TRANSPORT 2000 trust

LONDON COUNCILS

Low carbon transport for outer London

A report by MTRU for Transport 2000

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Executive summary

Concerns about the urgent need to tackle global warming continue to grow. The Government's working target of reducing Co2 emissions by 60 per cent by 2050 is being addressed in other sectors, but there is still considerable uncertainty about how transport could, or should, meet such a target. In London the Mayor has made the reduction of the city's contribution to climate change a high priority, and the current review of the London Plan also prioritises transport and London's suburbs.

The critical role of outer London

Analysing new and still unpublished data from the latest London Area Travel Survey, this study shows how critical outer London is for London's overall transport emissions and car use. Half of all journeys, and 87 per cent of all car driver trips, are made in outer London. Only 13 per cent of journeys are made by public transport in outer London compared to 62 per cent of journeys between inner and central London. Traffic volumes have been reduced substantially in central London, and stabilised or moderately reduced in inner London, but in outer London they continue to grow.

While car use is high in outer London, public transport use is surprisingly low, and there is considerable potential for growth. Despite more dispersed development, walking still accounts for about a third of all journeys and could account for more. Cycle use is negligible and has even higher potential.

Improving fuel efficiency and reducing traffic

This study reaches conclusions that point the way to effective policies. In order to meet climate-change objectives, it will be necessary to increase the fuel efficiency of engines through technological improvements, as well as reducing traffic levels in outer London.

The study identifies three general policy approaches that would reduce traffic. Allowance is made for underlying growth so these approaches represent reductions on the higher levels of traffic predicted for the future. Together they could achieve a 17 per cent reduction in car use by 2050, compared to 2000 levels.

- **A new flexibility in the provision of public transport** should include intermediate modes of light or ultra-light rail, guided bus and demand-responsive bus services, and additional bus priority integrated with the tendering process. These could achieve at least a 10 per cent traffic reduction in the medium term.
- **Intensive travel planning**, including workplace and personalised travel planning would help to reduce traffic. Particularly if combined with parking-space charges or wider congestion charging, this could have a rapid impact and reduce traffic by 20 per cent.

- **Land-use policies** to promote improved access, higher densities and reduced parking would allow more journeys to be made on foot and by bicycle, would have a gradual but consistent impact on traffic volume and would eventually produce a 20 per cent traffic reduction.

Making an early start

Thus a target of a 60 per cent reduction in carbon emissions can be achieved by a combination of improved fuel efficiency and traffic reduction. It is entirely realistic and would still leave car use in outer London 40 per cent higher than today's inner London level. The study estimates the growth in travel by other modes that would result from these policy changes and, again, these are realistic. Walking would go up by one third, cycling would quadruple from a very low base, and public transport use would double. A key conclusion of the study is that it is essential to make an early start on these policies, both to minimise outer London's contribution to climate change and to ease transition to more benign arrangements.

An opportunity to revise traffic targets

The Mayor's Transport Strategy set targets, reiterated in the London Plan, of reducing traffic in central London by 15 per cent, maintaining traffic volumes in inner London at the present level and reducing the rate of growth (not the absolute amount) of traffic in outer London by one third. It would be feasible to amend the outer London target to stabilisation by 2015, returning to 2000 levels by 2025 and 17 per cent reduction by 2050. Combined with technological improvements, this would allow a 60 per cent reduction in outer London climate-change emissions from transport, in line with national targets. It would bring a very real improvement in the quality of many suburban areas and in the quality of life of the 60 per cent of Londoners who live in the outer boroughs of the capital.

1. Introduction

Climate change: the wider context

While there is widespread acceptance that global warming is a problem, and that greenhouse gas emissions must be reduced, a clear pathway to achieving major reductions in transport has not been set out. The Government working target of reducing Co2 emissions by 60 per cent by 2050 has been addressed in other sectors, for example, housing, but there is considerable uncertainty as to how transport could or should meet such a target.

There are two basic ways in which reductions can be approached. The first is through technological change to vehicles, or the fuel which they use, which reduces the carbon emitted per mile travelled. The second is to reduce the total amount of travel through various demand management policies. The two can of course be combined. A completely technological solution does not appear to be available within the timescale of the targets.

Key technological options for the future are to:

- increase the efficiency of vehicles (public, private or goods)
- replace current fuels in whole or in part with so-called 'biofuels'
- introduce hydrogen based fuel cells.

The demand management options include:

- reducing the need for personal travel through land use policy
- reducing the need for goods movements through localising economic activities and increasing efficiency
- substituting communications for travel (for example, through use of the internet)
- making less carbon intensive forms of transport more attractive (carrots)
- making more carbon intensive forms of transport less attractive (sticks).

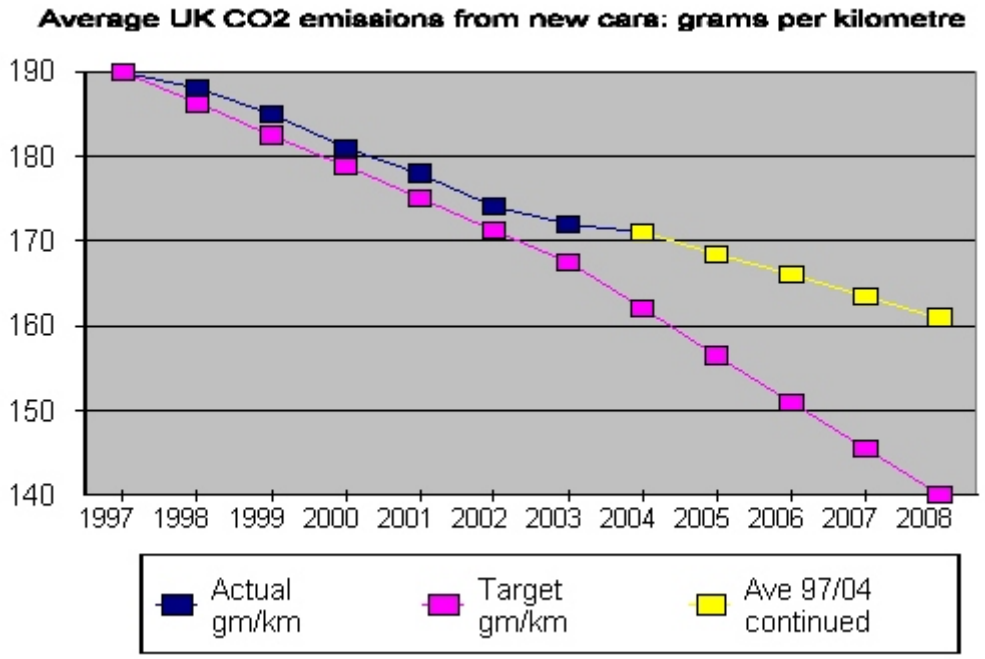
Technological solutions

The technological options for addressing climate change depend on national, and to an extent European, policies, although the introduction of the best performing vehicles could be accelerated in local areas. For this reason, before focussing on outer London - the case study for this report - it is important to review briefly the technological options from a national perspective.

Increasing vehicle efficiency

The EU is active in setting targets to improve vehicle efficiency, for example, with targets for reducing the grams of carbon needed per kilometre travelled for new cars sold. At the moment (2004) this is about 171gm in the UK and the EU hopes to achieve 140gm by 2008 and 120gm by 2012 through voluntary agreement with manufacturers. The UK target is for 10 per cent of new cars to achieve 100gm per km by 2012. Most independent observers do not believe these targets can be met. The reason for this is shown in Figure 1.1. While progress was made initially, it has now slowed.

Figure 1.1



Source: SMMT published data

The early gains were made, at least in part, due to increased sales of diesel cars. This is not without its problems - TfL considers that the lack of improvement in air quality in London is most probably explained by the increasing use of diesel cars.

The figures should in any case be treated with caution. They always relate to actual performance, for example, air conditioning, which can increase fuel consumption by 5-15 per cent, is *not* included in the target level. All car accessories that use power (CD, radio, heated seats etc) increase fuel use and thus carbon emitted.

There are also many trade offs in vehicle design, particularly between weight, safety, and engine efficiency. Different designs are better suited to different styles of driving. Clearly it is possible to reduce fuel consumption for cars by moving to smaller, lighter vehicles. However, such options are not available for goods vehicles or buses.

It is also possible to reduce carbon emissions further by using diesel instead of petrol, and sales of such cars have increased significantly, now providing over a third of all new cars in the UK. On average, however, they produce only 6 per cent less carbon, perhaps because they are used in larger vehicles such as 4X4s. Diesel has always dominated the commercial vehicle sector. There do not appear to be national carbon emission targets for goods vehicles or buses. The use of fuel duty rebates for buses does not encourage energy efficiency.

The hybrid approach

Perhaps the best known technology to reduce carbon emissions is the use of ‘hybrid’ technology which uses a small engine plus a battery and a braking system which will charge the battery instead of wasting the energy as heat. The engine either charges the battery or works with the battery to improve performance. Such systems are already available in production model cars and buses - there are a few in the UK but more in the US. It is

possible to achieve carbon reductions of about 40 per cent and much of this is in urban driving conditions because of the regenerative braking and the fact that the conventional engine is switched off. Some hybrids are actually more efficient in urban conditions than on motorways and this has an interesting policy impact. Pollution from congested urban conditions may no longer be a major problem if hybrids become more common.

Use of hybrid technology for buses and lorries is potentially attractive but there is little incentive to introduce it at present. Indeed, bus travel is supported by operators receiving a fuel duty rebate (BSOG) rather than being paid for the service they deliver. A hybrid bus would therefore take about twice as long to recoup its extra capital cost than otherwise - at current prices this strongly discourages their purchase, although models are available. It is suggested that as a matter of urgency a working group is set up with the industry to review and reform BSOG. This would be associated with flagship trials of the new vehicles. While this report was being completed (April 2006), Transport for London (TfL) has in fact announced that it will test six hybrid buses in service.

