.

Figure 2.1   TfL strategic models
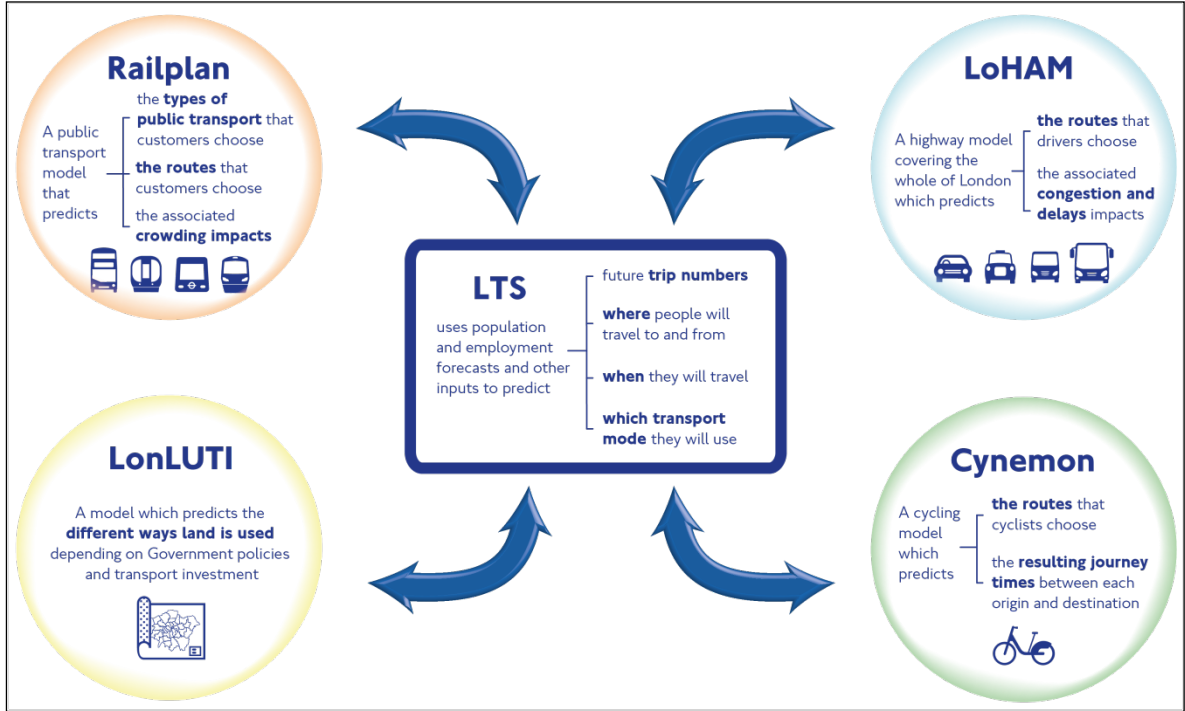
Source: City Planning, TfL

2.3. Role of strategic modelling

2.3.1. The role of the forecasting work for the new draft London Plan is outlined below:

   a. To establish an updated transport baseline, by updating the core reference case (as used in the draft MTS) with London Plan growth projections.

   b. To assess the expected outcomes of the plans and policies included within the MTS scenario against a background of London Plan growth

projections, and to demonstrate the action required to achieve the Mayor's vision.

2.4. Core reference and London Plan growth

2.4.1. A **core reference case**, with scenarios up to 2041, was produced for the draft MTS to give a baseline for the assessment of future candidate policies and schemes for inclusion in the Strategy. This shows the change from the 'current' situation, i.e. the 2015 baseline and reflects a 'business-as-usual' assumption. The baseline for emissions is 2013 reflecting the latest version of the London Atmospheric Emissions Inventory.

2.4.2. The core reference case includes population and employment projections from the GLA, along with funded changes to the transport network identified in the TfL Business Plan and National Rail funded plans, and wider assumptions about policies relating to aspects such as fares, fuel costs and car parking. It also includes the Mayor's intended investment in cycling which is expected to deliver a 6 per cent cycle mode share in 2041.

2.4.3. The core reference case used in the draft MTS has been updated to include the new GLA population and employment growth projections that form the basis of the new draft London Plan. This is referred to as the **London Plan core reference case**.

2.5. Uncertainty

2.5.1. All forecasting must accept that the future is inherently uncertain and that this uncertainty increases as we look further into the future. Robust assessment involves understanding how different trends or circumstances could alter the challenges facing London and the policies and schemes designed to tackle these challenges.

2.5.2. There are several sources of uncertainty in future travel demand, including uncertainty in growth forecasts, changes in travel behaviour/preferences and other external and technological changes. TfL has developed an approach which recognises the inherent uncertainty in forecasting. TfL's approach is to vary the input assumptions in modelling, rather than changing the modelled relationships themselves.

2.5.3. Aspects of uncertainty have been tested through sensitivity tests in the draft MTS Outcomes Summary Report which reflected a range of assumptions about population and employment and economic growth, and the cost of car and public transport use. These tests provide a useful range of plausible outcomes against which to assess proposals and schemes. The results show that the broad conclusions of the core reference case, including rapid growth in public transport use, walking and cycling and flat or declining car use are a robust basis on which to plan. A series of more radical changes have been considered in the draft MTS Outcomes Summary Report on a qualitative basis to provide an indicative understanding of the possible impacts of 'step-change' type events on the challenges facing London and the case for individual schemes and policies.

2.6. The preferred MTS scenario outcomes

2.6.1. The draft MTS Outcomes Summary Report used eight key quantified measures to assess the impact of the core reference case on travel conditions in London. These were also used to assess the relative impact of the MTS scenario against the core reference case, and, ultimately, against the Mayor's vision for London through to 2041. These results are published in the draft MTS Outcomes Summary report as part of the draft MTS evidence base.

2.6.2. The quantified measures are as follows:

a. Mode share for walking, cycling and public transport, by area of London.
b. Vehicle kilometres (motorised road vehicles).
c. Congestion for road traffic (traffic speed).
d. Bus speeds.
e. Public transport usage (passenger kilometres travelled).
f. Rail crowding.
g. Emissions – CO_2, NO_x, $PM_{2.5}$ and $PM_{10.}$
h. Connectivity provided by the transport network.

2.6.3. For the new draft London Plan evidence base, the core reference case has been updated to include London Plan growth projections and these eight key measures are used to assess the impact of the MTS scenario against a background of London Plan growth.

3. Forecasting Assumptions

3.1. Introduction

3.1.1. This chapter summarises the forecasting assumptions in the London Plan core reference case, and describes the new GLA London Plan growth projections.

3.2. Network and economic forecasting assumptions

3.2.1. The London Plan core reference case includes funded public transport and highway schemes consistent with the 2017 TfL Business Plan. A scheme list is provided in Appendix 1 and a summary of key schemes is provided below:

- Current view of funded National Rail schemes, HLOS programme, Thameslink programme, HS2, West Anglia and Great Western improvements.

- The opening of the Elizabeth Line in 2019, the Northern Line Extension, and Tube upgrades to the Victoria Line and Four-Line Modernisation programme.

- DLR, Trams, London Overground and bus service improvements.

- TfL's Healthy Streets portfolio including cycling infrastructure schemes and the introduction by 2019 of the Central London Ultra Low Emission Zone (ULEZ).

3.2.2. Wider assumptions have been made about policies relating to aspects such as fares, fuel costs and car parking, and they key economic assumptions are detailed in Table 3.1.

