

Proposals to reduce transport's contribution to climate change and improve its resilience

5.22 Reducing carbon dioxide emissions

5.22.1 Introduction

⁵⁸⁶ The Mayor proposes to structure his approach to reducing CO₂ emissions from ground-based transport around three core themes:

- Improved operational efficiency – to minimise unnecessary CO₂ emissions
- Supporting and enabling the development and use of low carbon vehicles, technology and energy – has significant potential to deliver CO₂ reductions. This will require close joint working with stakeholders and appropriate incentivisation
- Carbon efficient mode choice – massive investment is underway in London to improve the attractiveness of low carbon modes such as walking, cycling and public transport and to enable the movement of freight by water and rail

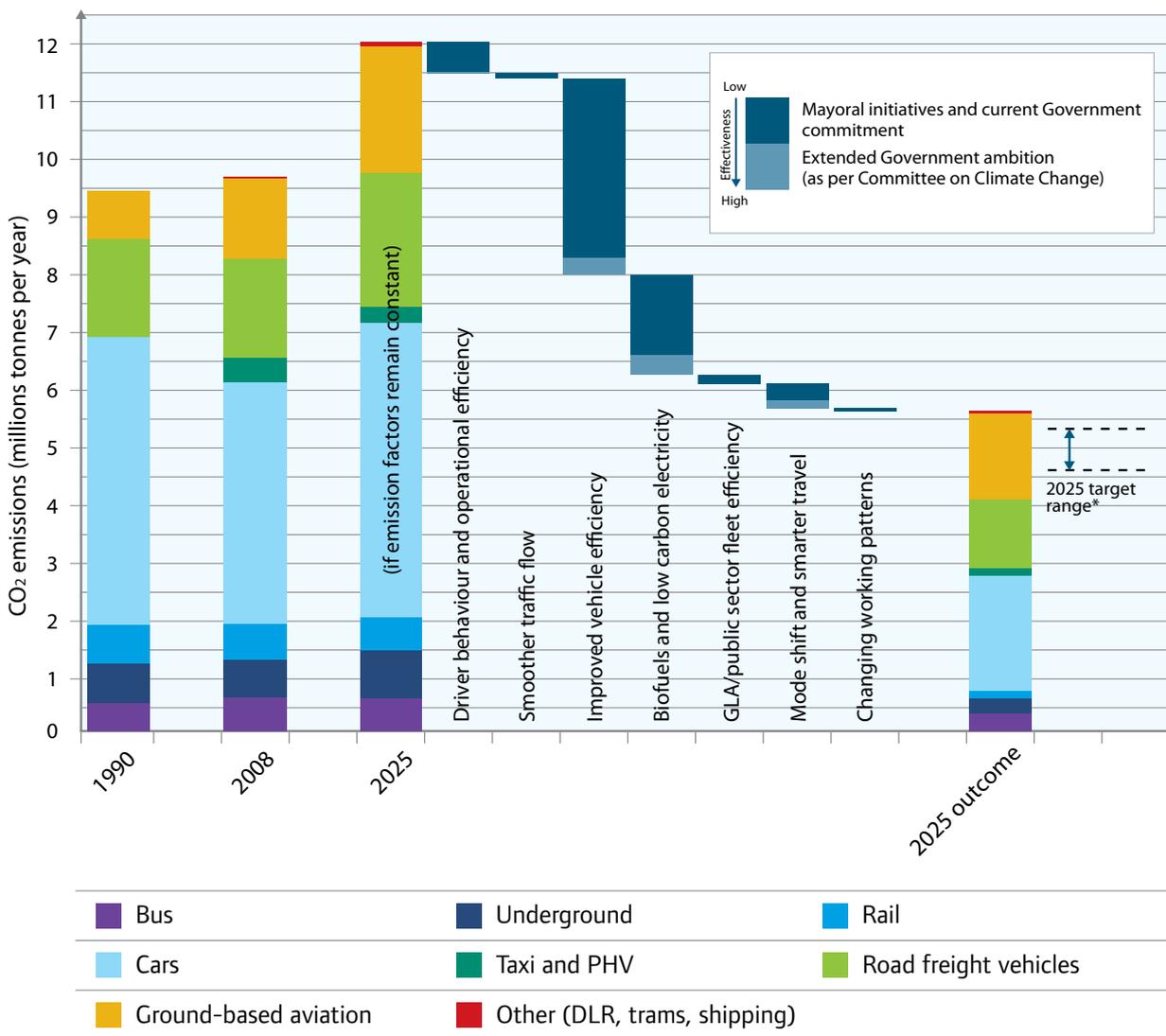
⁵⁸⁷ Significant CO₂ savings are required from all three themes for transport to meet its required contribution to the Mayor's target of a 60 per

cent reduction in London's CO₂ by 2025, from a 1990 base. Meeting this target will require significant investment and effort from the Mayor and a number of stakeholders. However, the Mayor recognises that the long-term costs of inaction are far greater than the shorter-term costs of action.