While electric-only vehicles are zero emitters locally, they require charging and thus rely on distant power generation which has its own carbon emission problems and distribution losses. Localisation of power generation and alternative energy supplies (wind, wave, biomass) may alter this picture but for the time being the hybrid approach seems to be promising and offers a track record in terms of producing viable production models. Long term reliability and endurance are yet to be fully tested. It seems sensible to assume that levels of improvement that are known to be achievable should be built in to our estimates of the carbon that will be produced by transport in future years. The issue is how quickly the new technology could spread. Early scrapping of vehicles could of course be counter productive, due to the very significant emissions from new car production.

Replacing current fuel with biofuel

There has been much interest in biofuels and an EU directive that seeks to increase the use of plant material to produce fuel. The material which can be used range from sugar beet to small trees and include some waste products such as straw or forestry trimmings. Biofuel is usually added to existing petrol or diesel at about 5 per cent although some can be used neat (for example, recycled cooking oil). There are some problems associated with widespread use of biofuels such as ethanol at high concentrations.

In addition there are high energy requirements for the production of fuels, including the use of artificial fertilisers, chemical preparation of the plant material, and heating during fermentation and distillation. There would be significant plant and labour costs. There are different methods of production and the Government therefore uses a savings figure of 40-57 per cent (Department for Transport, 2005).

The agricultural land required is also an important factor. There may be some land that is currently unused but if biofuel were to be a major replacement for petrol there would need to be a massive change in land use. A more likely alternative is the import of plant material, for example, date palm oil. This in turn would have a major environmental impact locally.

However, there is a further point that complicates the biofuel argument. The true cost of using land to produce carbon fuel is often assumed to be zero. In fact the use of ‘spare’ land for absorbing carbon (‘fixing’), for example, through forestry, means that there is a loss in terms of overall carbon reduction. In many parts of the world it is more likely that existing forests would be cleared and replaced with biofuel plantations. This would cause an immediate carbon release and loss of a long term carbon ‘sink’.

One very promising area is the transformation of agricultural waste into fuel where current forms of disposal that release carbon dioxide or methane can be avoided. On the other hand, local heat and power production may be a better way of reducing carbon dioxide emissions than using it for transport.

A hydrogen based solution

The use of hydrogen in fuel cells can produce electricity and the only waste is water. This makes it very attractive from the pollution point of view. However, the hydrogen needs to be produced and this requires energy, for example, passing electricity through water to produce hydrogen and oxygen. Other methods range from biological 'fermentation' to the use of superheated coal dust and steam. Currently most hydrogen is made from methane, and this process itself produces carbon dioxide. Many of the future methods are as yet untried but the first attempt to combine coal and steam and store the carbon dioxide underground is starting in the US. This is a decade-long project and the outcomes are uncertain.

The hydrogen is stored under extreme pressure, but is so light that simple leaks from a vehicle should not cause safety problems. However, major questions remain over transporting large volumes in tankers, storing it and then distributing it. There are already hydrogen stations in existence (for example, the 'hydrogen highway' in California), but to provide a network equivalent to the petrol stations of today would require a huge investment. There are other possibilities for using hydrogen in vehicles but these are speculative at the scale of current vehicle use.

Most promising is the use of hydrogen in specialist vehicles such as buses or light trams and the EU 'CUTE' programme has had buses running successfully in several cities including London.

Climate change and outer London

The commitment by the new Greater London Authority (GLA) to tackle the issues raised is clear in the statutory frameworks such as the Mayor's Transport Strategy (MTS) and especially the Spatial Development Strategy (*The London Plan*). A specific new organisation - the 'Climate Change Agency' has also been set up. The recent report on the environmental effectiveness of London (GLA, June 2005) shows how transport Co2 emissions are lower per unit of economic activity than in other regions. However, this is not surprising given the compact nature of London, its strong public transport network and the economic emphasis on finance, law and administration.

The role of outer London in addressing the issue of climate change and transport in London as a whole is difficult to overestimate. For example, 87 per cent of all car driver journeys by London residents end in outer London. This is shown in Figure 1.2 below. While the congestion charge may be effective, its impact on Londoners' traffic as a whole is remarkably small (less than half a percent). Within the charging zone of course, congestion has been reduced very significantly.

For the purposes of this and other data in this report, the definition of outer, inner and central London is drawn from the London Area Transportation Survey (LATS). This is based on areas smaller than boroughs which are then aggregated together. However, in broad terms outer London is very similar to the commonly used definition including the 19 outer boroughs. Further discussion of the LATS zones and districts can be found in the annual 'London Travel Report'.

Figure 1.2

Share of London car drivers
By destination area of London

Source: LATS 2001/2

From the above it is clear that the key task in tackling CO2 emissions from passenger transport in London is to address car use in outer London.

2. Approach in this study

Developing a low carbon emissions scenario in outer London

This report is intended to start the process of developing a low carbon emissions scenario for outer London. Transport policy in London is to a great extent the responsibility of the London Mayor and the Greater London Authority (GLA). The Mayor has produced a Transport Strategy and a Spatial Development Strategy has also been approved. Both support the reduction of greenhouse gases but neither have detailed proposals aimed specifically at reducing them. In fact outer London transport policies are less well developed in general. A 'Climate Change Agency' has now been established but its impact on transport is uncertain.

The data from the 2001/2 London Area Transport Survey (LATS) is now becoming available and this has been used extensively to explore what the patterns of travel are in outer London and potential influences on people's travel choice. The data has been extracted by MTRU directly from the Survey.

A working target for a low emissions scenario is to reduce carbon by 60 per cent by 2050 and by 50 per cent by 2030. Both of these targets are drawn from national research and are parallel to those adopted for the housing sector. While the London economy is generally less carbon intensive than elsewhere and traffic growth is predicted to be much slower than in other parts of the country, the national targets must include a London share. Regions which have less opportunity for modal shift through public transport may well expect London to exceed the national target.

Improving fuel efficiency

The starting point is to look at levels of carbon emissions from transport in outer London and how they might grow using different assumptions about traffic. This includes an allowance for the introduction of new technologies to improve fuel efficiency.

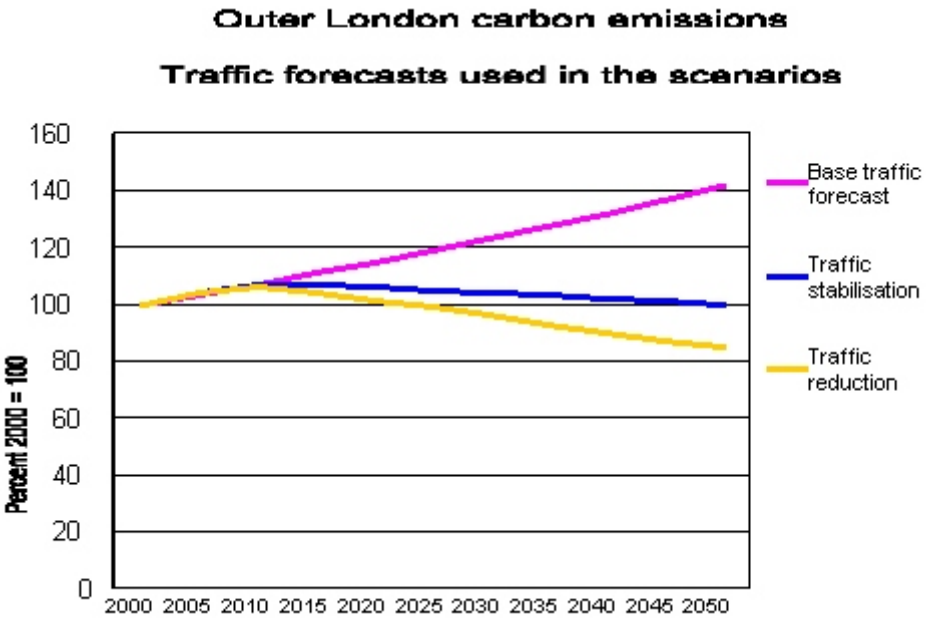
There is however, one note of caution on fuel efficiency. Currently there are voluntary agreements with the vehicle producers in Europe, Japan and Korea that the average fuel efficiency of new cars will improve so that instead of using 190 grams of carbon per kilometre (as in 1995) they will produce 140 grams. Progress was made at first, but has ground to a halt and this target is becoming increasingly implausible. This was shown in Figure 1.1 above.

The national road traffic forecasts assume that the voluntary agreement is achieved and new agreements achieve similar improvements. Interestingly the improved efficiency is predicted to encourage a little more traffic because driving gets cheaper. This illustrates the need for an integrated approach which avoids counter productive side effects. The risk of this happening has influenced the design of the exemplar transport policies for outer London set out later in this report.

Estimating traffic growth rates

To provide a base line, the current traffic growth rates for outer London are extended into the future. These are slower than national growth trends, but still significant at 41 per cent over the study period (2000-2050). This is shown in Figure 2.1 below as the 'Base' forecast.

Figure 2.1



Source: GLA forecasts & MTRU projections

While the base forecast uses GLA predictions to 2010 and extends them at the same rate, the 'traffic stabilisation' forecast assumes the GLA prediction to 2010 but then gradually brings traffic back to 2000 levels by the end of the study period. The traffic reduction forecast assumes that traffic can be stabilised more quickly, given the urgent need and the fact that many policies will have a significant impact within 10 to 20 years. This trend of reduction is then continued to the end of the study period.

Using the national assumptions it is then possible to estimate future carbon emissions. This is done in Figure 2.2 below. However, a variation was also tested in which it was assumed that efficiency could be improved faster, creating a fleet in 2025 that was as efficient on average as the best available vehicles today (small diesels and hybrids). This appears as the 'Higher Efficiency' option on the graph.

What is clear from the spreadsheet based forecasting done for this report is that outer London will not meet the national reduction targets through improvements to fuel efficiency alone. Even stabilising traffic will only allow targets to be met if all the vehicles in outer London in 2025 are as efficient as the best today. Given the time taken to replace vehicles and the current low availability and use of such vehicles this must be a risky strategy.