Table 3.1 Key forecasting assumptions

Assumption	Comments	Source
Parking supply and charges	Work place parking supply is expected to decrease from 2015 to 2041 and parking charges are expected to increase significantly reflecting recent trends and expected continued pressure on parking	TfL
Car ownership	Car ownership is expected to decrease in line with increasing population densities to an average of 0.29 cars per person in 2041	TfL
Economic assumptions	Highway and public transport economic assumptions are taken from WebTAG[1] December 2015 guidance	DfT
Public Transport fares	The Mayor's Fares Freeze applies to TfL fares, with other fares assumed to increase with inflation until 2020. An inflation-linked increase is assumed from 2021.	TfL

Source: City Planning, TfL

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[1] https://www.gov.uk/guidance/transport-analysis-guidance-webtag

3.3. Planning data forecasting assumptions

3.3.1. The core reference case described in the draft MTS Outcomes Summary report included the latest GLA projections at the time of publication which was the 2015 round SHLAA capped population projection[2] and the 2016 long term labour market projections[3]. Since publication, the GLA have published a new population projection[4] with a spatial distribution that reflects the new 2017 Strategic Housing Land Availability Assessment (SHLAA)[5] and a new 2017 long term labour market projection[6]. These new GLA projections form the basis of the new draft London Plan, and the core reference case has been updated to include these new projections of population and employment forming the London Plan core reference case.

3.3.2. Table 3.2 provides detail on the new GLA population and employment projections and comparison to the previous projections included in the core reference case for the draft MTS Outcomes Summary report.

3.3.3. Employment projections are provided for the Central Activities Zone (CAZ) and the North Isle of Dogs (NIOD), the remainder of inner London, and outer London. Population projections are provided for inner and outer London.

Table 3.2   Population and employment distribution and forecast growth

Population (millions)	Previous GLA projection			London Plan GLA projection		
	2015	2041	2015-2041 (% growth)	2015	2041	2015-2041 (% growth)
Inner	3.4	4.3	24%	3.5	4.4	25%
Outer	5.2	6.2	20%	5.2	6.4	23%
Total	8.6	10.5	22%	8.7	10.8	24%
Employment (millions)	**Previous GLA projection**			**London Plan GLA projection**		
	2015	2041	2015-2041 (% growth)	2015	2041	2015-2041 (% growth)
CAZ and NIOD	2.0	2.5	24%	2.1	2.7	28%
Inner (rest of)	1.3	1.7	27%	1.4	1.8	29%
Outer	2.1	2.5	16%	2.1	2.5	16%
Total	5.5	6.7	22%	5.6	6.9	24%

Source: Greater London Authority.

[2] https://data.london.gov.uk/dataset/constrained-r2015-shlaa-projection

[3] https://data.london.gov.uk/dataset/long-term-labour-market-projections

[4] https://data.london.gov.uk/dataset/projections

[5] https://www.london.gov.uk/what-we-do/planning/london-plan/new-london-plan/evidence-base

[6] https://data.london.gov.uk/dataset/long-term-labour-market-projections

3.3.4.   Total GLA population growth is greater in the new 2016-based projection reaching a total of 10.8 million in 2041 compared to the previous 2015 round projection with a total of 10.5 million in 2041.

3.3.5.   Population distribution in the new projection reflects the new 2017 SHLAA, which better represents the latest Opportunity Area homes capacity compared to the previous SHLAA from 2013 which was used in the previous projection. Inner London 2015-2041 population growth is 1 percentage point greater in the new 2016-based projection (25%), and outer London population growth is 3 percentage points greater in the new projection (23%).

3.3.6.   In 2041, total London employment is projected to reach 6.9 million in the new 2017 projection, compared to 6.7 million in the 2016 projection.

3.3.7.   The majority of additional employment growth in the new 2017 projection is in the CAZ and NIOD, where 2015-2041 growth is 4 percentage points higher than in the 2016 projection. Outer employment growth in the new 2017 projection remains the same as in the 2016 projection.

4.   The MTS scenario and London Plan growth

4.1.   Introduction

4.1.1. This chapter summarises the preferred MTS scenario as detailed in the draft MTS, and describes the outcomes of the modelling whereby the MTS scenario has been applied to a background of London Plan growth. Firstly, it outlines the contents of the MTS scenario and is then structured as a description of the outcomes London Plan core reference case and MTS scenario modelling against each of the eight key quantified measures outlined in Chapter 2.

4.2.   Description of the MTS scenario

4.2.1. The MTS scenario begins with the contents of the core reference case and then includes policies and proposals outlined within the draft MTS. A scheme list is provided in Appendix 1. A summary of key schemes beyond the current funded programme is provided below:

- Rail: deliver Crossrail 2, a London Suburban Metro, Elizabeth Line extension east of Abbey Wood and other upgrades to the national rail network.

- Tube: deliver Deep Tube programme, Bakerloo Line extension to Lewisham (and beyond), station capacity programme and step free Tube stations.

- DLR: deliver the DLR upgrades and potential DLR extension from Gallions Reach to Thamesmead.

- Trams: deliver Tram upgrades and potential Tram extension to Sutton.

- London Overground: deliver network-wide frequency upgrades, strategic interchanges, Barking Riverside extension and potentially other London Overground extensions

- Buses: develop the bus network to meet existing and future demand and deliver the bus priority network and Low Emission Bus Zones.

- Streets: implement the Healthy Streets Approach to deliver improved streets and priority for walking and cycling, deliver Silvertown Tunnel and associated bus improvements including at least 20 buses per hour in the first year.

- Environment: deliver the full Ultra Low Emission Zone, including London wide Low Emission Zone and inner London ULEZ, and policies on vehicle emissions set out in chapter 3 of the draft MTS.

- Traffic reduction: indicative measures including changes to residential and workplace parking, changes to the way road use is paid for and freight demand measures as required to deliver the Mayor's vision for travel in London.

4.2.2. Figure 4.1 shows the overall impact of the rail schemes on capacity. They would deliver an almost 90 per cent increase in capacity to Central London in the morning peak.

Figure 4.1   Morning peak rail and Underground capacity improvements to Central London, 2015 to 2041 in the MTS scenario
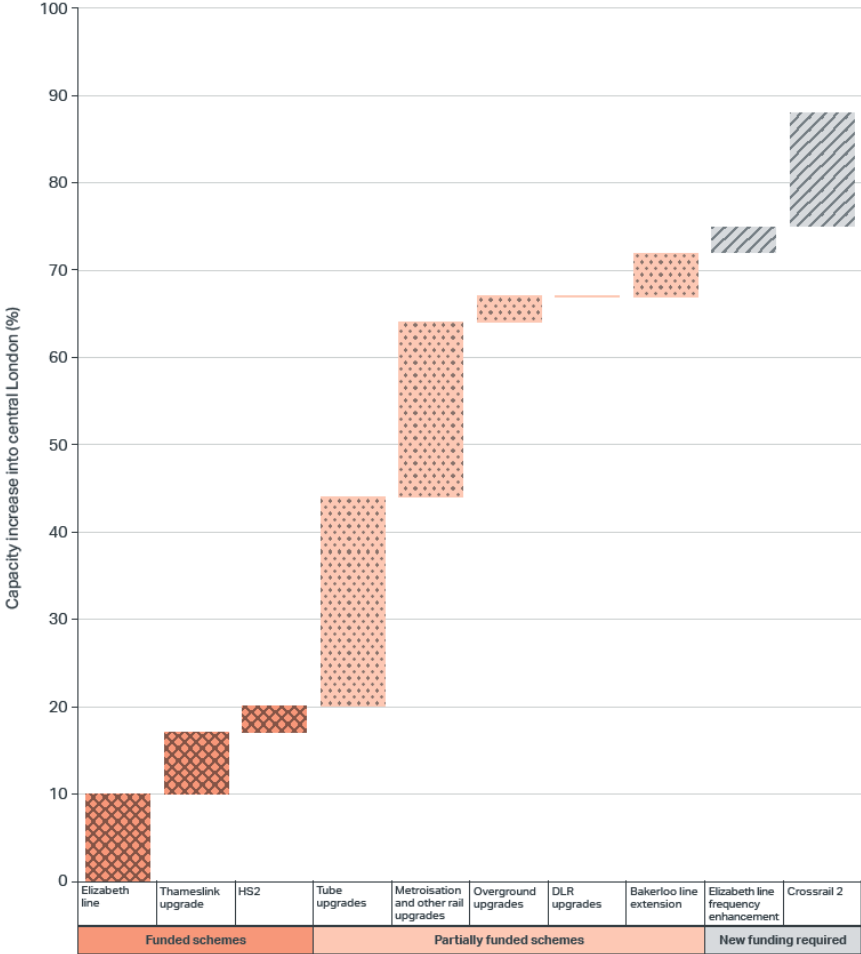
Source: City Planning, TfL