⁵⁸⁸ Figure 61 illustrates the potential range of contributions from identified policy areas in reducing transport-related CO₂ emissions. The Mayoral initiatives outlined in this document and the Mayor's CCMES together with the current level of Government ambition are anticipated to result in annual transport-related CO₂ emissions in London in 2025 of around 6.4m tonnes.

⁵⁸⁹ If the Government were to adopt the more ambitious approach as called for by the Committee on Climate Change, it is anticipated that annual transport-related CO₂ emissions in London in 2025 would be around 5.6m tonnes. It is anticipated that this higher level of Government ambition, if it were applied across all CO₂ emissions sectors in London, would result in a 57 per cent reduction in London's CO₂ emissions by 2025, compared to a 1990 base.

Figure 61: Mid-range estimate of CO₂ reduction impacts of transport policy areas by 2025



* The contribution required from the transport sector to meet the Mayor's CO₂ emissions target for 2025 is linked to the CO₂ emissions reductions from other sectors. It is anticipated that transport sector CO₂ emissions, in the range indicated on the chart, will be required to meet the Mayor's target of a 60 per cent reduction in London's CO₂ emissions by 2025 compared to 1990

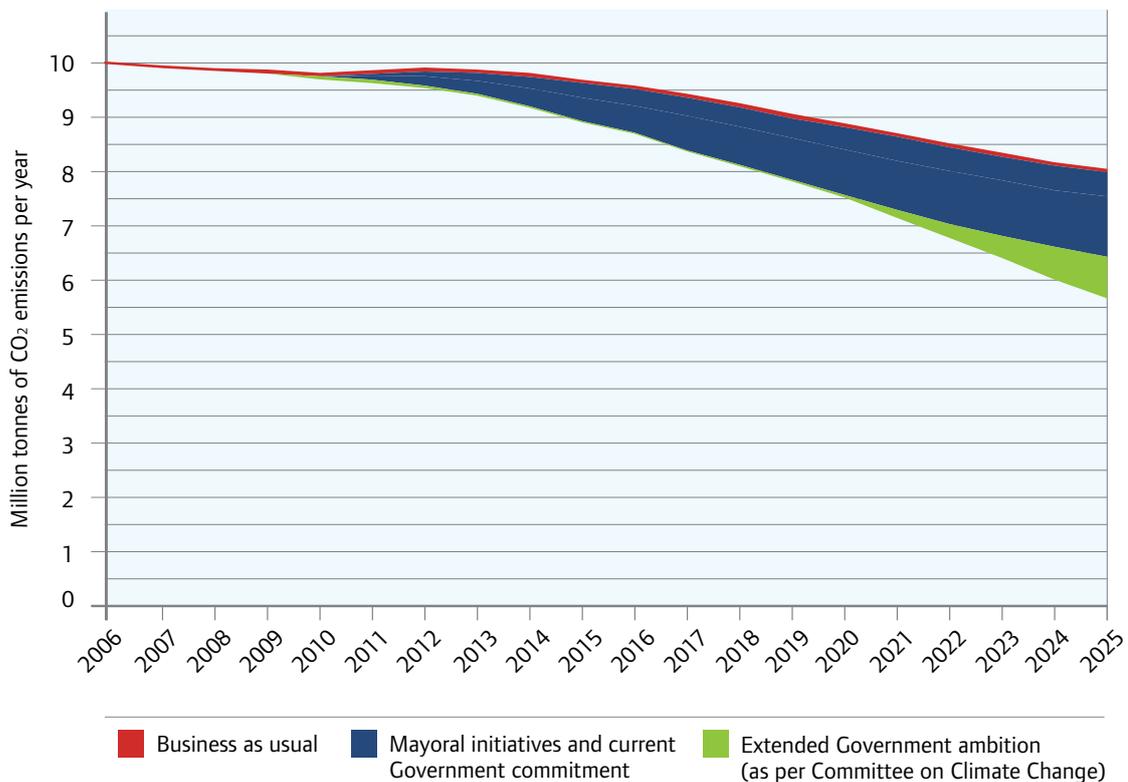
- 590 As illustrated in Figure 61 it is anticipated that transport sector CO₂ emissions in the range of 5.3 to 4.6m tonnes will be required in 2025 to meet the Mayor’s target. A range is given to reflect the level of uncertainty as to the distribution of CO₂ emission reductions across the CCMES emissions sectors of homes, workplaces and transport.
- 591 Figure 62 sets out projected CO₂ emissions reductions that could be achieved through Mayoral and Government transport programmes in London to 2025. The level of

further Government and/or Mayoral action required to meet CO₂ emissions targets will be kept under review as the effectiveness of policies to reduce CO₂ emissions are monitored over the period of the strategy.