This illustrates two key points for policymakers.

The need for efficiency plus demand management

First, the pursuit of a twin track approach (efficiency plus demand management) clearly reduces risk of failing to reach the targets. Demand management may be politically more complex, but it can be achieved with a higher degree of certainty than a longer term technological 'fix'.

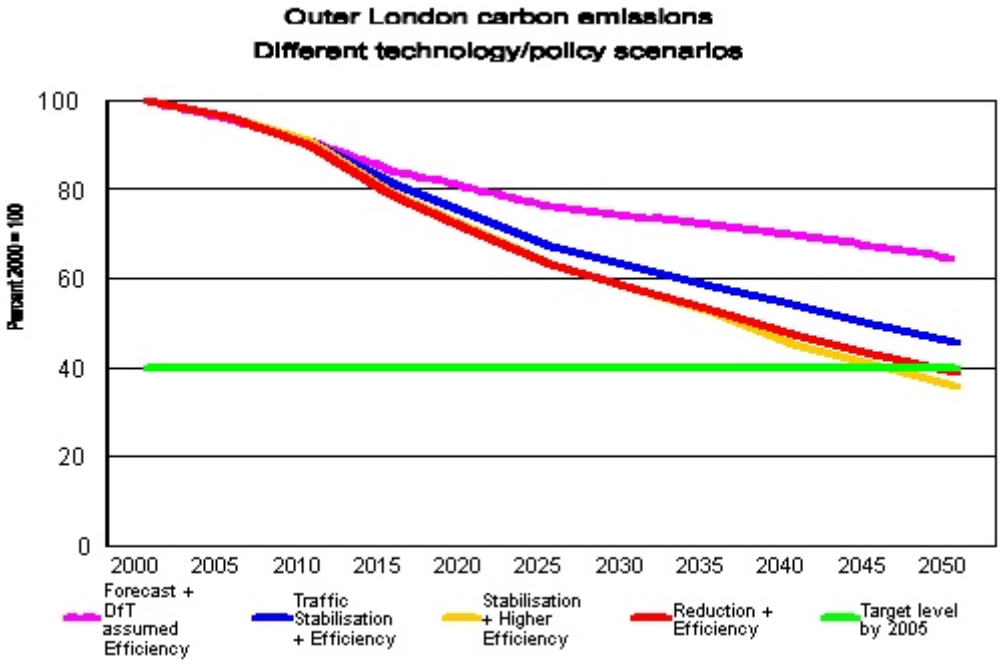
The importance of meeting low emissions targets

Secondly, exceeding the targets or, more importantly achieving them more quickly, reduces the total carbon dioxide output between now and 2050. This in turn reduces the climate change risk. It should be noted that the current target is not predicated on restoring historically stable levels of carbon dioxide in the atmosphere, but on achieving what is thought to be an acceptable increase. Commentators have already suggested that the 2050 target could be achieved by 2030 (VIBAT study, UCL and Halcrow, 2005) and that an 80 per cent reduction by 2050 may well be more realistic in relation to preventing climate change.

For these reasons this report sets out a set of policies which would achieve traffic reduction in outer London. Before doing so it undertakes an analysis of how much people travel to achieve different purposes (work, leisure, shopping, education etc.). This can then be linked to policy measures and their potential to achieve change.

Finally it should be noted that outer London conditions are typical of many outer conurbations and smaller urban areas. The travel patterns and travel solutions set out later in the report would be just as relevant in such places.

Figure 2.2



Source: DfT national forecasts, TfL forecast, MTRU calculations

3. Travel in different areas of London

Data sources

The most recent survey of Londoners' travel patterns (LATS, 2001/2) is now available and allows considerable exploration of how and why people travel. Thus much information in this section is drawn from new tabulations of the household data from LATS prepared for this report by MTRU. Throughout this section there is a focus on how the data suggests what schemes might be successful in creating more sustainable patterns of travel.

It should be noted that this extensive data is based on households and includes very little travel that starts outside the Greater London boundary. The data available for road traffic, for example, comes from Government traffic counts and TfL speed surveys. These two do not reach the same conclusions and this is discussed later in this section.

Nevertheless the household data reveals the overall picture, apart from long distance commuting and travel into the major outer London town centres from outside London, for example Kingston and Bromley.

Mode shares in outer London and London as a whole

In outer London it is clear that the role of the car is far greater than elsewhere - 70 per cent of all car journeys in London start there. However, this needs to be examined in more depth to understand why this is the case and what influences people's car use.

Journey lengths and mode share

Lower density of population should mean longer journeys and thus fewer trips on foot and more in vehicles. For example, for journeys within inner London there are twice as many trips on foot as by car. However, within outer London there are 21 per cent more car trips than those on foot. Perhaps surprisingly, walking is still the second most frequent choice for making journeys in outer London. The strong correlation between journey distance and walking is shown in Table 3.1 below.

Table 3.1: Journey lengths and walking mode share

Area	Percentage **Trips less than 1km**	Percentage **Walking mode share**
Within central London	68.3	75.1
Within inner London	48.3	46.8
Within outer London	37.5	30.6
Between inner and central	5.1	10.9
Between outer and inner	3.3	5.9
Between outer and central	0	1.5

Source: LATS database, MTRU tabulation

One immediate observation must be that the lower densities and dispersed facilities in outer

London are an important factor in car use. Policies that seek to reduce the need to travel by creating more dense and self sustaining communities are almost certain to lead to more walking and less use of mechanised modes. This will be a factor in designing the policy measures that are proposed later in this report.

Share of travel by different modes

The next piece of basic information is the share of personal travel taken by different modes both within different areas and for travel between them. This is based on the main mode used for any particular journey.

Table 3.2: Mode share by area of London: percentage of journeys

	Within			***Between***		
	Outer Lon	Inner Lon	Central L	IL & CL	OL & IL	OL & CL
Car driver	37.2	20.3	3.8	12.5	39.8	12.0
Car pass	15.9	8.5	1.6	4.8	13.2	4.0
Nat Rail	1.0	1.6	0.5	10.7	9.5	36.9
Ugrd/DLR	1.0	4.3	8.9	33.3	12.6	36.9
Bus/coach/tram	10.9	14.0	5.5	17.8	13.1	3.6
Walk	30.6	46.8	75.1	10.9	5.9	1.5
Cycle	1.3	2.1	0.7	3.6	1.4	0.8
Van/lorry	1.0	0.6	0.2	0.5	1.9	0.9
Taxi	0.7	1.4	3.3	3.9	1.2	1.3
M'cycle	0.3	0.3	0.4	1.7	1.2	2.0
Total	*100*	*100*	*100*	*100*	*100*	*100*

Source: LATS database, MTRU tabulation

The pattern of mode choice revealed in this table is logical; however, the performance of public transport for journeys in outer London is perhaps even worse than might have been imagined. It should be noted that some improvement to bus share should have taken place since the 2001 survey. It is, however, unknown whether this has reduced car use, walking or cycling.

Thus one of the first conclusions from the data is that walking is still very important in terms of the journeys made, even though they are much shorter. While outer London has a great deal of car use, walking is still very popular. This was underestimated in the 1991 survey because the shortest journeys were excluded and has important policy implications, particularly for land-use policies.

Share of journeys by area

Next it is clear that the highest car use for travel (car drivers in the above Table) is not actually within outer London, but between outer and inner London. Journeys are longer and hence walking is at a low level. However, Underground and bus use seem underdeveloped, especially when compared to their strong performance for journeys from inner to central

London. The reasons for this may be related to parking controls. The 2001 LATS household survey shows that, even in inner London, 80 per cent of drivers do not pay for their parking.

As expected, London's residents, especially those in outer London, are using suburban rail and Underground to travel to central London to a very great extent (up to 36.9 per cent). However, this use evaporates for travel within outer London (1 per cent) and more surprisingly is very weak for travel within inner London (1.6 per cent for rail and 4.3 per cent for Underground).

In terms of public transport share, this is not compensated for by significant increases in bus travel. In outer London there are many more car passengers than bus passengers.

Considering the policy implications, this suggests it is worth dealing with the 'missing mode' (i.e. intermediate mode similar to rail) by creating rapid transit services. In London the focus seems to be on heavy trams, but both guided bus and ultra light rail systems that do not need overhead wires may provide far cheaper solutions which can be implemented more quickly and more extensively. This is particularly true in outer areas. Policies that increase densities to create more local communities will make walking attractive but will also make the servicing of such communities with intermediate modes more practical.

To put the above figures in context, Table 3.3 shows how many trips take place in the different areas of London providing the basis for Table 3.2. Clearly the most significant numbers of journeys by London residents take place in outer London. The fact that journeys to central London appear low is explained by the large number of people who travel in from outside the Greater London area. However, it illustrates the importance of outer London in terms of sheer volume of travel and why it is crucial to the development of transport policies for Londoners as a whole.

Table 3.3: Share of journeys by area of London

Area	*Percent*
Within outer London	49.6
Within inner London	22.3
Within central London	4.4
Between inner and central	6.6
Between outer and inner	8.8
Between outer and central	4.8

Source: LATS database, MTRU tabulation

The nature of car travel in outer London

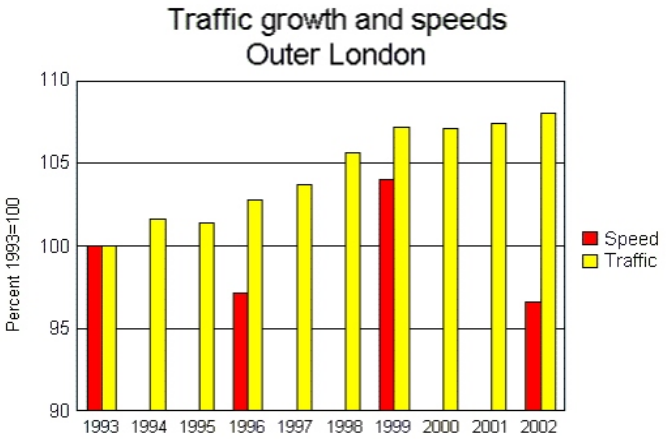
Having established the context, it is now possible to examine the nature of outer London's travel in more detail. The first issue concerns how fast it is growing and what impact this is having on the environment and congestion.