4.2.3.   The MTS package modelling in the draft MTS Outcomes Summary report has demonstrated that traffic reduction measures are likely to be necessary, in the longer term, to achieve the Mayor's vision of an 80 per cent mode share for walking, cycling and public transport in 2041. However, the approach to achieving this is illustrative of the required impact and should not be taken as an indication of specific proposals or scheme designs. The trajectory of the implementation reflects shorter term measures in the draft MTS such as air quality improvement and car reduction strategies and the desire to be more ambitious in reducing car ownership within new developments. Other traffic reduction measures and changes to the way road use is paid for are considered in the longer term. Table 4.2 provides a summary of measures tested.

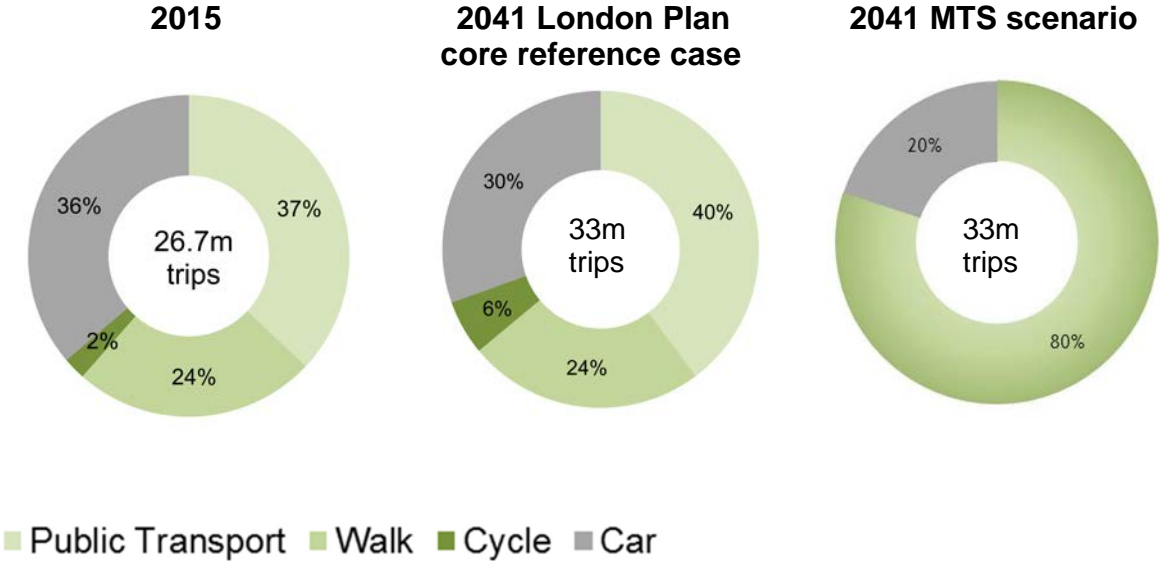**Table 4.2   Summary traffic reduction measures included in the MTS scenario**

Policy type	Description
Parking supply and charging	Further increases in parking charges, limits on free commuter parking or a work place parking levy
Car ownership and residential parking	Measures to accelerate the rate of car ownership reduction resulting in a quarter of a million fewer cars owned in London
Changes to the way road use is paid for	This has been assessed with an indicative distance-based road user charge in the longer term
Freight demand management	Measures to limit the growth of freight traffic, so that HGV traffic does not rise and van traffic grows only in line with population

Source: City Planning, TfL

4.3.   Summary of outcomes from the MTS scenario with London Plan growth: Travel demand and mode share

4.3.1.   Population and employment are key drivers of travel. Travel demand is therefore expected to increase in proportion to the growth in population and employment shown in Table 3.2. Greater growth in population and employment in the London Plan projections means that there are a greater number of total trips in the future compared to previous projections. In the draft MTS core reference case, demand for travel in London was forecast to increase from around 27 million trips per day in 2015 to around 32 million trips per day in 2041. In the London Plan core reference case, demand for travel is forecast to increase by approximately a further 0.5 million more trips per day, to around 33 million trips per day in 2041.

4.3.2.   Alongside this growth in overall travel demand from 2015 to 2041, mode share is also expected to change over time, with the majority of additional trips forecast to be by public transport or active travel, with only a small increase in car trips- reflecting the mix of funded interventions to 2041. As a result of this, the car mode share is projected to fall in the core reference case with London Plan growth from 36% in 2015 to 30% in 2041. This is summarised in Figure 4.3.

4.3.3.   If the MTS is delivered, the revised London Plan population and economic growth can be achieved with sustainable transport outcomes. The London Plan and MTS make a sustainable, active and efficient mode share of 80 per cent achievable as summarised in Figure 4.3.

**Figure 4.3   Mode share, 2015 to 2041 in the MTS scenario.**

| 2015 | 2041 London Plan core reference case | 2041 MTS scenario |

2015: 26.7m trips — 37%, 24%, 2%, 36%

2041 London Plan core reference case: 33m trips — 40%, 24%, 6%, 30%

2041 MTS scenario: 33m trips — 80%, 20%

■ Public Transport ■ Walk ■ Cycle ■ Car

Source: City Planning, TfL

4.4.   Traffic and congestion

4.4.1. In the London Plan core reference case, road traffic volumes are expected to grow modestly, at a rate slower than population growth. Traffic volumes are expected to fall in Central London by 4% as a result of reduced highway capacity and increased sustainable and active transport use, with growth concentrated in outer London (9% increase in traffic volumes) where there are fewer public transport options and car ownership and use is less constrained. Growth here is primarily driven by a rising population and growth in van traffic, which is forecast to form an increasing proportion of total motorised traffic.

4.4.2. Final highway modelling has not yet been completed for the MTS scenario on a background of London Plan growth. This work is being completed for the final MTS and Environment Strategy. The updated traffic and congestion results are expected to be very similar at a strategic level to those published in the draft MTS Outcomes Summary Report, and therefore these MTS scenario results are summarised in this section as a good indication of the final modelling outputs.

4.4.3. The measures proposed by the draft MTS are expected to deliver significant decreases in traffic in the morning peak across London, as shown in Figure 4.5. The greatest change is in inner London - a 27 per cent reduction. London-wide, the reduction in traffic in the morning peak is 15 per cent.