5.22.2 Carbon efficient travel behaviour

- 592 Awareness of the environmental impact of travel choices, driving style and vehicle maintenance is growing. Levels of awareness and action must increase in order to minimise the transport carbon footprint within the constraints of available technology and infrastructure.

Figure 62: Projected transport sector CO₂ emissions to 2025



593 TfL has pioneered the use of smarter travel initiatives to achieve improved CO₂ travel efficiency, including the widespread successful uptake of school and workplace travel plans. School travel plans cover nearly all of London's schools resulting in the proportion of trips to school by car reducing by around six per cent. More than 10 per cent of London's workforce work in locations with travel plans, thereby achieving a 13 per cent reduction in the proportion of car journeys to work at these sites. Smarter travel provides the opportunity to further explore flexible working patterns and remote working to support measures to reduce the need to travel, especially during peak hours. TfL has also run a two-year smarter driving campaign which has been complemented by the nationwide 'Act on CO₂' campaign, to communicate clear, practical methods to improve fuel efficiency.

Proposal 96

The Mayor, through TfL, and working with the London boroughs, transport operators and other stakeholders, will promote behavioural change and smarter travel measures aimed at encouraging more use of lower carbon modes, eco-driving practices, better vehicle maintenance and flexible working patterns to reduce CO₂ emissions.

594 Since 2000, the mode share of public transport and cycling has increased significantly. However, the potential exists to achieve more; the programme of committed investment in public transport, cycling and walking in London, and proposals for further schemes

contained within this strategy are anticipated to lead to a continued increase in the use of low carbon modes, with the joint mode share of public transport, cycling and walking expected to increase by six per cent in the period 2006 to 2031.

595 Figure 63 illustrates typical CO₂ emissions associated with the use of different modes of transport. To complement investment in London's transport system, an integrated approach to transport and land use planning will focus London's growth in locations with good public transport accessibility, walk and cycle accessibility and reduce the need to travel.

Proposal 97

The Mayor, through TfL, and working with the London boroughs, transport operators, and other stakeholders, will support, promote and improve sustainable, low CO₂-emitting transport (including public transport, cycling, walking, and rail and water for freight), and reduce the need to travel through integration of transport and land use planning.

- ⁵⁹⁶ London is a national leader in the development of car clubs with a rapidly growing membership of around 100,000. The Mayor will support car club expansion and the introduction of ultra low carbon vehicles to their fleets.

Proposal 98

The Mayor, through TfL, and working with the London boroughs, car club operators, and other stakeholders, will support expansion of car clubs and encourage their use of ultra low carbon vehicles.

5.22.3 Reducing CO₂ emissions from freight delivery

- ⁵⁹⁷ Existing freight-related initiatives such as DSPs, CLPs, and the FORS as defined in the London Freight Plan encourage improved efficiency and provide a framework for incentivisation and regulation. The Mayor will continue to develop these tools over time to ensure continuing and increasing contributions to improved freight movement efficiency.

Proposal 99

The Mayor, through TfL, and working with the London boroughs, road freight operators and other stakeholders, will:

- a) Adopt planning conditions that specify Delivery Service Plans for major developments (by spring 2011)
- b) Aim for 50 per cent of HGVs and vans serving London to be members of FORS by 2016

- c) Encourage, and where appropriate specify, improved freight movement efficiency through, for example, greater consolidation, more off-peak freight movement and greater use of water and rail-based transport
- d) Support freight industry land requirements for locally focused consolidation and/or break-bulk facilities and access to waterways and railways

5.22.4 Improving driving techniques on public transport

- ⁵⁹⁸ It has been demonstrated that driving style can have a significant impact on energy consumption and therefore CO₂ emissions. The Mayor is keen to demonstrate the positive impact driving style can have on reducing CO₂ emissions associated with the public transport fleet.