Traffic speeds and growth

It is clear that the published tables are not really compatible and this is shown in Figure 3.1 below. It is not clear which one is the best guide to what is really happening on street

although both indicate growth. The speed surveys are on a three year cycle and this may not provide a sufficiently robust data set. In either case this report recommends an assessment of what is required to provide a more certain measure of London's traffic growth, or whether the difference can be explained and a true picture obtained. The growth given by the Mayor's Strategy was used for Sections 1 and 2.

Figure 3.1



Source: London Speed Survey, Mayor's Transport Strategy

Journey purpose

Journeys are made for a variety of purposes, as shown in Figure 3.2 below. What is remarkable is that a quarter of all car trips in outer London - more than for commuting - are made to pick people up and drop them off. Over three-quarters of all car escort trips made by Londoners are made in outer London.

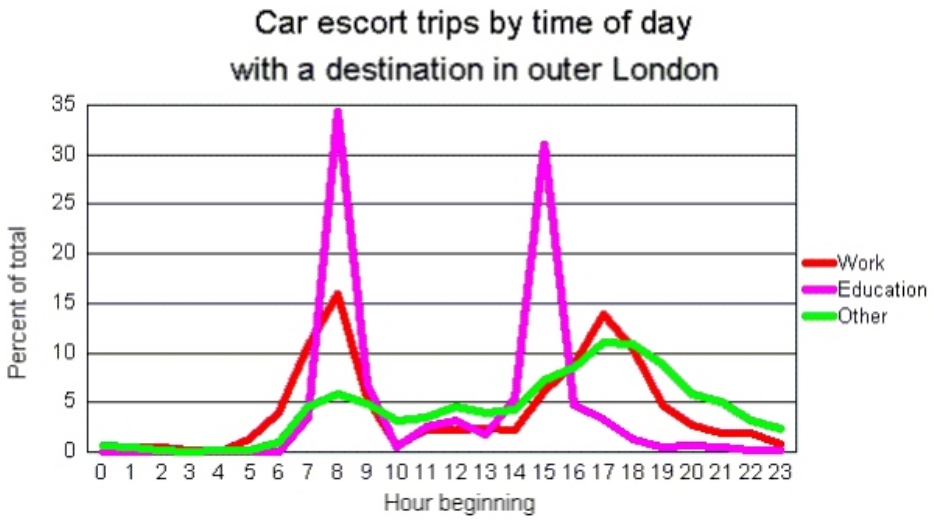
Figure 3.2

Source: LATS database, MTRU tabulation

Time of journey

Again the LATS 2001/2 data provides interesting information, as shown in Figure 3.3 below.

Figure 3.3



Source: LATS database, MTRU tabulation

Escort education (giving lifts to nursery, school or college) has, as expected, two clear peaks, one at 8-9am the other at 3-4pm (together accounting for two thirds of all escort education journeys). The much smaller number of car drivers taking people to work peaks at 7-9am (27 per cent of all trips). The afternoon escort work trips are slightly more dispersed with a peak between 4-7pm. These two peaks account for 60 per cent of all work escort trips.

Escort trips not for education or work purposes are more evenly spread through the day; however, they do have an evening peak. Between 5pm and midnight about half of these escort trips take place. This probably reflects shopping escort trips during the day and leisure/entertainment trips during the evening.

Paying for parking

Another key factor in car use in outer London can be drawn from the data on parking. From this it is very clear that the vast majority (95 per cent) of car parking is uncontrolled (no permit needed) or not charged for. Even in inner London, 80 per cent of parking was unpaid, although the number of cars parking was only a third of the level in outer London.

This strongly suggests that the tool of controlling parking is still largely underused in outer London. This could be extended through conventional means or through financial instruments such as the Workplace Parking Charge.

Conclusions

The data from London residents provides an insight into people's reasons for travel and the traffic patterns these produce. It is possible to use this information to develop policies to achieve the desired reduction in carbon emissions from transport in outer London. Ways forward, including some specific proposals, are set out in the next section.

4. A new approach to low carbon patterns of travel for outer London

Finding appropriate solutions

This report has shown how important outer London is in terms of transport emissions and how car use, as well as car efficiency, must be addressed if greenhouse gases from transport are to be reduced. Overall it will be necessary to at least stabilise and reduce traffic levels in outer London as soon as possible.

The study has taken an approach based on the different purposes behind car travel and now offers some solutions as to how people can fulfil those purposes while lowering their carbon use. Improving vehicle efficiency is also important, but only falls within the remit of the strategic authority for London to a limited extent, such as TfL's bus specifications and the regulation of goods vehicles. One example of a London initiative is the exemption of hybrid technology vehicles from the congestion charge. These powers should, however, be used to support the national and regional policies for carbon reduction in a transparent and integrated way.

The other solutions involve changing travel behaviour, which is in turn locked into land-use patterns and lifestyles. Internet shopping, digital photography (especially home printing) and mobile phone use are good examples of how traditional activities can change radically and very rapidly. Working with change is a key approach to reducing carbon levels, which is a weak area of current transport policy. At the moment if new technology reduces the need to travel this seems to be a fortuitous accident rather than any conscious engagement. A process such as this requires continuous monitoring and adjustment - it is in stark contrast to the single acts of infrastructure building that have previously dominated transport thinking. Infrastructure changes or construction may well be required, but they should start from people's behavioural responses (either in their personal travel needs or in relation to their business) to new objectives. If they do not, they will be inefficient, fail to deliver or, even worse, prove to be counter productive.

Land use planning, access and sustainable communities

In many ways national guidance and the regional framework (the London Plan) recognise the need for land-use planning to reduce the need to travel. Put simply this means that development should occur where local facilities are available and where the vast majority of longer-distance journeys can be undertaken by fast and convenient public transport services. This is exactly in tune with the Government's policies both for transport and for sustainable communities. It seems obvious that the other side to this approach is that areas where these conditions have not been achieved should not be developed to any significant degree without a guaranteed action plan to bring them up to the standards required.

Unfortunately the policies to achieve this are weak, for example, there is no clear procedure to identify and make good deficiencies in the provision of public transport services. The parking standards for outer London set out in the London Plan show huge variation and are not linked to the sustainability objectives. They will, however, be key in influencing how people travel. Public transport accessibility is not used to decide whether a particular level of development is acceptable, but whether more parking is needed if non-car modes are unavailable. This need not of itself encourage car-based development, but it creates a loophole through which pressure can be (and is) applied to relax parking limits.

New Government advice on using an accessibility analysis for new development is an improvement, but there are no accompanying mechanisms to create genuine consistency between planning authorities in reducing car-based development. This is unfortunately echoed in the London Plan, at least for office development. This will lead, as it has done so far, to a levelling down by planning authorities in outer London and the surrounding regions to the least sustainable level. Requiring companies to set up travel plans to avoid car commuting as part of planning permission is now accepted but how meaningful will this be without limits on the size of the company car park?

This illustrates the problem which could be tackled by applying the following principle in relation to transport and non-residential development:

The scale of development on a particular site would be limited by the ability of public transport and the local walk and cycle catchments to serve it.

The logic for this is simple - what counts on a transport network is how much travel a site generates. At the moment, for example, parking standards are usually worked out on floor area not site area. This means that a tower block with restricted parking can cause more congestion than a low-rise building with generous parking. It is surprising that this rather obvious fact has not caused a shift in the way parking standards are expressed, despite various proposals to do so. What it should also do, for the most part, is to relate the scale of development to the site's accessibility by sustainable modes. Clearly some car use will be catered for, but this should be related to national and regional targets for overall traffic. Without such direct and transparent links such policies cannot be effective.

Top down objectives, bottom up policies

One of the problems in developing transport policies is reconciling the 'top down' and 'bottom up' approaches. The first sets high level objectives, for example, improving safety and security, translates these into meaningful operation objectives and then sets targets for achieving them. Problems are defined as failing to meet objectives.

The second approach starts by analysing existing conditions and identifies problems immediately, for example, road congestion, and generates ideas to tackle them.

Both have strengths and weaknesses, for example, in the top down approach it can be difficult to translate high level goals into specific, stand alone operational objectives. It is surprising how confused even general aims can be. Second, the setting of targets can distort the prioritisation of schemes to those which will hit the right target at the right time. Without targets the process cannot be monitored, but this should not be allowed to drift away from the original objectives.

In the bottom up approach one weakness is that the full range of problems and, crucially, the relationships between them, may not be identified. Another is that transport solutions are often the opposite of what seems 'obvious'. One example is the provision of road capacity increases to deal with congestion in areas of high car ownership. The problem here is that car demand is very expandable to fill new capacity and thus such policies will not work without management policies, which usually have to involve price. To illustrate that this is a problem for all motorised modes, another example would be reducing public transport fares to attract car users. This can also generate new or longer trips or even switch people from walking. Both these examples may have a role in a well rounded package, but applied on their own can create as many new problems as the ones they were supposed to solve.

The approach adopted here is to assume the high level objective of carbon reduction and accept the Government's committed target for such reduction nationally for outer London. This represents the top down contribution.

Next, policies to achieve this target are derived by analysing why people are currently using cars to travel, in this instance, using journey purpose data for outer London and the experience of policy implementation in London and elsewhere. These policies give rise to the need for change, including charging for transport and represent more of a bottom up approach. Thus a policy to charge cars is not seen as a macro-economic instrument which operates on everyone's travel at the high level but one which should support behavioural change on the ground. This may be less 'pure' in economic theory, but relates better to people's actual travel.