Figure 4.5   Percentage change in morning peak vehicle kilometres, 2015 to 2041.
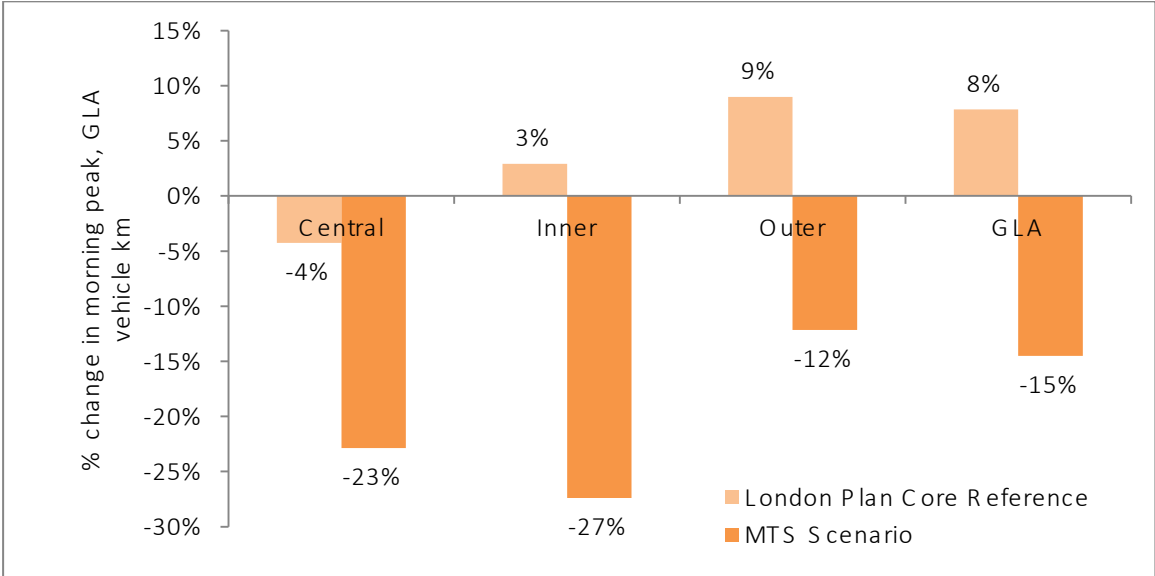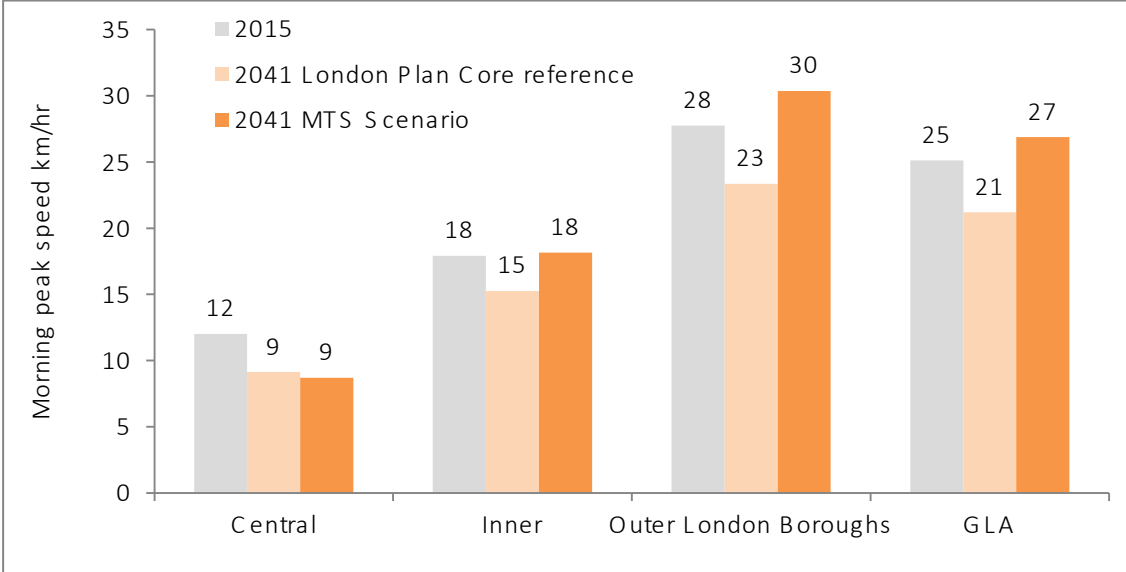

Source: City Planning, TfL

4.4.4. Highway capacity for general traffic in 2041 is lower in the London Plan core reference case compared to 2015 as a result of a range of changes, including growth in cycling, pedestrian priority and public realm schemes, which remove capacity for general road traffic. This, combined with increases in population and employment, means that congestion is expected to increase by 2041. Overall vehicle speeds in the London Plan core reference case are expected to decrease by up to 25 per cent in Central London from 2015 levels (Figure 4.6), with average vehicle speeds decreasing across London.

4.4.5. In the MTS scenario, fewer cars and shorter journeys mean that speeds are expected to increase across most of London, as shown in Figure 4.6. In Central London, very high levels of road space reallocation to sustainable and active modes means that speeds for general traffic slow, in inner London speeds remain around the same as now, and in outer London, average speeds rise from 28 to 30 kilometres per hour in the morning peak. In effect, reallocating road space to meet Healthy Streets objectives could be achieved while reducing delay at a London wide level.

Figure 4.6   Change in London wide morning peak vehicle speed, 2015 to 2041.

Source: City Planning, TfL

4.5.   Public transport use

4.5.1.   Strong growth in demand for public transport, particularly for rail based modes, is expected between 2015 and 2041. The London Plan core reference case shows a 57% increase in rail and Underground passenger kilometres in London between 2015 and 2041, resulting from London Plan growth and supported by extra capacity on the networks such as the opening of the Elizabeth Line. Under current plans, bus patronage growth is forecast to be lower than rail growth, reflecting the expected impact of new rail capacity in Central London on bus demand.

4.5.2.   The change in annual passenger kilometres by rail, bus and Tube from 2015 to 2041 in the London Plan core reference case and with the MTS scenario is shown in Figure 4.7. There is a near doubling of passenger kilometres from 2015 to 2041 in the MTS scenario as both infrastructure improvements and traffic reduction measures encourage more people to use public transport. The greatest increase is in rail from just over 30 billion passenger kilometres each year in 2015 to approximately 70 billion passenger kilometres in 2041. This is due to the planned introduction of the Elizabeth Line, Crossrail 2 and the London Suburban Metro. Tube passenger kilometres increase significantly due to the planned introduction of the deep Tube upgrades and the Bakerloo Line extension. Note that these forecasts assume higher mode shift from car to public transport than to active modes; in reality, the implementation of the Healthy Streets Approach may lead to a greater shift to active modes than forecast, reducing public transport passenger kilometres somewhat and also bringing crowding benefits.