Proposal 100

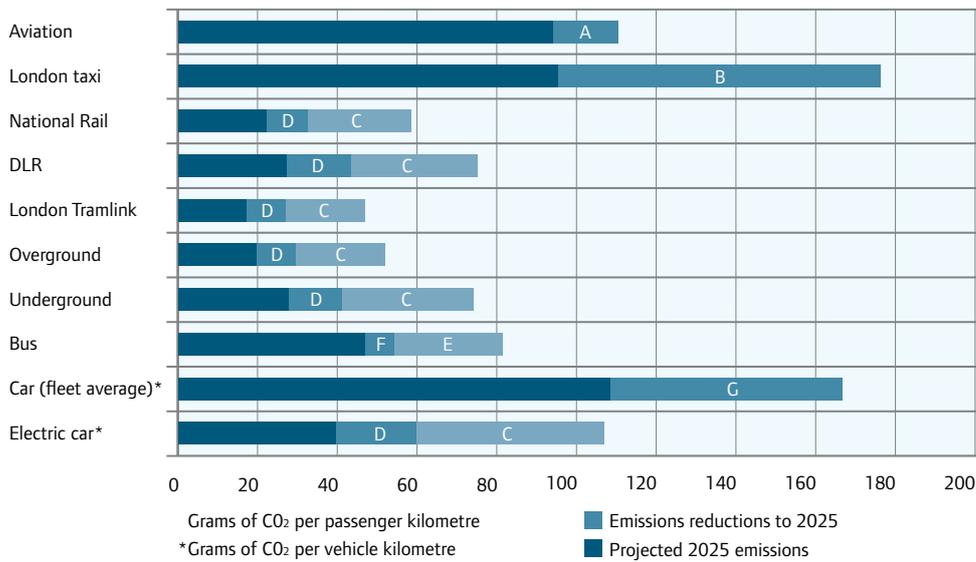
The Mayor, through TfL, will introduce automatic train control (a tool that can optimise energy efficiency through driving style) across the Tube network. Drivers of non-automatic railways, such as London Overground, will be given training on energy efficient driving style, as will London's bus drivers.

5.22.5 Reducing CO₂ emissions from aviation

599 Over 60 per cent growth in passenger numbers is anticipated at London's airports in the period to 2031. Therefore, efforts must be redoubled to tackle the environmental impacts of aviation if demand growth is to be met in a sustainable manner. The Mayor's powers to influence CO₂ emissions from aviation are limited, however, Government has a target to reduce aviation CO₂ emissions to below 2005 levels by 2050. Inclusion of aviation within the EU Emissions Trading Scheme provides a legal

framework through which to meet the target. The international connectivity that aviation provides is crucial to the competitiveness of London's economy in this era of globalisation. Therefore, strict limits on aviation growth in the London area are not tenable, nor would they be effective with demand shifting to competing aviation hubs. Meeting both the Government target for aviation CO₂ emissions and the Mayor's target for London CO₂ emissions will require either a breakthrough in aviation carbon efficiency or significantly lower than forecast growth. The Mayor supports the expansion of competitive rail-based alternatives to aviation,

Figure 63: CO₂ emissions by mode: 2008/09 emissions and 2025 projections



- Carbon reduction initiatives**
- A: Technological and operational improvements to 2025
 - B: Low carbon taxis
 - C: Low carbon electricity supply (300g CO₂ per kWh)
 - D: Extended Government ambition low carbon electricity (200g CO₂ per kWh)
 - E: Diesel-electric hybrids
 - F: 2025 further CO₂ reduction potential (eg biofuels, electric power, hydrogen, etc)
 - G: EU 2020 average new car CO₂ emissions target met

Case study

Electric road vehicles

Electric power has been identified as a particularly promising way to reduce emissions of CO₂, air pollutants and noise from road vehicles and reduce dependence on fossil fuels.