Thus the next part of the study focuses on some of the pathways to improvement for outer London through journey purposes. Transport provision and improvement relates directly to these and are supported through a new financial or regulatory 'push-pull' framework. This is not comprehensive but gives a good indication of where policies need to be developed. Where possible, a timetable or start date relating to the recommended actions is included.

In some instances the proposals have been grouped, for example, bus services are considered as a whole in relation to the new approach. It should be noted that this programme is geared towards the provision of transport services which would impact in the short to medium term; therefore we have not considered the impact of huge schemes such as Crossrail. Nor has it been within the scope of this study to consider the particular schemes serving the 2012 Olympics, although it will be difficult to resolve the issue of long term benefit to London versus serving a one-off event. The next section, however, starts by discussing the role of personal travel planning.

5. Pathways to reducing carbon for outer London

Starting with the individual - travel planning: commuting and beyond

The idea of asking people individually what changes would persuade them to change the way they travel, and then using this information to develop schemes which deliver what they want, might seem a rather obvious way of planning transport. Nevertheless, until a few years ago this approach was considered too labour intensive and inefficient, and instead large computer models were used to predict people's behaviour. Such predictions were frequently wrong and in any case required large-scale surveys of how people react in order to make them work.

Asking commuters about their travel

Just over a decade ago planners began to go back to the individual-based approach, at first in relation to commuting. Thus they began by talking to employees in their workplaces and undertaking simple mapping of where they lived using postcode data. New targeted schemes were then devised based on these individual workplaces. Most of these are reasonably successful and some achieve striking results in persuading people to reduce car use and increase use of alternative modes of transport.

It should be noted that these travel planning techniques are not the same as the generalised promotion of sustainable travel, for example, the 'leave your car at home' campaigns. Such marketing can support travel planning, but the planning itself is far more than persuasion. All the successful plans deliver through specific action plans, often involving changes to public transport services (including fare discounts), improving walking and cycling, operating car share schemes and providing financial incentives. Since the first schemes in the 1990s there are now many well documented examples of how this works, and the approach is well supported in Government policy and by many local authorities. Green commuter plans (now called company travel plans); school travel planning (including safe routes to schools); and personal travel planning (talking through people's travel needs in an interview process) are examples of these techniques.

Financial incentives

However, these initiatives are usually considered as some sort of accessory to the main body of work - this contains all the rail schemes, bus priority and other traditional elements of a transport strategy. Such attitudes seriously underestimate the role and the impact of individual based travel planning. For a fraction of the cost company travel plans have achieved a shift from car to public transport that puts tram schemes to shame. Involving the person who actually makes the travel decision in designing their service, and having the means to deliver the finance and service package they want, is a very powerful combination. Few employers are large enough or have the motivation to undertake this work. However, local authorities can use development control to insist on such plans, and new ways are being found to provide financial incentives.

A good example of the latter is the linking of workplace parking charges (which can now be imposed by local authorities) to company travel planning. Once parking space arrives on the company balance sheet as a cost, it is taken far more seriously. This influence is made stronger by ideas such as that pioneered by Nottingham, where the city is planning to pay back any of the parking space charge spent on legitimate company travel plans. This also helps to show that the charge is not a tax but a means of incentivising change. Thus if most employees avoided driving to work, there would be hardly any income but massive

environmental improvement and reductions in congestion. The synergy between the financial framework for transport and travel planning is strong and provides a clear way forward.

So what could be achieved? The answer is that percentage changes in travel choice which are in double figures are normal at individual workplaces or in areas where individual households are involved. While this report was being finalised TfL announced (March 2006) a pilot travel advice scheme covering 24,000 households in Kingston. What is essential is that such schemes are rolled out on a sufficient scale and that transport provision is genuinely influenced by people's needs. It is not just a question of making everyone better informed. This is very relevant to company plans: even where businesses are very small, initiatives that cover a number that are local to each other can be implemented.

Local authorities taking the lead

Thus the local authority should take the lead and there need to be two key mechanisms to be in place. The first is some means to encourage a high level of take up, for example, workplace charging at the company level. The second is a feedback mechanism from the travel planners to the service designers and providers. In London this is straightforward for buses - TfL has responsibility - and items such as walking and cycling routes are the subject of joint working with the boroughs. Fares are again mainly a TfL responsibility. National Rail services and stations are more complicated and services in particular are hard to influence. However, the creation of new super transit routes (see below) would offer a faster and controllable means of supplying longer distance travel options.

Guaranteeing the full effect of travel plans needs to encompass other areas of London life such as shopping and leisure; here again there is huge scope for combining the planning of new developments with travel. Southampton, for example, ensured through the planning process that when a new football stadium was built, fans received a public transport ticket attached to their entrance ticket.

Changing attitudes to travel planning

Above all the attitude that makes travel planning a poor relation and somehow not 'real' transport needs to be overcome and funding at a realistic level introduced. This would still be small compared to the cost of many road and public transport schemes and could be funded through new methods of charging. The travel purpose which is clearly a quick win is commuting, but this is not growing as fast as some others, for example there are as many leisure and shopping journeys as commuting and business trips. Overall the new approach would identify and deliver new demand for the sustainable modes of transport.

Ways forward would be:

- setting up a new initiative across all journey purposes to integrate travel planning with service design (extending current scheme starting 2006)
- expanding TfL's current travel planning role and closer working with boroughs, including a new London wide partnership (by end 2006)
- producing a good practice guide for London (by end 2006)
- ensuring all boroughs have their own travel plans in place and audited (by end 2006)
- boroughs taking a lead in creating new partnerships with local business
- setting up new financial incentives for employers and employees to make a change (starting end 2006)
- preparing for charging, for example, in workplaces, but implementation avoided if targets are achieved by voluntary means (starting end 2006).

Transforming London's on-street public transport

Current expansion plans

A great deal of new money has been invested in London's buses over the last four to five years and it has provided two main improvements. The first is a simplification and reduction in fares, especially relative to the Underground. The second is a significant increase in existing services and measures to protect them from congestion.

However, this expenditure has taken the form of more of the same rather than dramatically changing the services themselves. And providing more of the same has been very expensive - moving from a balance between operating costs and fares income in 1998 to losses in excess of £600 million in 2004. Costs are still rising and predicted to do so between now and the end of the decade. In the most recent TfL Business Plan, costs rise by £484 million from 2005 to 2010 with a rise in bus journeys of 147 million. Extra use is welcome but for each additional journey an additional £3.29 extra cost is involved. Income is bound to be significantly less than £1, leading to support per extra trip of at least £2.50. This is very similar to the previous five years.

This cost problem is compounded by the fact that some of the new bus passenger journeys have transferred from the Underground and thus income has been lost elsewhere on the public transport system.

The other area in on-street public transport where TfL has been active is promoting tram systems, both in Docklands and West London. Existing schemes have been successful in attracting passengers but also involve high infrastructure costs. Traffic diversions to create street space for trams in West London have caused serious opposition from local residents.

A new approach to transforming services

London's bus routes have evolved over decades and some still reflect old tram or trolleybus routes. New routes have been planned and attempts made to address congestion delays by shortening routes. Services linking mainline stations and others with limited stops have also been introduced. However, this has not amounted to the level of improvement that is needed to make bus travel sufficiently attractive, especially to car owners.

How should we approach London's on-street public transport? The first thing to do is set out the different types of journeys people want to make by bus. These are divided into three basic levels:

Micro services: where the bus is smaller, gets closer to where people live and has some of the benefits of a taxi or the car.
Classic services: the majority of current services - these need to be improved in an integrated way on a route by route basis and developed in response to new passenger demand.
Super services: More comprehensive faster services with purpose built vehicles and extensive priority, providing new levels of service for many journeys where conventional buses are too slow and rail (light or heavy) is unavailable. These could either be bus type vehicles that resembled trams, or bus type vehicles which run on rails, sometimes referred to as ultra light rail (ULR).

Micro services

The simplest, shortest journeys are very local in nature - maybe to get to the local shops, town centre or school from their home. But people also need to get to other public transport services - to the station or to pick up another bus. Such services need to get as close as

possible to people's homes, and the new ideas now being introduced in cities in the UK would benefit Londoners too. These include small buses which visit areas 'on demand' and can be booked by phone. Getting home from suburban stations late at night or accessing housing estates are other examples of how this approach can be economic where a conventional bus is not.

The analysis set out earlier in this report showed how far people are already driving other people around - in other words acting as unpaid taxis. There are a significant number of these journeys from early evening until about midnight. It should be noted that the blanket free travel on buses and trams for under 16s addresses cost but not the issue of security nor of having to pay to use the Underground (although a new scheme covering this has now been announced) and rail. Trying to serve this demand with new micro services and replacing underused evening bus services in outer London is an area TfL needs to explore as a matter of urgency.

Such a new approach could also make the whole system more accessible, not just to people with a disability, but to those who have problems walking far or who have children and buggies. Local priority schemes can be implemented that allow smaller buses to enter pedestrian areas or residential estates where other vehicles cannot. These services could also take some of the burden off existing Dial a Ride services. Service provision such as this should always be progressed concurrently with a review of all council transport services, in particular for education and social services.

Ways forward would be:

- feeding in the demand estimates from personal travel planning (ongoing from 2006)
- getting the boroughs and the community more involved with bus route and service planning (starting 2006)
- identifying new business, public and voluntary sector partners to design and support new local bus access
- implementing four pilot micro schemes in different areas of outer London by the end of 2007.

Classic services

Many existing routes fulfil clear roles in getting people to work, school or the shops. These familiar services won't be vanishing but will need to be better managed and developed further.

First there should be new demands for bus services from the work on travel planning as with the new micro bus feeders. For example, this will help to generate demand through workplace travel plans that involve existing commuters. They can tell the travel planners where they live and what is needed to make their journey fast and attractive. There will be clear incentives through workplace travel plans to use the new services. Some of these may mean improving existing services, others may be new or modified classic style routes and some may be express routes (see below).

One clear objective must be to take each route (or sometimes a group of related routes) and consider it as a whole. This is the only way that bus priority can be designed to maximise benefits for passengers and operators. It is also the only way that the reduction in operating costs that flow from bus priority can be shared by the users.