Figure 4.7   Change in annual passenger kilometres (millions), 2015 to 2041.
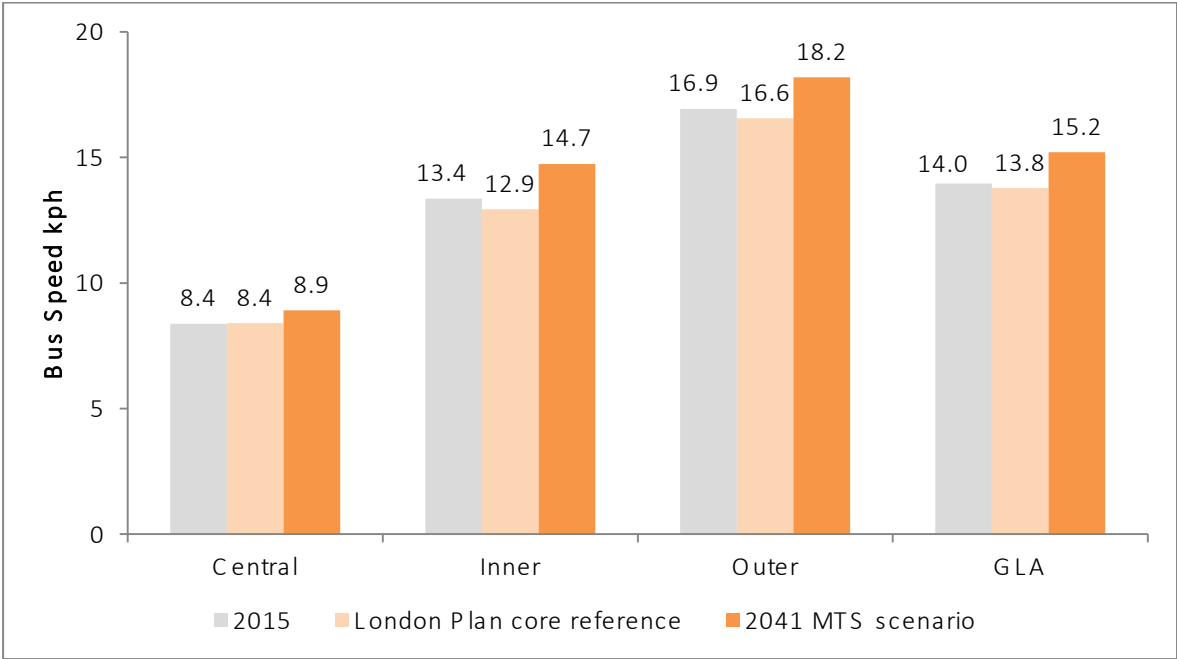

Source: City Planning, TfL

4.6.   Bus speeds

4.6.1.   The change in bus speeds from 2015 to 2041 is shown in Figure 4.8. In the London Plan core reference case road traffic slows from 2015 to 2041 with a detrimental effect on bus speeds. Unmitigated, planned changes to the road network in Central London would reduce general traffic and bus speeds. London wide bus speeds are projected to reduce from an average of 14.0 kilometres per hour in 2015 to 13.8 kilometres per hour by 2041 in the London Plan core reference case.

4.6.2.   In the MTS scenario, buses benefit from stable or improved speeds for general traffic as well as the reallocation of road space to buses so that bus speeds improve London-wide to 2041. Despite slowing speeds for general traffic, bus speeds improve in Central London due to the reallocation of road space to buses. London wide bus speeds are expected to increase from 13.8 kilometres per hour in 2015 to 15.2 kilometres per hour in 2041 in the MTS scenario.

Figure 4.8   12 hour London-wide bus speeds.

Source: City Planning, TfL

4.7.   Crowding on rail and Underground

4.7.1.   Demand for rail services will continue to rise after completion of the currently funded investment programme. Demand for public transport is projected to rise faster than supply from 2021 in the London Plan core reference case. Therefore crowding will worsen without further investment. Table 4.9 shows that, from 2015 to 2041, passenger kilometres travelled in severely crowded conditions (defined as links with more than 4 passengers standing per square metre) are expected to increase in the London Plan core reference case from 33% to 45% on rail and Underground. Figure 4.9 shows expected crowding levels in 2041 with funded investment and highlights that much of the Tube and rail network would experience crowding such that it would be effectively full throughout the entire morning peak.

4.7.2.   Crowding on rail services drops as a result of the MTS scenario, with the proportion of public transport passenger kilometres travelled on crowded links in the morning peak reducing from 33 per cent of the total in 2015 to 29 per cent in 2041. This means that, for an average journey, passengers will experience less crowding, as shown in Table 4.9. If more trips were made by active modes than in the core forecast, and fewer by public transport, crowding would be reduced further.

Table 4.9   Proportion of passenger kilometres on links with more than 4 passengers standing per square metre in the morning peak.

Mode	2015	2041 London Plan core ref	2041 MTS scenario
All rail and Underground	33%	45%	29%
National Rail, London Overground, Elizabeth Line	29%	39%	28%
Tube & DLR	41%	56%	31%

Source: City Planning, TfL
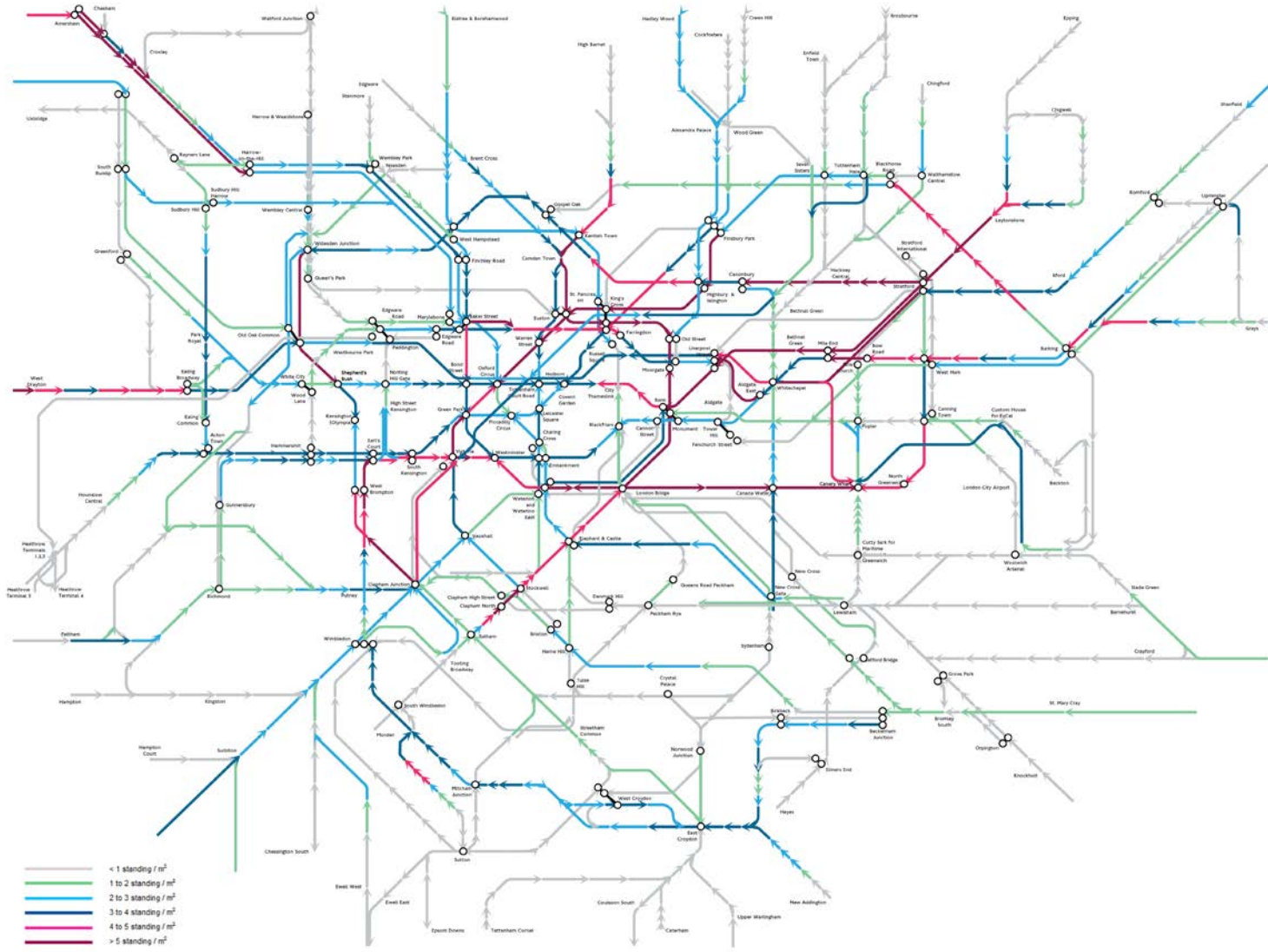
4.7.3. Figure 4.10 shows forecast crowding on National Rail, Tube, DLR, London Overground and Trams in the morning peak in 2041 with the MTS scenario.