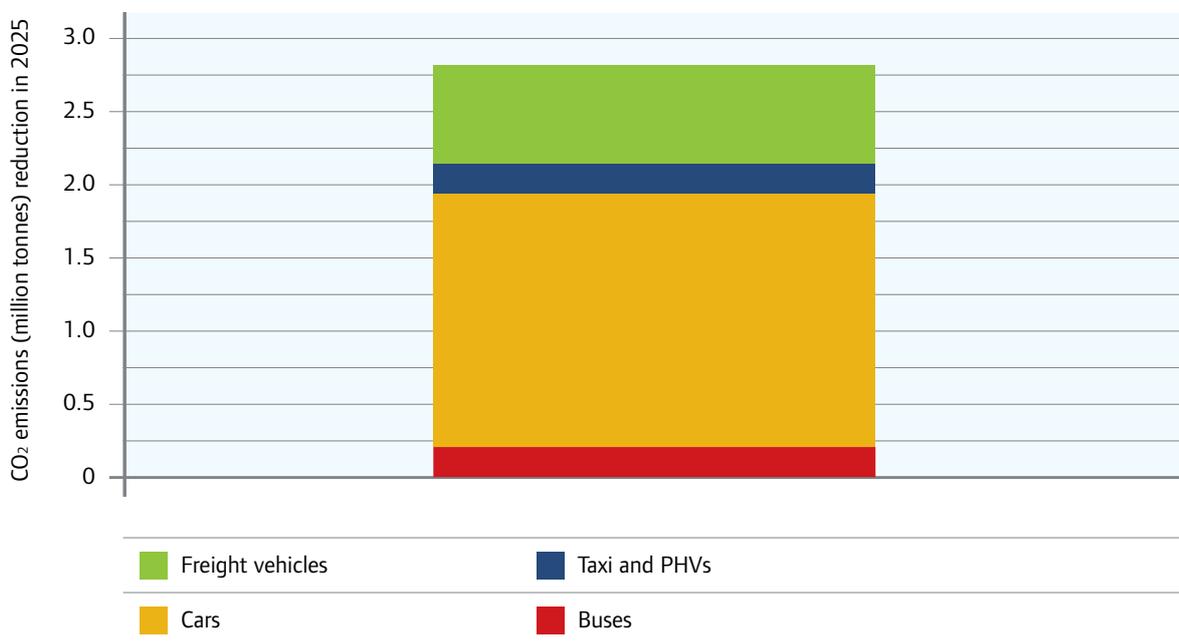
The inherent advantage of an electric motor is that typically around 90 per cent energy conversion efficiency is achieved, as opposed to around 20 per cent with internal combustion engines. CO₂ emissions associated with EVs are ultimately determined by electricity generation. Currently EVs account for around 40 per cent less CO₂ per kilometre than the average London car. As electricity generation becomes

more efficient, the carbon efficiency of EVs will improve further.

Plug-in hybrid, extended range electric and fully electric vehicles that offer the performance of conventional vehicles will be available on the mass market in the coming years. Plug-in hybrid and extended range EVs will generally have a range sufficient for a typical household's routine daily use, with the ability to use hydrocarbon-power on longer journeys. The uptake of EVs in London is a Mayoral priority, not only for environmental reasons, but also for the associated economic and job creation opportunities.



Figure 64: Annual road transport CO₂ emissions reductions by 2025, compared to 2007, due to improved vehicle efficiency



such as high-speed rail (for more details on high-speed rail, see the rail section 5.2).

- 600 The Mayor's target for CO₂ emission reductions includes emissions from ground-based aviation at Heathrow and London City airports (including take-off and landing cycles to an altitude of 1,000 metres).

Proposal 101

The Mayor, through TfL, or otherwise, will work with the DfT and other stakeholders to promote research, investment and regulation to achieve improved aviation carbon efficiency.

5.22.6 Smoothing traffic flow

- 601 Stop-start traffic conditions and congestion leads to increased CO₂ emissions. Improved management of London's road network (including rephasing of traffic signals and introduction of a state-of-the-art traffic control centre) and driver information will enable a smoother flow of traffic and ultimately reduce CO₂ emissions given a constant volume of road traffic (further detail of smoothing traffic flow is given in section 5.6, Managing the road network).

Proposal 102

The Mayor, through TfL, and working with the London boroughs, Highways Agency, and other stakeholders, will implement a package of measures (including signal timing reviews and the coordination of traffic signals) to reduce road traffic emissions by smoothing the flow of traffic and optimising the efficiency of London's road network.

5.22.7 Development and use of low carbon vehicles, energy and design principles

- ⁶⁰² Substantial reductions in transport-related CO₂ emissions are achievable through the use of low carbon vehicle technologies and fuels, particularly for road and rail-based transport. Technological hurdles to the decarbonisation of aviation and water-based transport remain more challenging. Strong incentivisation must be in place to catalyse the mass market uptake of low carbon vehicles and discourage use of higher CO₂-emitting vehicles. Implementation of distribution infrastructure networks for alternative fuel sources, such as electric charging points, biofuels and hydrogen refuelling facilities, will play a crucial enabling role. The MTS recognises other low carbon technologies may be forthcoming.
- ⁶⁰³ Figure 64 illustrates the anticipated annual CO₂ emission reductions in London in 2025 as a result of improved vehicle efficiency, compared to 2007 vehicle efficiencies.