At present Londoners and the Government pay for bus priority, and this is meant to bring very large benefits in the form of time savings, and therefore cost savings, to the bus operators. At present there is no direct mechanism for these operational benefits to be returned to the users, although they may experience faster journey times. TfL will also

receive any revenue from extra passengers attracted although they are likely to slow down the buses.

What is needed is a direct link between bus priority and tender deals, with measurable benefits flowing back to TfL. It is interesting to note that so far there has been a significant amount of money spent on priority schemes and most are meant to repay their costs within a few years. The cumulative ongoing benefits should be very high. What is required is for these to be made transparent and integrated with the tendering process in a way that everyone, including passengers, operators and tax payers, can understand.

To keep track of the financial benefits of bus priority a route-based approach will be needed. Closely related routes can be dealt with together. This is in fact the way that many tender packages are constructed already. This is one of the key ways in which the dramatic escalation in bus tender prices can be addressed - not in isolation but in an integrated framework.

Ways forward would be:

- developing services in tune with people's needs, in particular the demand created through travel planning (ongoing from 2006)
- integrating bus priority with tendering on a route or route package basis (ongoing from 2006)
- maintaining and increasing quality and reliability (ongoing from 2006)
- investigating bus congestion and the consequent limits to increased conventional services.

Super transit services

In outer London there is a missing mode between London's classic bus services and the rapid transit schemes such as the Croydon tram. Because trams have their own reserved track for much of their length, they are able to achieve faster travel times and keep closer to the timetable. They also have a different look and feel, and these factors combined mean that they can attract new passengers, many of whom leave their car at home.

However, for most people a tram scheme is either an unlikely prospect or a plan that will take a long time to implement and may be quite disruptive. Instead of placing the emphasis on a few rail based tram routes, Londoners would benefit more widely and more quickly from a number of super transit routes using a combination of bus and tram-based technology.

For example, trams are tightly controlled - all but eliminating bunching and achieving high reliability. This is mainly due to the systems used and the level of priority that is achieved. Such advantages can be reproduced with a new approach using bus-like vehicle technology with tram-like appearance and control. A route of this type is proposed in East London - the Greenwich Waterfront Transit. TfL favours a rubber wheeled vehicle, presumably on grounds of cost and ability to run on ordinary streets. This is at least partly because full on-street is perceived as being too difficult to implement, and in fact the local borough supports a conventional tram or ultra light rail.

These super services need to go beyond the current guided bus approach to look at methods of propulsion (hybrid diesel-electric is one clear possibility) and design. Many trams are relatively narrow - a requirement where space is at a premium. Fitting narrower lanes into certain areas would be a real possibility and certainly easier than trying to achieve conventional or even guided bus lanes. The greater control over trams means that some short stretches of priority, for example, in shopping streets, could be for super transit travelling in alternate directions. This would allow dedicated priority in places that would

otherwise have to be closed to traffic. The London market is large enough to justify such a radical, tailor-made, vehicle design.

Some systems may be bus based but others should take advantage of the lower energy requirement of rail. This is usually absorbed by the use of heavyweight rail vehicles but need not be the case. If the design is engineered up from the bus rather than down from heavy rail vehicles would be very much lighter. This has two significant advantages. The first is that overhead electricity supply is not required and either a hybrid or fuel cell on board option is viable. The fuel cells would not need to be as large as those used for the buses in the London CUTE project. The second advantage is that the depth of foundation for the rails themselves is far less because the vehicle weights are closer to a bus. One of the main reasons for the cost escalation of tram projects is the need to undertake large-scale street works, inevitably causing problems with all the underground services in established urban areas. In addition, in many parts of London rapid transit networks are required to serve regeneration sites, and conventional heavy trams simply cannot be provided within a reasonable cost and time.

These new services would need to develop into a complementary network to the Underground and surface rail systems and some of them would link up places without any direct public transport services at present, particularly in outer London. The lack of such services is well illustrated in the mode shares - outer London has significant bus use but no large-scale transit comparable to inner and central areas. Over the longer term, some of these routes might develop into higher capacity systems and even light rail or tram schemes. However, they would do so along an evolutionary path. This is important because it reduces the risks involved in putting huge resources into a small number of fixed routes. Instead more routes can be tested and more people can benefit in a shorter timescale.

The integration of the super routes with traditional services and new local feeders offers a further opportunity to make bus routes more understandable. People tend to be able to come to grips with their own local patch, and the new route diagrams on bus stops are a great improvement. However, venturing further afield by bus is difficult for the novice. The layering of bus services and the introduction of a network of fast routes would create the opportunity for improved information and marketing.

Ways forward would be:

- creating a vision for a network of street transit services of a quality and image comparable to a conventional tram (ongoing 2006)
- supporting the above by identifying classic routes/corridors where providing more bus capacity by conventional means is a problem (this work is probably already available)
- using other buses to feed into the network (as schemes come forward, 2007 onwards)
- providing easy-to-understand information for longer distance users (ongoing 2008 onwards)
- working with partners especially in the regeneration area to identify service needs
- setting up a pilot project for ultra light rail to replace one of the bus based transit schemes in east London (starting 2008).

Interchanges and street stops

One implication of the new hierarchy of services is that moving from one type of service to another must be made easy and reliable. Frequent, regularly spaced and reliable services are much more straightforward to feed into than conventional buses. Again the super routes

should create a similar confidence to that which people have in trams and light rail - they will then be willing to take a micro link bus (or a traditional bus) from near their home to a superstop. These of course will have to be a step up in quality from existing bus shelter - quality design should not be underestimated and a new house style should not be expensive to create. Some bus stops are already moving in this direction, with CCTV and well-illuminated shelters.

Interchange points will also have to reflect the hierarchy and this means changing the design of existing bus interchanges and current busy bus stops. These can often lead to severe bus congestion, with buses holding each other up even when a series of stops is used to break up the stationary vehicles. This is already a serious problem in some places and will get worse if bus services continue to increase (see street transit section above).

All existing bus stops are also key interchanges - between walking and the bus. A comprehensive review of walking accessibility to all stops should be undertaken as an improvement programme. The constraining factor will be staffing rather than cost because the analysis and design need to be of the highest standard. Schemes which are compromised because of cost or time may not work and worse may annoy other users. Putting in a bus lane and removing a pedestrian refuge in order to do so is an example of how things can go wrong.

Interchange also implies that tickets must be suitable for changing buses. Passes obviously work well but single tickets are completely unsuitable. The delays caused by buying another ticket are being addressed through off bus ticketing, but the real solution must lie in reforming the single ticket system. Time based tickets are an obvious solution, but given the investment in the Oyster system and its apparent sophistication, it should be possible to implement this and market it.

Ways forward would be:
- upgrading of stopping places as well as larger-scale interchanges
- using the new bus hierarchy to simplify information
- solving current through ticketing problems when journeys start on a local bus.

Walking

Walking is the most fundamental mode of transport and is essential to access all other modes. Replacing car journeys with walking is beneficial for the environment, reduces congestion and helps keep us all healthy. Old arguments about walking journeys being so short that they don't make an impact and so can be ignored have been discredited but walking is still low on London's transport agenda.

In broad terms there are four different types of walking that are important for the transport strategy. These are:
- carrying out a whole journey on foot (eg home to shops)
- walking to get access to public transport (eg to a bus stop or station)
- walking as an important activity in its own right (eg meeting in the street, window shopping)
- walking purely for pleasure (eg along the Thames, through parks or places of cultural or historic interest).

New methods for assessing how 'walkable' London's urban spaces are currently, and how they can be improved, have been developed and need to be brought into the centre of the new strategy. Local authorities and TfL will be able to use these to progress a programme of

improvements that will range from local access to workplaces, shops, stations and buses, to pedestrianisation of key public spaces, for example, London's squares. These need to be relieved of considerable amounts of traffic. They can then be better connected to the local area and other walking links.

Integrated funding

TfL funding to boroughs for walking needs to be integrated with all other local authority spending on the two London road networks (TfL and boroughs). Again very modest increases in spending, together with more developer funding and commercial partnership, and a new integration of local authority efforts, would result in a steady and measurable improvement. The current strategy's aim that London will become 'one of the most walking friendly cities' by 2015 is laudable but so far no attempt has been made to measure how walkable it is currently, what improvements are needed or to prepare an action plan to achieve the objective.

In this regard there are two basic elements which are required. The first is an analysis of the places where people live; how they walk locally, for example to the shops or schools; how they walk to gain access to public transport; and finally how attractive, safe and easy it is to make these journeys on foot.

The second is to look at the other end of people's journeys and analyse conditions for walking around the key places that they visit: workplaces, shops, places to eat and drink, health centres, leisure centres and open spaces. Very often this will take the form of an analysis of a local or town centre on an area basis, and will fit well with an assessment of the same space for bus and cycle priority. In other cases employer-based travel programmes will generate proposals which can be included in walking plans and walking should always be included in travel planning initiatives.

Financially walking can be encouraged, for example, through a comprehensive travel bonus scheme. At work, people can be offered a travel account that has a certain value at the start of the year. They can spend this on parking or public transport but will avoid this by car sharing, walking or cycling. At the end of the year any surplus is converted into cash. For shopping, people could have free home delivery if they travel by public transport, walking or cycling, plus a discount on their shopping funded by charging for the car park. This could be part of planning permission.

Overall, people like walking during daylight hours. This changes after dark, when security concerns become important. The current change from summer time in October exaggerates the impact on walking and is counter productive in terms of road accidents. The change was instituted a long time ago to allow early morning agricultural activity in natural light. This is no longer necessary and is inappropriate, particularly outside Scotland. While London may not have the power to set its own time zone, it is suggested that pressure is mounted to at least extend summer time through the winter. This would also avoid the inconvenience of changing the clocks twice a year.