Figure 4.9   Morning peak crowding on rail and Underground services in London, 2041 with London Plan growth
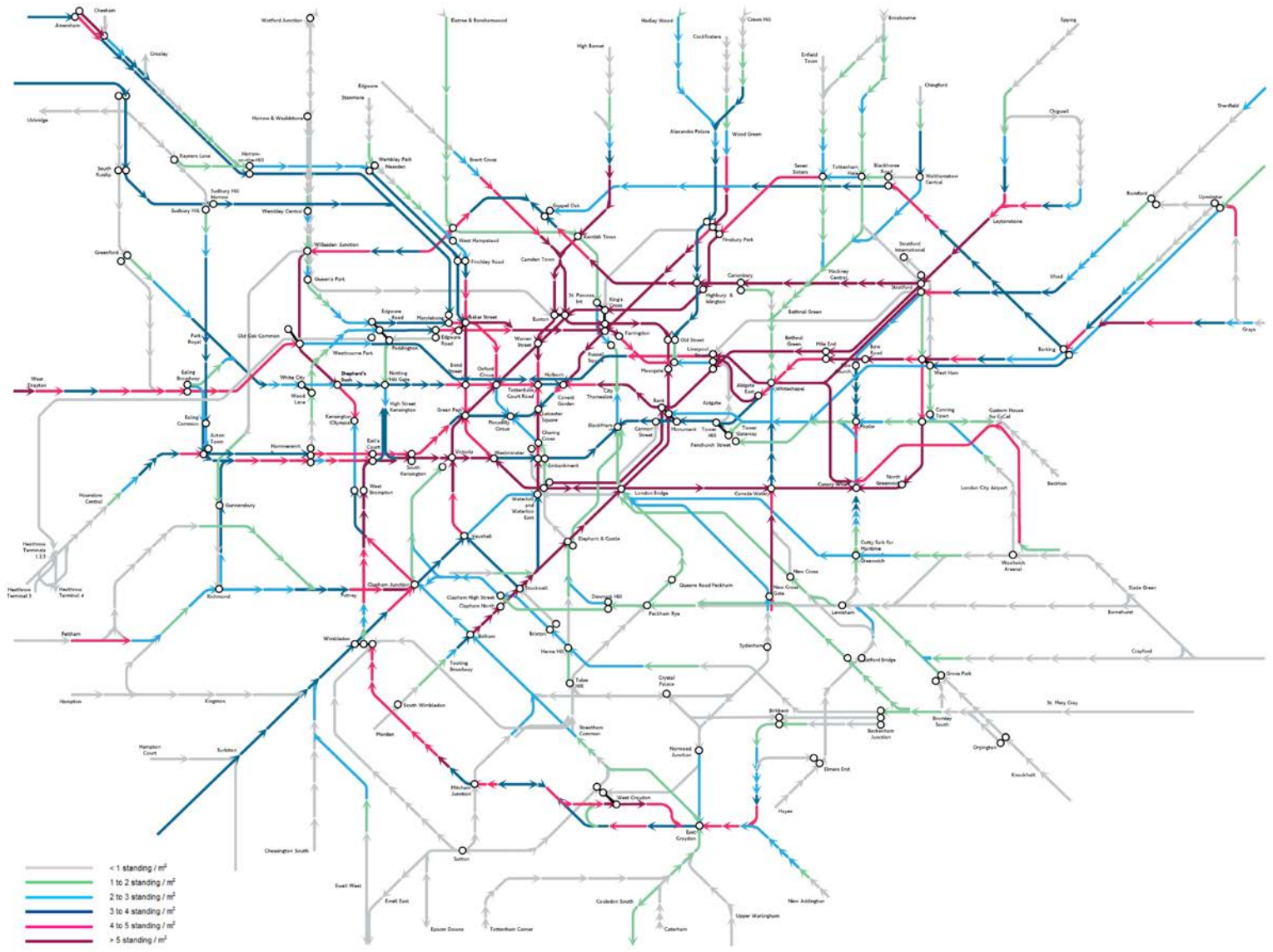
Figure 4.10   Morning peak crowding on rail and Underground services in London, 2041 with London Plan growth + MTS

4.8.   Emissions

4.8.1. Emissions modelling has not yet been completed for the London Plan core reference case and the MTS scenario on a background of London Plan growth. This work is being completed for the final MTS and Environment Strategy. The updated emissions results are expected to be very similar at a strategic level to those published in the draft MTS Outcomes Summary Report (based on previous GLA projections of population and employment), and therefore these results are summarised below as a good indication of the emissions modelling outputs.

4.8.2. With the planned Ultra Low Emission Zone in place in 2019 in Central London, together with improvements to vehicular technology, levels of the four key emissions (CO_2, PM2.5, PM10 and NOx) are expected to fall from 2013 to 2041 in the London Plan core reference case.

4.8.3. Figure 4.11 shows the 2021, 2031 and 2041 road vehicle emissions of the full MTS scenario against the 2013 baseline, as published in the draft MTS Outcomes Summary Report. Under this scenario, we assume delivery of the full Ultra Low Emission Zone, including London wide Low Emission Zone and inner London ULEZ, and policies on vehicle emissions set out in chapter 3 of the draft MTS. The whole bus fleet becomes electric or hydrogen powered by 2037, and the uptake of ultra-low emission vehicles across all vehicle types is in line with the trajectory required for all road transport to become fully zero emission by 2050.

4.8.4. This could deliver:

- A 72 per cent reduction in CO_2 emissions from transport (excluding aviation, 2013 base) in London by 2041, with road and rail transport on a clear trajectory to reach zero carbon by 2050.

- A 94 per cent reduction in road transport NOx emissions, and compliance with legal limit values for NO_2 levels on London's streets.

- A 47 per cent reduction in road transport PM2.5 and 36 per cent reduction in road transport PM10 emissions.