- ⁶⁰⁴ While much can be done at a local level to accelerate the uptake of low carbon technology (for example, parking and Congestion Charging incentives and provision of support infrastructure such as electric charging points), national and international incentives in the areas of industry support and vehicle purchase and scrappage will be crucial to realising the full potential rate of change and scale of impact.

Proposal 103

The Mayor, through TfL, and by working with the London boroughs, will encourage a switch from conventional to low CO₂-emitting road vehicles and low carbon fuel sources where feasible. The Mayor will lobby Government and other stakeholders to follow suit in order to establish a package of integrated incentives across national, regional and local government to ensure low carbon road vehicles are price competitive with conventional technology.

- ⁶⁰⁵ Road vehicles currently account for around 72 per cent of ground-based transport CO₂ emissions in London. Reducing emissions from road vehicles will be achieved through a number of means, for example, improved internal combustion engine efficiency, hybridisation, biofuels, hydrogen and electric power¹. In the long run, the combination of electric power and decarbonisation of electricity generation has the potential to go a long way to the decarbonisation of car use. This would meet environmental needs, while maintaining the societal and economic benefits

¹ The Mayor launched 'An Electric Vehicle Delivery Plan for London' in May 2009

realised through the advent of affordable private motorised travel. Regulation and incentivisation will play key roles in determining the rate of change.

606 Given the international nature of the climate change challenge, the large automobile and aircraft manufacturing companies and regulations and agreements at an international level have the potential to be particularly effective. EU regulations will enforce average emissions from new cars in Europe of 130g CO₂/km from 2015 (compared to around 150g CO₂/km today), with a target of 95g CO₂/km by 2020. A similar EU directive is being negotiated for vans. The Mayor supports further development of the Copenhagen Accord to deliver a binding international agreement to tackle emissions from aviation and shipping.

607 The Mayor supports the use of sustainable biofuels. The European Renewable Energy and Fuel Quality Directives require that 10 per cent of transport energy comes from renewable sources by 2020. It is intended that the national Renewable Transport Fuel Obligation be updated to reflect the EU target.

Proposal 104

The Mayor, through TfL, or otherwise, will continue to examine the feasibility of increasing the use of sustainable biofuels in vehicle fleets controlled or regulated by Mayoral bodies, and will encourage the boroughs and other vehicle fleet operators to do likewise.

608 The Mayor aims to secure a London EV fleet of 100,000 vehicles as soon as possible, including GLA and functional body vehicles. To support the uptake of electric-powered road vehicles the Mayor is committed to supporting the delivery of a network of electric recharging points in London.

Proposal 105

The Mayor, through TfL, and working with the London boroughs and other stakeholders, will enable and support the development and mass market uptake of low carbon road vehicles (including EVs) through, for example, the delivery of infrastructure required for the distribution of alternative transport fuel sources, including EV recharging points.

609 The Mayor recognises that the provision of charging points will play a crucial enabling role in the conversion to electric powered road vehicles and fully supports initiatives to streamline the planning process to enable implementation of EV charging points. However, he also recognises that EV charging infrastructure must be integrated sympathetically with the urban realm and on building exteriors. In particular, opportunities to integrate EV charging infrastructure with other street furniture should be sought to minimise street clutter in support of the 'better streets' initiative.

610 London's Electric Vehicle Infrastructure Strategy¹ provides further detail on plans for EV recharging infrastructure in London. The Mayor

¹ Launched by the Mayor for consultation in December 2009

is aware that mass-market introduction of EVs is dependent on joint working across a number of stakeholders. The Mayor will therefore continue to develop the London Electric Vehicle Centre of Excellence and Electric Vehicle Partnership as well as being an active member of the nationwide Low Carbon Vehicle Partnership.

- 611 The majority of London's rail-based public transport networks are electrified. The Mayor will lobby for further investment to complete electrification of London's rail network, including the Gospel Oak to Barking line. Regenerative braking (which typically provides around 15 per cent CO₂ savings) is a feature on a number of recently introduced rail fleets and is now standard on all new electric-powered rail rolling stock. Rolling stock on the Central,

Jubilee and Northern lines, the DLR and some of the more modern National Rail fleet in London are capable of transferring electricity produced while braking to the power supply network for other trains to use.