Ways forward would be:

- giving greater recognition to the fundamental role of walking
- encouraging innovative travel bonus schemes to make walking more attractive for all journey purposes
- ensuring closer co-operation between TfL and boroughs
- using new techniques to measure London's walkability
- developing a twin track approach to analysing conditions for walking where people start and where they finish their journeys
- putting pressure on national Government to avoid changing clock times in October.

Cycling

As the other person powered form of transport (alongside walking) cycling has an important role to play. There are four general lines of approach to encouraging cycling. The first is convenient and secure parking at the origin (including residential areas) or destination (such as workplaces or shopping centres). The second is the provision of safe and attractive conditions while on the move, for example, through effective cycle priority and routeing schemes. The third is the use of information, persuasion and marketing, examples of which are initiatives such as travel planning and training. Finally there is the issue of the total resources deployed, particularly those ring fenced to provide parking and cycle priority schemes.

Extending cycle parking

TfL already has a programme of providing cycle parking but this needs to be extended. Places at schools and educational centres are required, and minimum standards are needed for all new developments. Travel plans often include financial support for cycle parking. Facilities need to be of a high standard (convenient, lockable, dry route to final destination) and in greater numbers. Cycle-friendly street design and on-street provision in town centres is also needed, again to a high standard.

Improving journey quality

The next area which is critical in delivering increased cycle use is cycle priority and protected road space for cycling. Some outer London authorities have concerns about the safety implications of encouraging cycling and this needs to be addressed. It is clear that some cycle lanes have been compromised by the needs of motorised road traffic and any route is only as attractive as its weakest link. Thus any discontinuity such as an abrupt end and then resumption on a route is very undermining. Painted lanes, especially where these appear to take up half a car lane at traffic signals, are mostly unsatisfactory.

The original London cycle network needs to be revisited and, in a way comparable to bus priority, a ‘whole of route’ approach is required. This again needs to be undertaken for origins (such as residential areas) and destinations (such as schools). Again this could address some of the escort car trips which were identified in the analysis earlier in this report.

Information, training and marketing

As part of travel planning support TfL is now offering to supply employers with free cycle stands, cost price cycles and match funding up to £1,000 for showers and lockers. This is a very positive move but take up will be increased if the financial framework which supports the travel plan is also used to encourage cycling. In addition, the travel bonus account and shopping discount (and/or home delivery) described in the walking section would also benefit cycling to a significant degree.

Financial support for cycling

One problem specific to cycling and walking is that health benefits are not fully taken into account in assessing the value for money of cycling schemes. Nor is carbon reduction through cycling rated as highly as it should be in the evaluation methods used. These are often adopted from road based financial models. While transferring travel to targeted public transport can reduce carbon emissions, any form of motorised travel has its carbon cost and is unlikely to improve health. Cycling will always be more effective and is particularly useful for travel distances where walking becomes less attractive (over 2 km).

Overall cycling expenditure is still relatively low and needs to be enhanced so that the

process of upgrading and extending cycle routes in London is accelerated. Despite this comment, cycling policy has been an area where TfL has achieved significant growth and has set up a Cycling Centre of Excellence to pursue the improvement of cycling in London.

TfL has therefore made progress on this front and the first six action points listed below are to an extent in hand and are not given start dates. However, the reflection of the importance of mode transfer and carbon reduction needs to be built in to the evaluation of cycle schemes and the programme will need to be expanded.

Ways forward would be:
- creating a new extended cycle network for London
- upgrading existing cycle provision to a new level
- expanding the number of parking spaces both at commercial premises and on-street
- encouraging innovative travel bonus schemes to make cycling more attractive for all journey purposes
- setting up a twin track approach to analysing conditions for cycling where people start and finish their journeys
- ensuring close co-operation between TfL and boroughs on all the above
- using new techniques to measure the attractiveness of London's cycling network
- putting pressure on national Government to avoid changing clock times in October.

Financial and regulatory supporting framework

Financial

Financial instruments are considered here as providing the incentives needed to support new travel choices (including substituting for travel). Thus the aim is not to raise revenue but to signal and directly encourage change. The congestion charge is well known, but a similar scheme for outer London should be undertaken in concert with any national scheme. The exact form of this is still unknown and its implementation is a long way off. In this case the available instruments are more limited. The specific extension of the congestion charge being proposed is not studied in detail here, but the implication of this report is that other ways of addressing road traffic demand that are focussed on outer London should be pursued as a matter of urgency, rather than extending the central London scheme.

Ways forward would be:
- preparing a Workplace Parking Charge scheme for outer London, pending take up through the voluntary travel planning partnership
- making parking controls and charges more consistent
- ensuring that the congestion charge extension does not distract efforts from outer London; parking controls should be considered for inner London instead
- extending financial support for travel planning, for example, through:
    - additional free advice and plan preparation
    - infrastructure provision
    - new services and fares.

London Spatial Development Plan/Mayor's Transport Strategy (London Regional Transport Strategy)

In addition to the financial measures the statutory guidance issued by the GLA will need to be amended as follows.

Transport

- Adopting the development principle from section 4 of this report:
  'The scale of development on a particular site would be limited by the ability of public transport and the local walk and cycle catchments to serve it.'
- Amending parking standards to reduce permitted spaces in outer London developments
- Making submissions on need for consistency with the new outer London standards to all neighbouring local and regional authorities
- Adopting site area based parking standards as opposed to floorspace area
- Amending outer London traffic target to stabilising by 2015
- Including new targets to stabilise traffic at the same level as 2000 by 2025 and achieve a reduction of 15 per cent on 2000 levels by 2050.

Land use

Housing development in the UK tends be of the type where capital is invested in land and construction by the private sector and profits are captured by freehold sales. Capital is also then available for further development. This creates a situation where developers often have a low long term involvement with projects and the communities that inhabit them.

Thus new ways need to be found of ensuring that facilities and amenities are maintained throughout the life of residential developments, and this in turn needs a new initiative reflected in the London Plan. Without being prescriptive, discussion needs to take place between local authorities and the development industry to ensure the long term future of land uses, such as small shops, and local services, which are essential to supporting sustainable communities.

6. What would the impact of the new policies be?

In order to illustrate what the new patterns of travel could be like in a lower carbon future, and what the pattern of benefits would be from now until 2050, the different policies were grouped into three basic types.

Policy profiles

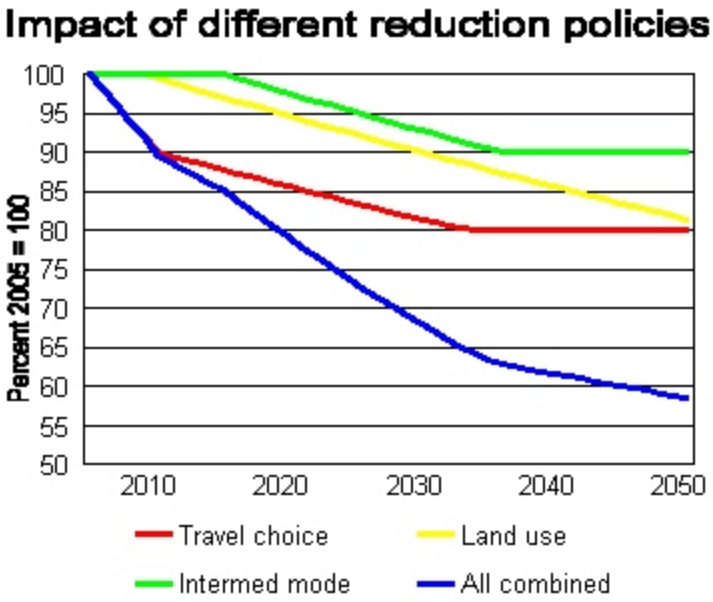
The first policy type would include infrastructure, such as a new tram or intermediate mode, which would have a period of design, public consultation and then construction. Thus there would be no short term impact on people's choice of mode, and effects would start in the mid term and grow as people adjusted to the new service.

The second profile is almost the opposite, having a rapid impact within a few years and then slowing down. An example would be intensive travel planning, particularly combined with parking space charges or wider congestion charging in outer London.

Finally there are policies that have a gradual but consistent impact, in particular those relating to land use and the creation of more self-sustaining communities, improving accessibility by sustainable modes and reducing parking.

An illustration of the impact of the three types of policies described above is set out in Figure 6.1 below. This is trip, not distance based, and the real impact would require further surveys of trip lengths to be undertaken. The illustration below is likely to underestimate the impact of intermediate modes which tend to have longer trip distances. It is important, however, to start the process of using such profiles in carbon reduction strategies.

Figure 6.1



It should be noted that in order to produce an estimate of the reductions in carbon emissions, the above have to be applied to assumptions about growth in travel demand and then combined with technological improvements. This process was used for the graphs shown in Section 2 of this report and is explored further in Table 6.1.

Long term targets versus continuous profiles

It is crucial to use profiles because the use of an end-date target can be seriously misleading in assessing carbon reduction. In terms of climate change, what matters is that we reach a situation where atmospheric concentrations of greenhouse gases can be stabilised. However, the total amounts of such gases that are emitted during the run up to the target date is also of critical importance. Policies that aim to achieve most of the reduction at the end of the period are not only politically high risk, but also allow more emissions in total and thus lengthen the period of risk following the date on which emissions and absorption reach the stable level. This makes an early start and rapid progress extremely important and of high value.

The second factor to be considered is that exceeding the targets is a benefit and as research progresses, it is likely that the targets themselves will have to be tightened. The risk being faced is caused by not knowing the probability of different degrees of climate change occurring. This level of change ranges from problematic (very likely) to catastrophic (not so likely but possible). The latter might include the release of methane in large quantities from the deep sea or ice bound tundra. Closer to home, it certainly includes the interruption of the Thermo Haline Current (Gulf Stream) and severe drought in many traditional agricultural areas of North Africa and the Mediterranean region. For transport in outer London there appear to be opportunities for early action at reasonable cost. The problem will be in making a fast enough transition and ensuring diversion of enough resources in sufficient time.