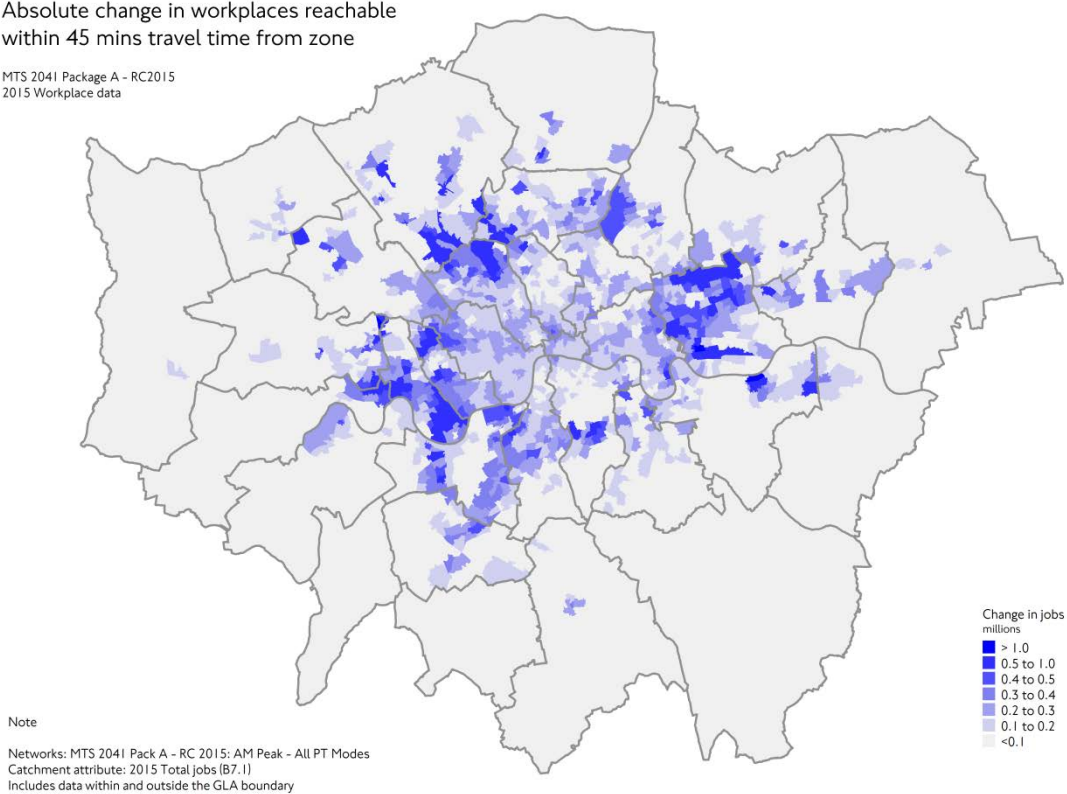**Figure 4.11   Road vehicle emissions including vehicle emissions policy measures, 2013 to 2040.**

- 2013
- 2031 MTS scenario
- 2021 MTS scenario
- 2041 MTS scenario
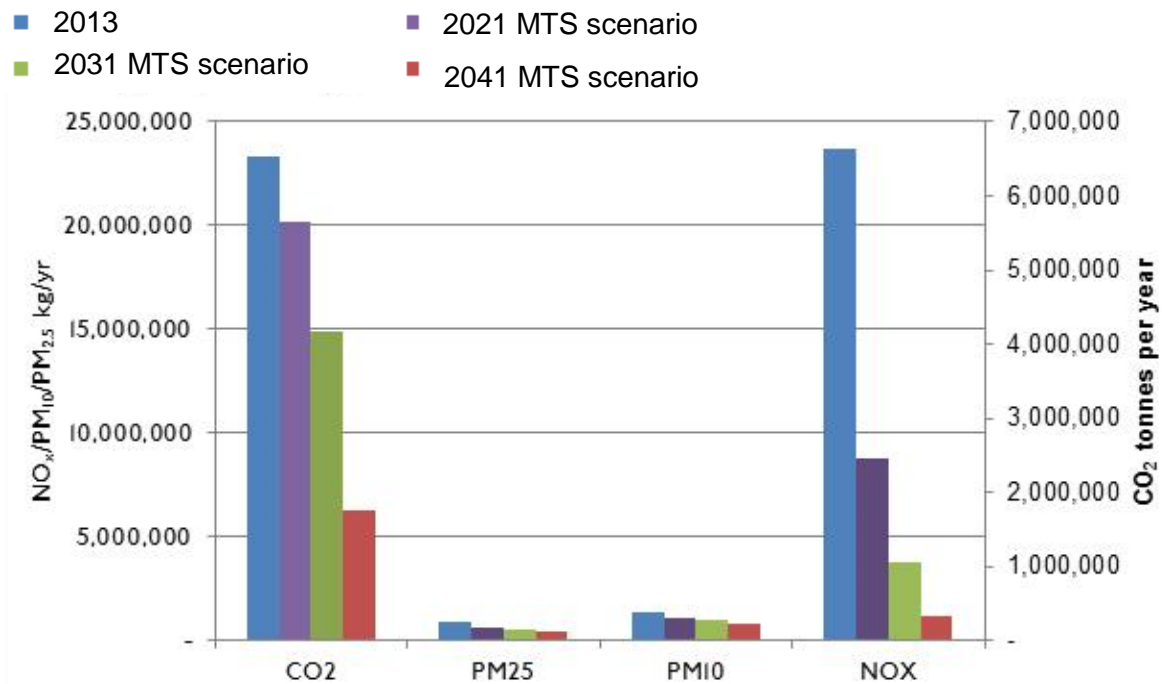
Source: City Planning, TfL

4.9.   Connectivity

4.9.1.   Public transport connectivity can be measured in terms of the number of jobs that can be reached from each area of London within 45 minutes public transport travel time. This is an important aspect of the connectivity of residential locations.

4.9.2.   Figure 4.12 shows the change in access to jobs within 45 minutes brought about by improvements to public transport services in the core reference case with London Plan growth. It shows the impacts of the Elizabeth Line, the funded Tube upgrades and other National Rail schemes. Some areas such as Abbey Wood and Newham, currently less well connected to the jobs market, gain access to up to one million extra jobs. By contrast Central London shows less significant change because this area is already served by a well-connected public transport network.

Figure 4.12 Change in number of jobs reachable within 45 mins travel time by public transport, 2015 to 2041 in the core reference case with London Plan growth.


Absolute change in workplaces reachable
within 45 mins travel time from zone

MTS 2041 Package A - RC2015
2015 Workplace data

Change in jobs
millions
> 1.0
0.5 to 1.0
0.4 to 0.5
0.3 to 0.4
0.2 to 0.3
0.1 to 0.2
<0.1

Note

Networks: MTS 2041 Pack A - RC 2015: AM Peak - All PT Modes
Catchment attribute: 2015 Total jobs (B7.1)
Includes data within and outside the GLA boundary

4.9.3. Figure 4.13 shows the change in access to jobs within 45 minutes brought about by improvements to public transport services identified in the MTS scenario.

4.9.4. New and enhanced public transport connections and improvements to bus speeds would mean that London residents will be better connected to jobs, services and to one another.

4.9.5. In total, 7.6m people would live within 45min travel time of Central London, 2.3m more than today. The number of jobs accessible to the average Londoner within 45 minutes by public transport would increase by 70 per cent. The assessment only considers travel time changes rather than the impact of new jobs and assumes that all identified schemes are in place by 2041. In addition to the Elizabeth line, this package includes schemes such as Crossrail 2 and the Bakerloo line extension. All areas in Central London would see an increase of at least 0.25 million jobs reachable in 45 minutes. In Inner London many areas would experience an increase of over 1 million extra jobs reachable within 45 minutes.

4.9.6. Fewer London residents would be dependent on a car to access opportunities and services. Nearly 1.8m more people would be living in

places with the best transport connections, defined as areas with a public transport accessibility rating of four or above.

Figure 4.13   Change in number of jobs reachable within 45 mins travel time by public transport, 2015 to 2041 in the MTS scenario.