Proposal 106

The Mayor, through TfL, and working with Network Rail, and the DfT, will endeavour to:

- Provide low loss electricity supply infrastructure on London's rail networks
- Implement regenerative braking where feasible on London's rail networks
- Develop, trial and seek to implement measures that minimise the loss through electricity distribution on the Underground





5.22.8 Energy supply

⁶¹² Electricity is anticipated to supply a growing proportion of transport energy requirement. Therefore, the CO₂ efficiency of transport and electricity generation will become ever more closely linked. The Mayor's support for decentralised energy production in London will lead to CO₂ savings and improve security of supply as will Government ambitions for decarbonisation of the National Grid supply. Uptake of electric powered road vehicles will increase demand for electricity. However, it is anticipated that the majority of the additional demand could be met without substantial additional generating capacity if incentives to ensure the vast majority of recharging occurs at night are provided.

Proposal 107

The Mayor, through TfL, and working with the DfT, energy companies, and other stakeholders, will deliver additional low/zero carbon electricity-generating capacity and investigate the potential for micro-generation at sites on the transport system.

5.22.9 Mayoral innovation and leadership

⁶¹³ The strategy builds on a track record of Mayoral innovation and leadership in addressing the challenge to achieve carbon efficiency. In 2007/08, TfL established a three-year £25m Climate Change Fund to support schemes to reduce CO₂ emissions and trial low carbon technologies.

⁶¹⁴ The Mayor intends to continue to lead by example to demonstrate what is achievable through low carbon best practice. A trial of light emitting diode (LED) traffic signals that reduce power consumption by around 60 per cent has been successful and funding is available to install LED signals at around 300 junctions across London. The Mayor supports the further trialling and roll-out of LED low energy lighting technology at signals, street lights, stations and other locations across London.

Proposal 108

The Mayor, through TfL, and working with the London boroughs and other stakeholders, will promote CO₂ standards for vehicles and infrastructure controlled, procured or regulated by the Mayor, GLA Group and/or other public sector bodies (for example, public transport vehicles, taxis, street and station lighting and infrastructure embodied carbon) to reduce emissions from existing and new vehicles and infrastructure, including the following specific measures:

- a) The Mayor, through his functional bodies, will increase the proportion of his vehicle fleet powered by electricity
- b) All new buses entering fleets operated on behalf of the Mayor from 2011/12 will be lower carbon
- c) Work with vehicle manufacturers and the taxi trade to develop a new low carbon and low air pollutant version of the London taxi

- d) A trial of at least five hydrogen powered buses from 2010
- e) Trialling of low energy station lighting and automatic meter reading
- f) LED traffic signals preferred to conventional technology when replacing life-expired signal sets and further development of LED lighting leading to a preference for LED technology when replacing life-expired lighting, if proved to be feasible
- g) Major infrastructure schemes will conduct a carbon footprint assessment
- h) Where relevant, encourage the GLA group, boroughs, other public sector bodies and their suppliers to procure freight services from FORS members or freight operators able to demonstrate equivalent competencies

⁶¹⁵ The Mayor recognises that in many cases improving energy efficiency not only brings environmental benefits but can save money. TfL will participate in the Carbon Reduction Commitment, covering the use of energy for non-motive purposes (for example, lighting and offices) which provides a financial incentive to secure greater CO₂ reductions than peer organisations. TfL engagement with the

Mayor's Building Energy Efficiency Programme is anticipated to continue to reduce energy consumption in office buildings and save TfL money. The Mayor is also keen to create stronger links between efficiency requirements and procurement processes, a combination that has already demonstrated an ability to reduce environmental impacts and save money.

⁶¹⁶ It is anticipated that the previously outlined measures will be insufficient to achieve the Mayor's target for reductions in London's CO₂ emissions by 2025. Accordingly, further action from Government, the Mayor and/or London boroughs will be required. The Mayor's CCMES contains further details.

Proposal 109

The Mayor, through TfL, and working with the London boroughs, DfT, Highways Agency, and other stakeholders, will keep under review the option of road user charging and/or regulatory demand management measures to influence a shift to more CO₂-efficient private and commercial road vehicles, and to lower carbon travel options such as walking, cycling and public transport.