Mode switch differences

Each of the different policy groups will also make different modes of travel more or less attractive. For example, land use planning, leading to communities with more local facilities, should lead to a reduction in travel over different distances, particularly by car. The main increases will be in walking and cycling. A short walk trip may replace a medium distance car trip.

On the other hand, travel planning for the journey to work or school in outer London is likely to reduce car use by attracting people to car sharing, public transport and cycling. Average distances may well be longer and walking may be less attractive particularly in winter. Land use policies should clearly be designed to support travel planning.

For intermediate modes of travel between communities in outer London, the main switch will be from car, and to bus transit or tram.

Each will also have different cost profiles. For example, travel planning tends to be quite rapid in its implementation and relatively cheap per person switching from car use. However, it is labour intensive. Land use policies are hard to define in terms of cost, and changes in design and higher density should increase development value per hectare. Other changes, such as the provision of public transport services, have a revenue cost that can be ongoing. This is also true for some forms of travel planning. Charges that support such policies and are raised from less sustainable modes will tend to have a windfall benefit in the short term while people are still changing their behaviour. In the long term they will have a lower income and should be revenue neutral.

It is also true that different modes have different collateral impacts, in particular, walking and cycling have positive health and social benefits.

One important further issue arises here for equity and economic development. Some of the costs implied in improving sustainable modes will fall on the public purse and some on private businesses. These often result in benefits specific to the people and businesses that pay. In the case of more general charges, for example, a workplace parking levy, it is useful to recycle the revenue as close as possible to the business that is paying. Ideas such as paying the charge back to a business to be used in its own travel plan, address this issue. Travel bonus schemes, where staff who car share or use public transport can get a cashback, are another example. Some businesses benefit significantly from the transport improvements made to reduce carbon emissions, for example, being close to a new light or ultra light rail route. Capturing this under current planning rules is difficult.

New patterns of travel in outer London

Using this basic pattern it is possible to allocate impacts in an approximate manner and check the reality of the changes that would have to take place. To illustrate this the figures for travel within outer London by Londoners have been adjusted to show the impact of the traffic reduction policy for each mode.

This process involved making assumptions about traffic growth and growth in public transport, walking and cycling. Car use was predicted to rise, as indicated earlier in this report, by extending current TfL forecasts to 2050. Other modes were more complex, and public transport in particular will be influenced by new projects such as DLR extensions and Crossrail as well as fares policy. Given the huge uncertainties involved, public transport use was increased in line with car use to produce a 'business as usual' case. Cycling is the subject of an intensive improvement programme already and thus it is assumed to double by 2010 and grow similarly to the motorised modes thereafter. There are high levels of uncertainty given the changing nature of travel in London and the number of initiatives from the new strategic authority. However, it would be fairly straightforward to adjust this exercise as new forecasts become available.

The intended traffic reduction is achieved by applying the three policy families, with their different profiles, sequentially to the 2050 forecast for higher use, starting with land use, followed by smarter travel choice and finally adding intermediate mode improvement. This is to avoid double counting as far as possible. The level of impact and timing of each policy group was shown in Figure 6.1 above.

The results of this exercise on mode share are shown in Table 6.1 below. As a reality check the current mode shares for travel within inner London are also shown.

Some key changes are immediately apparent. First, there is a clear reduction in car driver share. However, it must be remembered that journeys overall have risen by 25 per cent and thus the actual traffic levels do not decline as much. In fact, due to increased demand for car use, this is only a 17 per cent decrease in total car traffic compared to today.

Car passengers may be attracted to other modes but would also be encouraged, for example, through car sharing schemes. In terms of total volume there is a small predicted rise (7 per cent).

Walking has a modest increase in mode share but this represents an increase of about a third on today's levels. Cycling increases by more than threefold but this is one area where there is most likely to be an underestimation due to the low starting base. About half the significant increase in public transport is through new intermediate mode schemes.

Table 6.1: Mode share 2001 and 2050
London residents travel within outer London and within inner London

	Outer 2001/2	Adjusted 2050	Inner 2001/2
Car driver	37.2	25	20.3
Car pass	15.9	13	8.5
Nat Rail	1.0	2	1.6
Ugrd/DLR	1.0	3	4.3
Bus/coach/tram	10.9	17	14.0
Walk	30.6	32	46.8
Cycle	1.3	4	2.1
Van/lorry	1.0	1	0.6
Taxi	0.7	1	1.4
M'cycle	0.3	2	0.3
Total	*100*	*100*	*100*

Source: LATS and MTRU calculations

Is this realistic?

Given a period of over 40 years, changes such as an increase in walking of a third, quadrupling cycle use and doubling public transport use seem feasible in terms of people's changing attitudes and the capacity of different systems to cope. In particular, the 'designing in' of the slow modes to new patterns of development (residential and commercial) has great potential, although it is also an area where past efforts to create sustainable access have underperformed. Parking standards is an example. The principle is that the different strands of policy will need to be integrated and progressed together. The diversity and acceptability of new travel choices will depend on adopting a range of delivery mechanisms and not relying on a single 'magic bullet'.

Considering the patterns in inner London, car use in outer London would still be substantially higher in 2050 than it is in inner London today - 38 per cent of trips rather than 29 per cent. Walking would still be much lower, although bus and intermediate modes would take a greater share. These differences match what would be expected, given the lower densities and greater travel distances in outer London.

Other motorised modes

This report focusses on car use as a key factor in current carbon dioxide emissions in London. However, there remain two important areas where progress can be made outside national policies. These are public transport road vehicles and commercial vehicles.

Buses

Local policies can influence both of these in London, particularly public transport. A recent trial of hydrogen powered buses was interesting but is not planned to lead to a rapid change

in bus fuel use. In fact it will be critical for TfL to consider its tender specifications and possibly its own purchasing policies. Hybrid powered buses are available but currently at a very high premium, for example raising the price of a £120,000 bus to £200,000. London is a huge market for bus purchase and to a major extent supplies the second hand market elsewhere. A programme for the immediate testing and early introduction of hybrid technology in the bus fleet by TfL was one original recommendation of this report. As the report was completed, TfL announced an initial programme (six vehicles from one manufacturer). Operators will clearly have to be involved in this initiative to find acceptable vehicles and plan their introduction. London is in a unique position to take the lead in this area and a new partnership arrangement could be set up to further champion this policy.

Commercial vehicles

As far as heavier commercial vehicles are concerned, consultation has begun (January 30th 2006) on restricting the use of vehicles that do not meet the latest European specifications in London, as part of a Low Emissions Zone (LEZ). These currently only reduce harmful exhaust gases on grounds of air quality, although nitrogen dioxide (which should be reduced as part of the new standards) is also a serious greenhouse gas. However, hybrid technology is a clear possibility for many commercial vehicles, and again a new initiative is needed. This could start with a voluntary arrangement but with the prospect of including fuel-use standards as part of lorry controls in London. Including this in the Night and Weekend Lorry Ban should also be actively considered as a pilot scheme for London as a whole.

Again there is opportunity for mode switching - this time of freight from road to rail and water. London has many opportunities for water transport and one proposal already put forward was that building materials for all riverside developments should be brought in by water. Many development areas in London could be served. Waste is already transported by river but there needs to be co-ordination between land use planning and transport, for example, placing recycling facilities close to the river. TfL is currently working with British Waterways in West London with the aim of contributing to a tenfold increase in water freight over a decade.

Rail could also play a greater role in waste transport and other commodities, and a recent TfL report identified 42 possible sites (from a short-list of 130). To make these viable a range of actions would be required: lorry control schemes including future pricing (such as the LEZ), planning controls, and support to set up new facilities. London is developing a Freight Plan and targets for mode transfer should be set, together with the mechanisms that will help to achieve it. TfL's proposed LEZ is an essential first step.

For this report we have not calculated specific changes in carbon emissions from buses and lorries but clearly these would have to make a similar reduction. The scope for more rapid technological improvement is significant with buses, and the replacement of buses with rail based technology could lead to even greater energy savings. This will depend, however, on the production of newer ultra-light forms of tram, and possibly guided bus. Heavy tram systems carry a severe weight penalty as well as requiring overhead power supply, although the latter gives a flexibility of supply. Again this is an area where further work is required.

7. Conclusions

1 A reduction of 17 per cent in car use from today's levels by 2050 would make a significant contribution to achieving carbon dioxide reductions from transport in outer London.

2 This reduction would have to be accompanied by significant technological improvement to increase the fuel efficiency of cars, buses and lorries. Technology cannot deliver the carbon reduction targets without traffic stabilisation or reduction.

3 There are a range of measures that would extend current TfL policies into outer London and achieve the required reductions. These have different profiles for delivering the levels of demand management needed.

4 The cheapest methods of demand management - based on changing travel choice (supported by regulation and pricing) - are also the fastest and should be prioritised.

5 Slow achievement of targets, with a rush towards the target at the last minute, is not only politically risky, it also emits more carbon in total. As far as the climate is concerned this is equivalent to not achieving the target.

6 This report therefore recommends that targets should be expressed in terms of total carbon emitted by 2050 rather than an end date reduction.

7 A spectrum of measures is needed to create user choice, to avoid 'magic bullet' syndrome and to reduce risk. For example, a congestion-based charge will be ineffective for carbon reduction if hybrid vehicles dominate - their efficiency savings are greatest in congested conditions.

8 These demand management measures should be based on solutions for individual journey purposes. This relates more to personal travel choice and is both effective and publicly more comprehensible.

9 Regulation and pricing are needed but to facilitate and encourage the travel choice policies. There will be windfall income to assist change, but the long term aim should not be revenue raising. Recycling income back to those affected should be an aim wherever possible.

10 Exceeding the targets reduces climate risk and is a benefit - thus any targets whether long term or annual should therefore be considered as minima.

11 The extent of change does not seem unrealistic given the timescale and the range of options available. For example, car use in outer London in 2050 would still be about 40 per cent higher than it is in inner London today.

12 The key priority, both for climate reasons and for the ease of transition, is to make an early start.