Absolute change in workplaces reachable within 45 mins travel time from zone

MTS 2041 Package D - RC2015
2015 Workplace data

Change in jobs
millions
- > 1.0
- 0.5 to 1.0
- 0.4 to 0.5
- 0.3 to 0.4
- 0.2 to 0.3
- 0.1 to 0.2
- <0.1
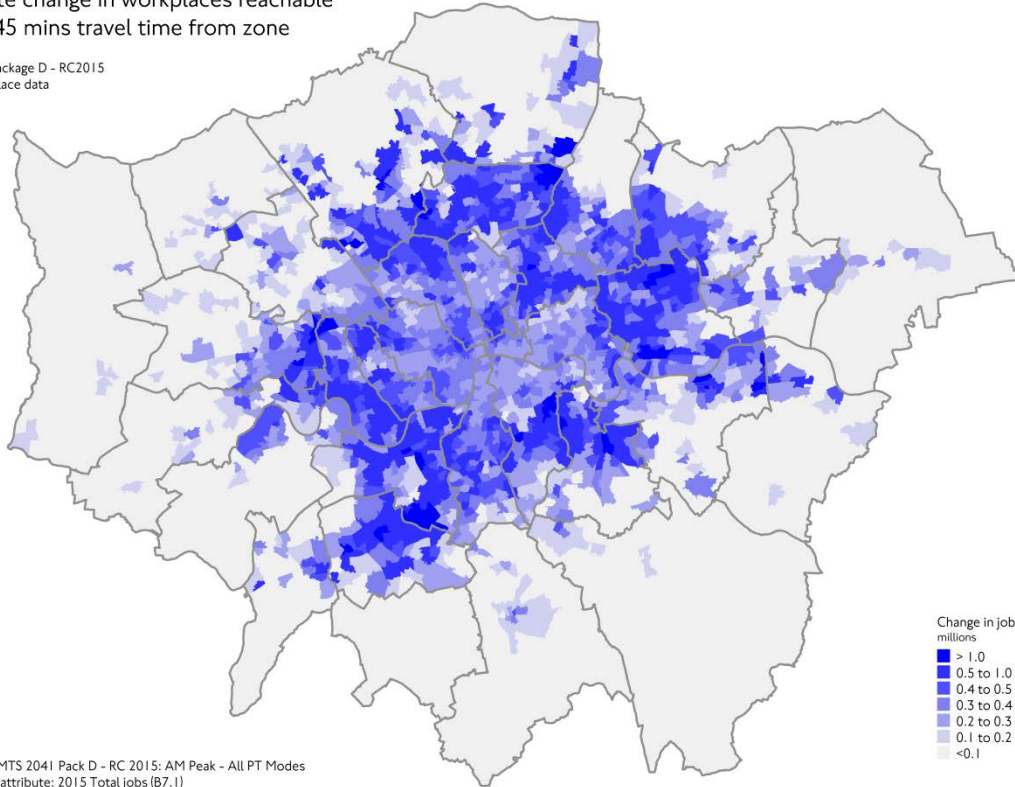
Note

Networks: MTS 2041 Pack D - RC 2015: AM Peak - All PT Modes
Catchment attribute: 2015 Total jobs (B7.1)
Includes data within and outside the GLA boundary

5.   Conclusion

5.1.   The GLA has published a new 2016-based population projection with a spatial distribution that reflects the new 2017 Strategic Housing Land Availability Assessment (SHLAA) and a new 2017 long term labour market projection. These new GLA projections form the basis of the new draft London Plan, and the core reference case used in the draft MTS has been updated to include these new projections of population and employment forming the London Plan core reference case.

5.2.   Total GLA population growth is greater in the new 2016-based projection reaching a total of 10.8 million in 2041 compared to the previous 2015 round projection with a total of 10.5 million in 2041. In 2041, total London employment is projected to reach 6.9 million in the new 2017 projection, compared to 6.7 million in the 2016 projection.

5.3.   Population and employment are key drivers of travel. Travel demand is therefore expected to increase in proportion to the growth in population and employment. Demand for travel is forecast to increase from around 27 million trips per day in 2015 to around 33 million trips per day in 2041.

5.4.   In the London Plan core reference case, car percentage mode share would be expected to fall from 36 per cent of all trips in 2015 to 30 per cent in 2041.The delivery of the MTS would enable travel in London to increase to approximately 33 million trips per day in 2041 in a more sustainable, active and efficient way, with car percentage mode share forecast to fall to 20 per cent in 2041.

5.5.   The draft MTS scenario would result in fewer cars, quicker journey times for cars and buses and enable the reallocation of road space to achieve Healthy Streets.

5.6.   Significant Rail and Tube investment in the draft MTS scenario supports the increased demand for public transport between 2015 and 2041, and results in a decrease in crowding on rail services despite rising passenger numbers.

5.7.   The draft MTS scenario could deliver further significant reductions in the four key emissions CO_2, $PM_{2.5}$, PM_{10} and NO_x by 2041. The draft MTS scenario is also expected to better connect London residents to jobs, services and to one another.

5.8.   **The key conclusion is that if the MTS is delivered, the revised London Plan population and economic growth can be achieved with sustainable transport outcomes. The London Plan and MTS make a sustainable, active and efficient mode share of 80 per cent achievable.**

Appendix 1: Scheme List

Scheme	Scenario*
Elizabeth line	London Plan core ref case
TfL Business Plan Tube service improvements to Victoria Line	London Plan core ref case
Four-Line Modernisation programme – Metropolitan, District, Hammersmith & City and Circle	London Plan core ref case
Northern Line extension	London Plan core ref case
TfL Business Plan DLR capacity and service improvements including New Train for Docklands	London Plan core ref case
TfL Business Plan London Overground capacity and service improvements including Gospel Oak to Barking Line electrification, new trains and increased frequency on North London Line	London Plan core ref case
TfL Business Plan Tram service improvements including Dingwall Loop and increased frequency to New Addington	London Plan core ref case
TfL Business Plan Bus service improvements including changes to bus routes to improve reliability and reduce congestion and additional services to support residential growth	London Plan core ref case
HS2 phase 1 and associated National Rail changes, including mitigation of impacts at street level	London Plan core ref case
Thameslink Programme	London Plan core ref case
HLOS programme	London Plan core ref case
Stratford–Angel Road service	London Plan core ref case
Funded improvements to the cycle network	London Plan core ref case
Healthy Streets portfolio	London Plan core ref case
ULEZ in Central London	London Plan core ref case
Elizabeth Line 30 trains per hour	MTS scenario
Tram upgrades	MTS scenario
Croxley Link	MTS scenario
Bus priority network	MTS scenario
Low Emissions Bus Zones (including bus priority)	MTS scenario
Essex Thameside Increased frequency	MTS scenario
Watford DCs increased frequency	MTS scenario
Great Northern Frequency upgrade	MTS scenario
Healthy Streets Approach	MTS scenario
Longer term replacement of higher capacity trains on Jubilee and Northern lines	MTS scenario
Deep Tube programme – Piccadilly, Central, Bakerloo and Waterloo & City	MTS scenario
DLR upgrades	MTS scenario
London Overground frequency upgrades (network-wide)	MTS scenario

London Suburban Metro	MTS scenario
Brighton Mainline Upgrade (higher frequencies)	MTS scenario
West Anglia Main Line 4-tracking)	MTS scenario
Increased rail capacity (other lines)	MTS scenario
Silvertown Tunnel and associated bus services	MTS scenario
Crossrail 2	MTS scenario
Bakerloo Line extension to Lewisham and beyond	MTS scenario
Elizabeth Line extension east of Abbey Wood	MTS scenario
DLR extension from Gallions Reach to Thamesmead	MTS scenario
Barking Riverside London Overground Extension	MTS scenario
Strategic interchanges at Clapham Junction, Lewisham, Stratford and Old Oak Common	MTS scenario
Other London Overground extensions (including Hounslow–Cricklewood)	MTS scenario
Other new public transport river crossings in East London	MTS scenario
Tram extension to Sutton	MTS scenario
Develop bus network to meet existing and future demand	MTS scenario
HS2 phase 2	MTS scenario
Reduce, re-time and re-mode deliveries and encourage more freight consolidation	MTS scenario
Healthy Streets Approach – further measures	MTS scenario
Traffic reduction measures	MTS scenario
ULEZ in inner London	MTS scenario
Longer term changes to the way road use is paid for	MTS scenario

*All schemes in the London Plan core reference case are also included in the MTS scenario.