5.23 Adapting to climate change

5.23.1 Introduction

- ⁶¹⁷ There is substantive scientific evidence that our climate is changing. Despite efforts to mitigate emissions of greenhouse gases, deviations from long-term climatic trends experienced over past years are projected to intensify. Changes in London's climate as a result of increasing concentrations of greenhouse gases (most notably CO₂) in the earth's atmosphere are anticipated to be milder, wetter winters and hotter, drier summers. An increased frequency of 'extreme' weather conditions such as heatwaves, droughts, tidal surges, storms and heavy rainfall is also predicted.
- ⁶¹⁸ The result would bring an increased risk of flooding, storm damage, droughts and uncomfortably hot weather, together with secondary consequences such as increased incidence of ground instability/movement and periods of poor air quality in the summer. Furthermore, sea levels are forecast to rise, adding to the risk of flooding. Climate change is anticipated to have health impacts on Londoners, ranging from heat-related illnesses to injuries, stress and anxiety caused by extreme weather events. In addition, heatwaves can exacerbate the health impacts of air pollution.
- ⁶¹⁹ The Mayor's Climate Change Adaptation Strategy sets out the priorities for climate change related risk assessment, including for transport infrastructure and services.
- ⁶²⁰ The London transport system comprises infrastructure that has been built over a number of centuries to varying standards and specifications. Long-lived infrastructure such as embankments, cuttings and bridges will be vulnerable to climate change as a result of increased incidence of intense rainfall and greater inter-seasonal temperature and soil moisture variation. Additionally, the London Regional Flood Risk Appraisal finds that around a quarter of Underground (including DLR) stations, 15 per cent of rail stations, 30 per cent of bus depots and London City airport are in locations identified as being at risk from tidal or fluvial flooding. A programme of risk assessment must be completed to gain a better understanding of the vulnerability of the transport system to the threats posed by climate change.

Proposal 110

The Mayor, through TfL, and by working with the London boroughs, Network Rail, Highways Agency, airport operators and other stakeholders, will determine the vulnerability of transport assets to the impacts of climate change and maintain existing infrastructure (including remedial works where effective and affordable) to improve resilience to climate change.

- ⁶²¹ Effective and affordable solutions must be sought to reduce potential risk to passengers from the threats posed by climate change, and improve the operational resilience of the transport system. In some instances alteration of maintenance regimes may achieve improved resilience to the threats of climate change. For

example, poorly maintained storm drains have been identified as the source of some past Tube flooding incidences.

- 622 Measures to adapt to future climate change will make London's transport system more resilient to extreme weather conditions that currently occur, often with significant impacts. For example, the rainstorm of 7 August 2002 forced five main line London rail termini to shut for a number of hours over the rush hour.

Proposal 111

The Mayor, through TfL, and working with the London boroughs, Network Rail, and other stakeholders, will prepare adaptation strategies to improve safety and network resilience to threats posed by climate change, and ensure that new transport infrastructure is appropriately resilient. The adaptation strategy should include:

- a) Climate change impacts risk assessment of infrastructure and operations to identify key risks and mitigation opportunities
- b) The prioritisation of identified risks and proposals for appropriate management and/or mitigation action plans, including emergency planning and investment plans
- c) Guidelines for major procurement contracts (including design, construction and maintenance) to demonstrate a climate risk assessment for the lifetime of the investment

- 623 To ensure long-term value for money is achieved through transport investment

programmes, new transport infrastructure must also be designed and built with climate change in mind. The existing system will be adapted where possible in a cost effective manner.

Proposal 112

The Mayor, through TfL, and working with the London boroughs, Network Rail and other transport infrastructure owners, will ensure the transport system is developed with climate change in mind, by:

- a) Designing, locating and constructing new infrastructure to withstand climatic conditions anticipated over its design life
- b) Introducing energy efficient air-conditioned rolling stock where feasible, for example, on London Overground services and sub-surface Tube lines
- c) Continuing to investigate the feasibility of innovative methods of cooling the deep tunnelled sections of the Tube network
- d) Ensuring that all new buses entering the London fleet will feature specific climate change adaptation measures

- 624 Increasing the number of trees and vegetation in London (urban greening) will contribute climate change adaptation and mitigation by providing shade and absorbing rain water. This will also enhance the built environment by improving the urban realm and increasing biodiversity.

Proposal 113

The Mayor, through TfL, and working with London boroughs, Network Rail and other transport infrastructure owners, will plant an additional 10,000 street trees by 2012, with the ambition of an additional two million trees in London's parks, gardens and green spaces by 2025.

625 Despite best efforts to assess, manage and mitigate risks, it will be impractical and unaffordable to eliminate all risks posed by climate change to London's transport system. However, as the occurrence of severe weather

events increase in future years, contingency planning for these conditions will become ever more important in maintaining a safe and reliable transport system. Figure 65 shows areas of London at tidal and fluvial flood risk.

Proposal 114

The Mayor, through TfL, and working with the London boroughs, Network Rail, and other stakeholders, will develop and test plans and procedures to minimise risk to person and property, manage disruption and ensure rapid transport system recovery from the impact of climate change related events.

Figure 65: Areas at risk of tidal and fluvial flooding in London

